California Environmental Protection Agency

AIR RESOURCES BOARD

Final

CALIFORNIA TEST PROCEDURES FOR 2026 AND SUBSEQUENT MODEL YEAR ZERO-EMISSION VEHICLES AND PLUG-IN HYBRID ELECTRIC VEHICLES, IN THE PASSENGER CAR, LIGHT-DUTY TRUCK AND MEDIUM-DUTY VEHICLE CLASSES

Adopted: [INSERT DATE OF ADOPTION]

[Note: The entire text of these test procedures set forth below is new language in "normal type" proposed to be incorporated by reference in title 13, California Code of Regulations.]

NOTE: This document is incorporated by reference in section 1962.4, title 13, California Code of Regulations (CCR). Additional requirements necessary to complete an application for certification of zero-emission vehicles and plug-in hybrid electric vehicles are contained in other documents that are designed to be used in conjunction with this document. These other documents include:

1. "California 2026 and Subsequent Model Year Criteria Pollutant Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles":

2. “California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles” (incorporated by reference in section 1976(c), title 13, CCR);

3. “California Refueling Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles” (incorporated by reference in CCR, title 13 section 1978(b));

4. "OBD II" (CCR, title 13, section 1968, et seq. as applicable);

5. “California Environmental Performance Label Specifications for 2009 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Passenger Vehicles” (incorporated by reference in CCR, title 13, section 1965,);

6. “Warranty Requirements” (CCR, title 13, sections 1962.8, 2037, and 2038);

7. “ZEV Data Requirement” (CCR, title 13, section 1962.5);

8. “Specifications for Fill Pipes and Openings of Motor Vehicle Fuel Tanks” (incorporated by reference in CCR, title 13, section 2235);

9. “Guidelines for Certification of Federally Certified Light-Duty Motor Vehicles for Sale in California” (incorporated by CCR, title 13, section 1960.5,); and

10. “California Non-Methane Organic Gas Test Procedures for 2017 and Subsequent Model Years,” (incorporated by reference in CCR, title 13, section 1961.2(d)).

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CALIFORNIA TEST PROCEDURES FOR 2026 AND SUBSEQUENT MODEL YEAR ZERO-EMISSION VEHICLES AND PLUG-IN HYBRID ELECTRIC VEHICLES, IN THE PASSENGER CAR, LIGHT-DUTY TRUCK AND MEDIUM-DUTY VEHICLE CLASSES

A. Applicability.

1. The test procedures in this document are applicable to 2026 and subsequent model year zero-emission passenger cars and light-duty trucks (zero-emission vehicle or ZEV), and 2026 and subsequent model year plug-in hybrid electric passenger cars, light-duty trucks, and medium-duty vehicles. The test procedures in this document are also applicable to 2026 and subsequent model year zero-emission medium-duty vehicles that a manufacturer uses to satisfy the requirements of California Code of Regulations (CCR), title 13, section 1962.4.

2. The general procedures and requirements necessary to certify a 2026 and subsequent model year vehicle for sale in California are contained in the "California 2026 and Subsequent Model Year Criteria Pollutant Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" (hereinafter "LDV/MDV TPs") and apply except as amended herein.

3. The "as adopted or amended dates" of the 40 CFR Part 86 regulations and the 40 CFR Part 1066 regulations referenced by this document are the dates identified in the "California 2026 and Subsequent Model Year Criteria Pollutant Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles".

B. Definitions and Terminology

1. Definitions.

In addition to the following, these test procedures incorporate by reference the definitions and abbreviations set forth in Title 40 Code of Federal Regulations (CFR) §86.1803-01, the definitions and abbreviations set forth in the LDV/MDV TPs, and the definitions set forth in CCR, title 13, sections 1900 and 1962.4.

"All-Electric Range (AER)" means the total miles driven electrically after the battery has been fully charged and, in the case of a plug-in hybrid electric vehicle, before the engine turns on for the first time. The AER is determined by these test procedures and is typically defined in terms of a driving cycle specific range such as the Urban All-Electric Range (AER_u) or the Highway All-Electric Range (AER_h).

"All-Electric Range Test" means a test sequence used to determine the range of a battery electric vehicle, or, a plug-in hybrid electric vehicle without the use of its engine.

"Alternative Continuous Urban Test Schedule" means a series of the following sequence: Urban Dynamometer Driving Schedule (UDDS), 10 minute key-off hot soak, UDDS, and 10-30 minute key-off hot soak. This alternative procedure may be substituted for the Continuous Urban Test Schedule when the Continuous Urban Test Schedule cannot be performed.

"Alternative Continuous Highway Test Schedule" means a series of the following sequence: Highway Fuel Economy Driving Schedule (HFEDS), 15 second key-on pause, HFEDS, and 10-30 minute key-off hot soak or a 15 second key-on pause. This alternative procedure may be substituted for the Continuous Highway Test Schedule when the Continuous Highway Test Schedule cannot be performed.

"Auxiliary power unit (APU)" (also referred to as "engine") means a device that converts consumable fuel energy into mechanical or electrical energy. Some examples of auxiliary power units are internal combustion engines, gas turbines, or fuel cells.

"Battery electric vehicle (BEV)" means any vehicle that operates solely by use of a battery or battery pack, or that is powered primarily through the use of an electric battery or battery pack but uses a flywheel or capacitor that stores energy produced by the electric motor or through regenerative braking to assist in vehicle operation.

"Battery" or "battery pack" or "high voltage battery pack" or "traction battery" means any electrical energy storage device consisting of any number of

individual battery modules or cells that is used to supply power to propel a zero-emission vehicle, or plug-in hybrid electric vehicle. These terms also generically refer to capacitor and flywheel energy storage devices used to supply power for propulsion of the vehicle.

"Battery state-of-charge (SOC)" means the remaining level of charge in the battery relative to the maximum level of charge of the battery expressed in percent. This term also generically refers to the state-of-charge for other energy storage devices such as a capacitor or flywheel in lieu of or in addition to a battery.

"Blended plug-in hybrid electric vehicle (PHEV)" means a plug-in hybrid electric vehicle (PHEV) that uses the engine during charge depleting operation (e.g., to supplement battery/electric motor power).

"Charge-depleting (CD) operation" means a type of vehicle operation in which the battery SOC may fluctuate but, on average, decreases while the vehicle is driven.

"Charge-depleting cycle range" or "R_{cdc}" means the distance traveled on the Urban or Highway Charge-Depleting Test Procedure up to the test cycle prior to where the state-of-charge is above the lower bound state-of-charge tolerance for one test cycle. This range will appear as the sum of a discrete number of test cycle distances. This range shall be reported to the nearest 0.1 miles.

"Charge-increasing operation" means a type of vehicle operation that occurs when the battery SOC may fluctuate but, on average, increases while the vehicle is driven over two or more consecutive UDDS cycles. To test plug-in hybrid electric vehicles or plug-in fuel cell electric vehicles with charge-increasing operation, follow the test requirements for charge-sustaining operation in section E.4 with the modifications specific to charge-increasing operation. A charge-increasing driver-selectable mode is not included in this definition as it is considered a type of mode and not a type of operation.

"Charge-sustaining (CS) operation" means a type of vehicle operation in which the battery SOC may fluctuate but, on average, is maintained at a certain level while the vehicle is driven.

"Cold start UDDS" is defined as the first UDDS cycle in which the engine turns on.

"Consumable fuel" means any solid, liquid, or gaseous matter that releases energy when consumed by an auxiliary power unit such as an engine.

"Constant speed cycle (CSC)" means a driving trace that accelerates smoothly from a vehicle speed of zero up to the designated vehicle speed within one minute or less and then remains at a steady state speed at the designated

vehicle speed. For example, a 65 miles per hour CSC shall use 65 miles per hour as the designated vehicle speed.

"Continuous Highway Test Schedule" means a repeated series comprised of four consecutive key-on HFEDS with a 15 second key-on pause in-between each HFEDS cycle. If this schedule cannot be performed continuously, a key-off soak up to 30 minutes is permitted after every fourth HFEDS cycle.

"Continuous Urban Test Schedule" means a repeated series comprised of UDDS; each test is followed by a 10 minute key-off soak period.

"Continuous US06 Test Schedule" means a repeated series of US06 driving schedules (US06) with a key-on idle period of not less than one minute and not greater than two minutes between each US06.

"Default mode" means the operating mode to which the vehicle automatically reverts after a vehicle is turned off and subsequently turned on. A vehicle with default mode would require the driver to select an alternative mode each time the vehicle is turned on if the driver chooses to use an alternative mode.

"Driver-selectable mode" means an operating mode that the vehicle driver can manually engage by means of an instrument panel button, switch, screen menu, etc., anytime the vehicle is activated (e.g., when the key is in the on position).

"Energy storage device" means a storage device able to provide the minimum power and energy storage capability to enable engine stop/start capability, traction boost, regenerative braking, and (nominal) charge sustaining operation.

"Equivalent all-electric range (EAER)" means the portion of the total charge-depleting range attributable to the use of electricity from the battery over a charge-depleting test.

"Fuel cell electric vehicle (FCEV)" means any vehicle that uses an onboard hydrogen fuel cell system, with or without the use of other energy storage devices, to supply power for propulsion of the vehicle. For the purposes of these test procedures, FCEVs that have off-vehicle charge capability are considered plug-in FCEVs, not FCEVs.

"Fuel-fired heater" means a fuel burning device that creates heat for the purpose of warming the passenger compartment of a vehicle but does not contribute to the propulsion of the vehicle. ZEVs with fuel-fired heaters do not qualify for vehicle values under section 1962.4, title 13, CCR.

"Full state-of-charge (SOC)" means the battery of a BEV, plug-in hybrid electric vehicle, or plug-in FCEV is at its maximum level of charge following a recharging event with an off-vehicle charger.

"Highway Fuel Economy Driving Schedule (HFEDS)" means the highway fuel economy driving schedule as specified in 40 CFR §600.109(b).

"Normal Mode" means the operating mode where the vehicle automatically optimizes powertrain and braking operation for the most common driving conditions as determined by the manufacturer. Normal mode would be equivalent to default mode if the vehicle has default mode.

"Off-Vehicle Charge Capable" means having the capability to charge a battery from an off-vehicle electric energy source that cannot be connected or coupled to the vehicle in any manner while the vehicle is being driven.

"Plug-in Hybrid Electric Vehicle (PHEV)" means any vehicle that is off-vehicle charge capable, that is not a zero-emission vehicle, and that can draw propulsion energy from both of the following on-vehicle sources of stored energy: 1) a consumable fuel and 2) an energy storage device such as a battery, capacitor, or flywheel.

"Plug-In Fuel Cell Electric Vehicle" means any FCEV that is off-vehicle charge capable.

"Regenerative braking" means the partial recovery of the energy normally dissipated into friction braking that is returned as electrical current to an energy storage device.

"Run-Out" means the point at which the pressure in the vehicle's on-board hydrogen tank(s) no longer allows vehicle operation on a 65 miles per hour constant speed cycle within the speed tolerances specified in 40 CFR §1066.425(b) for performing emission tests with exhaust measurements.

"SAE J1634" means the SAE International "Battery Electric Vehicle Energy Consumption and Range Test Procedure," April 2021, incorporated by reference.

"SAE J1711" means the SAE International "Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles, Including Plug-in Hybrid Vehicles," June 2010, incorporated by reference.

"SAE J2572" means the SAE International "Recommended Practice for Measuring Fuel Consumption and Range of Fuel Cell and Hybrid Fuel Cell Vehicles Fueled by Compressed Gaseous Hydrogen," October 2014, incorporated by reference.

"SC03" means the U.S. EPA SC03 driving schedule representing vehicle operation with air conditioning, as set forth in Appendix I of 40 CFR Part 86, which is incorporated herein by reference.

"State-of-Charge (SOC) Net Energy Change Tolerance" means the state-of-charge net energy change tolerance that is applied to the SOC Criterion for charge-sustaining plug-in hybrid electric vehicles when validating an emission test. See section E.10 of these procedures for tolerance specifications.

"State-of-Charge (SOC) Criterion" means the state-of-charge criterion that is applied to a charge-sustaining plug-in hybrid electric vehicle to validate an emission test. The SOC Criterion requires that no net change in battery energy occurs over a given test cycle, i.e., the final battery state-of-charge that is recorded at the end of the emission test must be equivalent to the initial battery state-of-charge that is set at the beginning of the emission test. The SOC Net Energy Change Tolerance shall be applied to the SOC Criterion.

"Urban Dynamometer Driving Schedule (UDDS)" means the urban dynamometer driving schedule as set forth in Appendix I of 40 CFR Part 86.

"US06" means the US06 driving schedule as set forth in Appendix I of 40 CFR Part 86.

"Zero-emission vehicle (ZEV)" means a vehicle that produces zero exhaust emissions of any criteria pollutant (or precursor pollutant) or greenhouse gas excluding emissions from air conditioning systems, under any possible operational modes or conditions. BEVs, FCEVs, and plug-in FCEVs are examples of ZEVs.

2. Terminology

	Abbreviation	Units
Charge Depleting Net Energy Consumption	E_{cd}	Wh
Charge Depleting CO2 Produced	M_{cd}	g/mi
Charge Sustaining CO2 Produced	M_{cs}	g/mi
Highway All-Electric Range	AER_h	mi
Highway Charge Depleting Actual Range	R_{cdah}	mi
Highway Charge Depleting Cycle Range	R_{cdch}	mi
Highway Charge Depleting to Charge Sustaining Range	R_{cdtcsh}	mi
Highway Electric Range Fraction	ERF_h	%
Highway Equivalent All-Electric Range	$EAER_h$	mi
Highway Equivalent All-Electric Range Energy Consumption	$EAEREC_h$	Wh/mi
National Institute of Standards and Technology	NIST	n/a
Urban All-Electric Range	AER_u	mi
Urban Charge Depleting Actual Range	R_{cda}	mi
Urban Charge Depleting Cycle Range	R_{cdcu}	mi
Urban Charge Depleting to Charge Sustaining Range	R_{cdtcsu}	mi
Urban Electric Range Fraction	ERF_u	%
Urban Equivalent All-Electric Range	$EAER_u$	mi
Urban Equivalent All-Electric Range scaled to 40 mi limit	$EAER_{u40}$	mi
Urban Equivalent All-Electric Range Energy Consumption	$EAEREC_u$	Wh/mi

C. Test Procedures for 2026 and Subsequent Model Year Zero-Emission Vehicles

1. **Electric Dynamometer.**
   Vehicles must be tested using an electric dynamometer meeting the requirements of 40 CFR Part 1066 Subpart C.

2. **Vehicle and Battery Break-In Period.**
   Vehicles shall be stabilized as determined by the manufacturer. The manufacturer shall use good engineering judgment in determining the proper stabilized mileage to ensure the results of testing will be representative of range and energy consumption for a new vehicle.

3. **Operating Mode for Testing.**
   Vehicles shall be tested for range and energy consumption in default mode or in normal mode if the vehicle does not have a default mode.

4. **SAE J1634 Test Procedures.**
   BEVs shall be tested utilizing SAE J1634 test procedures except as noted.

   4.1. A manufacturer may utilize the single-cycle range and energy consumption test, the multi-cycle range and energy consumption test, the short multi-cycle range and energy consumption test, or the short multi-cycle range and energy consumption test plus steady state as allowed in J1634 to determine the range and energy measurements required by these test procedures. However, regardless of which option the manufacturer uses for certification, the Executive Officer may use any of the four options when performing confirmatory, in-use compliance, or other enforcement testing. It is the manufacturer's obligation to ensure that its vehicles will meet all applicable requirements including minimum durability requirements regardless of the test method used to determine range and energy consumption.

   4.2. If the manufacturer uses the short multi-cycle range and energy consumption test method, the manufacturer shall disclose the constant discharge rate used for testing and the methodology used to determine that rate in the application for certification. If the manufacturer uses the multi-cycle range and energy consumption test method or the short multi-cycle range and energy consumption test plus steady state method, the manufacturer shall disclose the distance and/or time the vehicle was operated for the constant speed cycle portion of the test.

4.3. Vehicles are prohibited from using thermal conditioning during the vehicle soak time subsequent to charging or prior to being operated on the dynamometer to determine range and energy consumption. Vehicles may utilize thermal conditioning during charging only if such action is the default mode or normal mode of the vehicle.

5. **SAE J2572 Test Procedures.**

5.1. FCEVs shall be tested utilizing SAE J2572 test procedures except as noted:

5.2. For the calculation of usable fuel amount in SAE J2572, manufacturers shall utilize the definition of Run-Out in these test procedures when determining the unusable fuel amount.

5.3. For plug-in FCEVs, manufacturers shall propose a method prior to certification for Executive Officer approval to determine urban and highway ranges and energy consumption in accordance with sections C and E of this test procedure, as appropriate. Such a proposal shall be submitted to the Executive Officer at least 90 days prior to submittal of a certification application for the vehicle. The Executive Officer shall approve the proposed method in writing within 60 days upon finding the approach uses good engineering judgment to adjust the test procedures to determine ranges and energy consumption separately attributable to off-board electricity and hydrogen fuel with equivalent accuracy and precision as the test procedures generate for BEVs or FCEVs.

6. **Required Testing.**

6.1. Vehicles are required to be tested to determine cycle-specific range and energy consumption (i.e., both alternating current and direct current energy consumption and all-electric range for BEVs and hydrogen consumption and driving range for FCEVs) for the UDDS (urban) and the HFEDS (highway).

6.2. BEVs are required to be tested to determine usable battery energy.

6.3. Manufacturers are required to determine usable fuel amount in the vehicle's on-board fuel tank(s) for FCEVs in accordance with SAE J2572 except as noted in subsection 5.2.

7. **Determination of Battery Specific Energy for ZEVs.**
Determine the specific energy of traction batteries in accordance with the U.S. Advanced Battery Consortium's Electric Vehicle Battery Procedure Manual (January 1996), Procedure No. 2, "Constant Current Discharge Test Series,"

using the C/3 rate. The weight calculation must reflect a completely functional battery system as defined in the Appendix of the Manual, including pack(s), required support ancillaries (e.g., thermal management), and electronic controller.

8. **Determination of the Emissions of the Fuel-fired Heater for ZEVs.**
The exhaust emissions result of the fuel-fired heater shall be determined by operating at a maximum heating capacity with a cold start between 68°F and 86°F for a period of 20 minutes and dividing the grams of emissions by 20. The resulting grams per minute shall be multiplied by 3.0 minutes per mile to obtain a grams per mile value.

9. **Application of Good Engineering Judgment**
The provisions of Title 40, Code of Federal Regulations, § 86.1851-01, Application of good engineering judgment to manufacturers' decisions, as of [INSERT DATE OF ADOPTION], are incorporated by reference except that section 86.1851-01(f) is amended as follows:

(f) Within 30 working days following receipt of notification of the Executive Officer's determinations made under paragraph (d) of this section, the manufacturer may request a hearing on those determinations. The request shall be in writing, signed by an authorized representative of the manufacturer, and shall include a statement specifying the manufacturer's objections to the Executive Officer's determinations, and data or other analysis in support of such objections. If, after review of the request and supporting data or analysis, the Executive Officer finds that the request raises a substantial factual issue, they shall provide the manufacturer a hearing in accordance with the process for appeals of Executive Officer decisions in Cal. Code Regs., tit. 17, Art. 2, Administrative Hearing Procedures for Petitions for Review of Executive Officer Decisions, section 60055.1, et seq., with respect to such issue.

D. This section is left intentionally blank.

E. Test Procedures For 2026 And Subsequent Model Year Plug-In Hybrid Electric Vehicles.

1. Test Equipment and Recording Requirements.

1.1. Dynamometer Equipment for Testing.

All vehicles must be tested using an electric dynamometer meeting the requirements of 40 CFR Part 1066 Subpart C.

1.2. Data Recording Requirements.

The following data shall be recorded for all tests and for each individual test cycle therein, except for the 20°F and 50°F tests, conducted in accordance with section E.8:

(a) mileage accumulated during the All-Electric Range portion of the test, where applicable;
(b) Net DC energy from the battery that was expended during the test (may be reported as the total DC battery energy output and the total DC battery energy input);
(c) AC energy required to fully charge the battery after a charge depleting or charge sustaining test from the point where electricity is introduced from the electric outlet to the battery charger;
(d) Net DC amp·hr from the battery that was expended during the test (may be reported as the total DC amp·hr output and the total DC amp·hr input); and
(e) Measured AC and DC watt hours and amp hours shall be reported to the nearest hundredth of a kilowatt hour and tenth of an amp hour.

1.3. Measurements Accuracy.

The overall error in voltage and current recording instruments shall be NIST traceable with an accuracy as specified in 40 CFR §1066.501 subparagraph (a)(2)(iv) [February 19, 2015]. Instruments measuring voltage and current shall be as specified in 40 CFR §1066.501 subparagraph (a)(4) [February 19, 2015].

Alternative measurement methods may be used if shown to yield equivalent results and if approved in advance by the Executive Officer under the procedure outlined in E.3.2.1. The manufacturer must provide information to demonstrate measurement equivalency between the alternative measurement method and the method outlined in this subsection E.1.3.

1.4. Watt-Hour Calculation.

DC energy (Watt-hours) shall be calculated as follows:

1.1.1 DC energy = $\int v(t)*i(t)dt$

Where:

v = vehicle DC main battery pack voltage

i = vehicle DC main battery pack current

AC energy (Watt-hours) shall be calculated as follows:

1.1.1 AC energy = $\int v(t)*i(t)dt$ in Watt-hours

Where:

v = AC instantaneous voltage

i = AC instantaneous current

1.5. Charging Equipment Requirements.

The standard charging apparatus (or equivalent) normally furnished with or specified for the vehicle shall be used for charging during vehicle testing.

2. All-Electric Range Testing.

For All-Electric Range testing in section E.2, vehicles shall be stabilized according to the requirements specified in section C.2.

2.1. Provision for Use of Alternative Procedures

Alternative procedures may be used for all-electric range testing if shown to yield equivalent results and if approved in advance by the Executive Officer under the procedure in subsection E.3.2.1. The manufacturer must provide information that demonstrates the all-electric range measured by the alternative test procedure is equivalent to the all-electric range measured by the applicable method outlined in this section E.2.

2.2. Driver Selectable Mode for Range Testing.

A vehicle shall be range tested in default mode or in normal mode if the vehicle does not have a default mode for the purpose of determining: Urban All-Electric Range and Urban Equivalent All-Electric Range in accordance with section E.2.4; Highway All-Electric Range and Highway Equivalent All-Electric Range in accordance with section E.2.5; and US06 all electric range capability in accordance with section E.2.6.

2.3. Regenerative Braking.

Regenerative braking systems may be utilized during the range test. The braking level, if adjustable, shall be set according to the manufacturer's specifications for normal driving conditions prior to the commencement of the test. The driving schedule speed and time tolerances specified in 40 CFR §1066.425 shall not be exceeded due to the operation of the regenerative braking system.

2.4. Urban All-Electric Range.

2.4.1. Urban All-Electric Range Definition.

The Urban All-Electric Range shall be defined as the distance that the vehicle is driven from the start of Urban Charge-Depleting Emission Test until the engine first starts in accordance with section E.4.3.2.1. Record the SOC when the engine first starts. The Urban Charge-Depleting Emission Test is performed with the vehicle initially at full state-of-charge. When emission testing a vehicle in a driver-selectable mode other than default mode or normal mode, the distance of the Urban All-Electric Range, which occurs during the first portion of the Urban Charge-Depleting Emission Test, shall not be considered as certification urban all-electric range for the purposes of compliance with the requirements in section E of "Zero-Emission Vehicle Requirements for 2026 and Subsequent Model Year Passenger Cars and Light-Duty Trucks".

2.4.2. Cold Soak and Vehicle Charging

The vehicle shall be stored at an ambient temperature not less than 68°F (20°C) and not more than 86°F (30°C) for 12 to 36 hours. During this time, the vehicle battery shall be charged to a full state-of-charge. The vehicle must be turned off during charging. Charge time shall not exceed soak time.

2.4.3. Urban Equivalent All-Electric Range Calculation.

Urban Equivalent All-Electric Range shall be calculated in accordance with section E.11.

2.5. Highway All-Electric Range.

2.5.1. Highway All-Electric Range Definition.

The Highway All-Electric Range shall be defined as the distance that the vehicle is driven from the start of the Highway Charge Depleting All-Electric Range Test until the engine first starts. The Highway Charge Depleting All-Electric Range Test is performed with the vehicle initially at full state-of-charge.

2.5.2. Cold Soak and Vehicle Charging

The vehicle shall be stored at an ambient temperature not less than 68°F (20°C) and not more than 86°F (30°C) for 12 to 36 hours. During this time, the vehicle battery shall be charged to a full state-of-charge. The vehicle must be turned off during charging. Charge time shall not exceed soak time.

2.5.3. Highway Charge Depleting All-Electric Range Test.

Starting at full state-of-charge, the vehicle shall be placed or pushed onto a dynamometer and operated through the Continuous Highway Test Schedule until the SOC Net Energy Change Tolerances (specified in section E.10 of these test procedures) indicate charge sustaining operation are met for one HFEDS cycle. Additional Alternative End-of-Test Criteria as provided for in the Urban Charge-Depleting Emission Test in sections E.4.3.4.1 and E.4.3.4.2 may be used for the Highway Charge-Depleting All-Electric Range Test with approval from the Executive Officer under the procedure outlined in subsection E.3.2.2.

Emissions shall be measured for all test cycles when the engine is operating. For each test cycle during which emissions are not generated, emissions are not required to be sampled. However, the manufacturer must validate that the engine did not turn on at any time during the test cycle.

The Alternative Continuous Highway Test Schedule may be substituted for the Continuous Highway Test Schedule if the test facility is unable to perform the Continuous Highway Test Schedule.

2.5.4. Vehicle Charging after the Highway Charge Depleting All-Electric Range Test.

Vehicle charging shall begin within three hours after the Highway Charge Depleting All-Electric Range Test and the vehicle shall be charged to the manufacturer specified full state-of-charge. During charging, all applicable requirements in section E.1 must be met, and energy consumption shall be calculated according to the requirements in section E.11.2.

2.5.5. Highway Equivalent All-Electric Range Calculation.

Equivalent All-Electric Range shall be calculated in accordance with section E.11.

2.6. US06 All-Electric Range.

2.6.1. US06 All-Electric Range Definition.

The US06 All-Electric Range shall be defined as the distance that the vehicle is driven from the start of the US06 All-Electric Range Test until the end-of-test criteria in section E.2.6.3 are met. The US06 All-Electric Range Test is performed with the vehicle initially at full state-of-charge.

2.6.2. Cold Soak and Vehicle Charging.

The vehicle shall be stored at an ambient temperature not less than 68°F (20°C) and not more than 86°F (30°C) for 12 to 36 hours. During this time, the vehicle battery shall be charged to a full state-of-charge. The vehicle must be turned off during charging. Charge time shall not exceed soak time.

2.6.3. Dynamometer Run.

At the end of the cold soak period with the vehicle in default mode or in normal mode if the vehicle does not have a default mode, place or push the vehicle onto a dynamometer, and drive the vehicle on a Continuous US06 Test Schedule until one of the following conditions is met:

(a) the auxiliary power unit starts, or
(b) the vehicle can no longer meet the speed trace limits of the US06 driving schedule as specified in CFR 86 Appendix I to within 2 mph higher than the highest point on the trace within 1 second for the upper limit or within 2 mph lower than the lowest point on the trace within 1 second for the lower limit, or

(c) the vehicle completes six (6) full US06 drive cycles without starting the auxiliary power unit.

When any of these conditions is met, the test may be ended. The US06 All-Electric Range for this test, in miles, shall be the distance driven from the start of the test to when condition (a) or (b), whichever occurs first, is met. However, if condition (c) is used to end the test, then the All Electric Range for this test shall be equal to the distance of six full US06 drive cycles. Emission sampling is not required for this test to determine US06 All-Electric Range.

2.6.4. Vehicle Charging after the US06 All-Electric Range Test.

The vehicle may be fully charged following the US06 All-Electric Range Test. If this option is performed, vehicle charging shall begin within three hours after the US06 All-Electric Range Test and the vehicle shall be charged to the manufacturer specified full state-of-charge. During charging, all applicable requirements in section E.1 must be met, and energy consumption shall be calculated pursuant to the requirements in section E.11.2.

3. Emission Testing General Provisions.

3.1. Applicability and General Provisions

Emission testing must be conducted pursuant to 40 CFR §1066.801, except as noted.

3.2. Use of Alternative Procedures and Alternative End-of-Test Criteria

3.2.1. Provision for Use of Alternative Test Procedures

A manufacturer may use alternative test procedures that are shown to yield equivalent results and have been approved in advance by the Executive Officer of the California Air Resources Board. A manufacturer must submit a request to the Executive Officer, at least 60 days in advance of the certification application of the applicable vehicle test group, with an engineering evaluation that demonstrates or justifies, based on good engineering judgment, the use of the alternative test procedures will yield equivalent results for the applicable vehicle test group. The Executive Officer shall review the submitted evaluation and shall use good engineering judgment to consider, on a case-by-case basis, the similarities and differences between the alternative procedures and the test procedures outlined in the applicable section of this document. Upon review, the Executive Officer shall approve, on a case-

by-case basis, the alternative procedures if they yield equivalent results for the applicable vehicle test group. The Executive Officer shall notify the manufacturer of the decision no later than 30 days after receiving the request for the use of alternative test procedures.

Unless otherwise specified, approval requests and supporting information must be provided to the California Air Resources Board via e-mail at: onrld@arb.ca.gov

3.2.2. Provision for Use of Alternative End-of-Test Criteria

Where noted, a manufacturer may use alternative end-of-test criteria if approved in advance by the Executive Officer of the California Air Resources Board. A manufacturer must submit a request to the Executive Officer, at least 60 days in advance of the certification application of the applicable vehicle test group, vehicle test data or an engineering evaluation that justifies, through the application of good engineering judgment, the use of alternative-end-of test criteria and demonstrates that the alternative end-of-test criteria requirements are satisfied for the applicable vehicle test group. The Executive Officer shall review the submitted documents and shall use good engineering judgment to consider, on a case-by-case basis, the justification for the use of alternative end-of-test criteria and evaluate whether the alternative end-of-test criteria is satisfied by the applicable test group. Upon review, the Executive Officer shall approve, on a case-by-case basis, the use of alternative end-of-test criteria if the manufacturer justified the use of alternative end-of-test criteria and demonstrated that the alternative-end-of test criteria requirements are satisfied by the applicable vehicle test group. The Executive Officer shall notify the manufacturer of the decision no later than 30 days after receiving the request for the use of alternative end-of-test criteria.

Unless otherwise specified, approval requests and supporting information must be provided to the California Air Resources Board via e-mail at: onrld@arb.ca.gov

3.3. Vehicle and Battery Break-In Period and Emission Stabilization.

A manufacturer shall use good engineering judgment in determining the proper stabilized emissions mileage test point and report same according to the requirements in section (i)(2) of the "Zero-Emission Vehicle Standards for 2026 and Subsequent Model Year Passenger Cars and Light-Duty Trucks".

3.4. Vehicle Operation and Driver Selectable Mode Requirements for Worst-Case Emission Testing.

3.4.1. Urban Emission Testing.

For the purpose of demonstrating compliance with urban exhaust emission criteria pollutant standards, a vehicle must be emission tested in the vehicle operation (i.e., either charge-depleting, charge-sustaining, or charge-increasing operation) and driver-selectable mode (e.g., normal mode, economy mode, performance mode, battery charging mode, or any other operating mode available to the driver) that represents the worst-case NMOG + NOx emissions.

3.4.2. Alternative Urban Emission Test.

For vehicles that qualify for and are tested on the Alternative Urban Emission Test in section E.5, the worst-case NMOG + NOx urban emissions may be determined for the Alternative Urban Emission Test alone. If driver-selectable modes are available, each driver-selectable mode must still be considered for worst-case NMOG + NOx emissions for the Alternative Urban Emission Test.

3.4.3. Highway and SC03 Emission Testing.

For the purpose of demonstrating compliance with highway and SC03 criteria pollutant exhaust emission standards, a vehicle must be emission tested in the vehicle operation (i.e., either charge-sustaining or charge-increasing operation) and driver-selectable mode (if available) that represents the worst-case NMOG + NOx emissions.

3.4.4. US06 Emission Testing.

For the purpose of demonstrating compliance with US06 charge-sustaining emission test standards, a vehicle must be emission tested in the vehicle operation (i.e., either charge-sustaining or charge-increasing operation) and driver-selectable mode (if available) that represents the worst-case NMOG + NOx emissions.

For the purpose of demonstrating compliance with US06 charge-depleting emission test standards, a vehicle must be emission tested in charge-depleting operation and in default mode or in normal mode if the vehicle does not have a default mode.

3.4.5. 20°F and 50°F Urban Emission Testing.

To satisfy test requirements for the 50°F emission test, a vehicle shall be emission tested in the vehicle operation and driver-selectable mode (if available) that represents the worst-case urban NMOG + NOx emissions as determined either (1) using the procedure in section E.4 at 50°F or (2) using the procedure in section E.4 at temperatures between 68°F and 86°F and an engineering evaluation. The manufacturer must report the data and/or engineering evaluation used to determine the worst-case operating mode at 50°F.

To satisfy test requirements for the 20°F emission test, a vehicle shall be emission tested in the vehicle operation and driver-selectable mode (if available) that represents the worst-case CO emissions of the urban charge-depleting emission test or urban charge-sustaining emission test following the procedure outlined in section E.4 at 20°F.

If a vehicle qualifies for the Alternative Urban Emission Test, the worst-case emissions for the 20°F and 50°F emission tests shall be determined according to subsection E.3.4.2.

3.4.6. Alternative Determination of Worst-Case Driver-Selectable Modes.

In lieu of demonstrating worst-case emissions by certification testing in every driver-selectable mode for the Urban Emission Test Provisions in sections E.4 and E.8, Highway Emission Test Provisions in section E.6, and SFTP Emission Test Provisions in section E.7, a manufacturer may determine the worst-case driver-selectable mode by using non-certification emission data or an engineering evaluation. The manufacturer must report the data or engineering evaluation used to determine the worst-case driver-selectable mode. The manufacturer must demonstrate compliance with all applicable emission standards using test data for the worst-case driver-selectable mode.

4. Urban Emission Test Provisions.

4.1. Urban Test Applicability and General Provisions.

To be conducted pursuant to 40 CFR §1066.801 with the following revisions:

4.1.1 Subparagraphs (a) through (b). [No change.]

4.1.2 Amend subparagraph (c)(1): The Urban Charge-Sustaining Emission Test and the Urban Charge-Depleting Emission Test.

4.1.3 Amend subparagraph (c)(1)(i): The Urban Charge-Sustaining Emission Test consists of an engine startup during the first UDDS cycle followed by a 10-minute key-off soak. After a 10-minute key-off soak, the subsequent UDDS cycle is a hot-start UDDS cycle. The Urban Charge-Depleting Emission Test consists of a series of charge-depleting UDDS cycles each followed by a 10-minute key-off soak until charge-sustaining operation is achieved. The Urban Charge-Depleting Emission Test begins with the vehicle at full state-of-charge with engine startup occurring during the driving of the series of charge-depleting UDDS cycles. The first engine startup (with all accessories turned off) that occurs during a UDDS cycle followed by a vehicle shutdown at the end of the UDDS cycle makes a complete cold-start UDDS cycle. After a 10-minute key-off soak, the subsequent UDDS cycle is a hot-start UDDS cycle. For the Urban Charge-Depleting Emission Test, additional hot-start UDDS cycles each followed by a 10-minute key-off soak may be needed to achieve charge-sustaining operation. The UDDS cycle can be considered as a two-phase cycle where the first 505 seconds of the UDDS cycle is the transient phase, and the remaining 867 seconds of the UDDS cycle is the stabilized phase.

4.1.4 Subparagraphs (c)(1)(ii) through (c)(5). [Not applicable.]

4.1.5 Subparagraph (d). [No change.]

4.1.6 Subparagraph (e). [No change except the hot soak test temperature in the three-day diurnal emission test sequence is 105°F.]

4.2. Urban Charge-Sustaining Emission Test.

4.2.1. Vehicle Preconditioning for Urban Charge Sustaining Emission Test.

To be conducted pursuant to the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles" with the following supplemental requirements:

4.2.1.1 The vehicle shall be preconditioned in charge-sustaining operation with the vehicle in default mode or in normal mode if the vehicle does not have default mode. If, however, the vehicle is to be tested in charge-increasing operation (this does not apply to a driver-selectable charge-increasing mode), then the initial SOC for the preconditioning drive

shall be set at the lowest normal SOC level allowed by the vehicle when driving on the UDDS cycle.

4.2.1.2 The vehicle shall be pushed or towed to a work area for the initial fuel drain and fill according to section III.D.1.5 of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

4.2.1.3 Following the initial fuel drain and fill, the vehicle shall complete an initial soak period of a minimum of 6 hours.

4.2.1.4 After completing the initial soak period, the vehicle shall be pushed or towed into position on a dynamometer and preconditioned.

4.2.1.5 The preconditioning cycle shall be the UDDS cycle and performed at this time. Except as noted in section E.4.2.1.8, the initial SOC may be set after the preconditioning cycle by driving an additional distance on the chassis dynamometer such that the SOC Criterion for the subsequent emission test is more likely to be satisfied when applying the ±1% SOC Net Energy Change Tolerances in section E.10.

4.2.1.6 A fuel drain and fill shall be performed pursuant to the provisions of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

4.2.1.7 The vehicle shall be soaked for 12-36 hours. During this soak period, canister preconditioning shall be performed pursuant to the provisions of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

4.2.1.8 Initial SOC may be set during the soak period by discharging or charging the vehicle such that the SOC Criterion for the subsequent emission test is more likely to be satisfied when applying the ±1% SOC Net Energy Change Tolerances in section E.10, except as follows:

4.2.1.8.1 If the Alternative End-of-Test Criterion in section E.4.2.4 is used, then initial SOC setting shall not be permitted after

the preconditioning cycle nor during the soak period prior to the Urban Charge-Sustaining Emission Test.

4.2.1.8.2 If testing a vehicle in a charge-increasing driver-selectable mode, then initial SOC setting shall not be permitted after the preconditioning cycle nor during the soak period prior to the Urban Charge-Sustaining Emission Test.

4.2.1.8.3 If testing a vehicle in charge-increasing operation, then the initial SOC for the Urban Charge-Sustaining Emission Test shall be set at the lowest normal SOC level allowed by the vehicle when driving on the UDDS cycle.

4.2.2. Determination of Urban Charge-Sustaining Emissions –Dynamometer Test Run, Gaseous and Particulate Emissions.

To be conducted pursuant to 40 CFR §1066.815 with the following revisions:

4.2.2.1 General

4.2.2.1.1 Amend subparagraph (a): General. The Urban Charge-Sustaining Emission Test consists of a cold-start UDDS cycle and a hot-start UDDS cycle as described in section E.4.1.3. If driver-selectable modes are available, activate the driver-selectable mode to be tested for the Urban Charge-Sustaining Emission Test to determine worst-case emissions as described in section E.3.4.

4.2.2.2 PM Sampling

4.2.2.2.1 Amend subparagraph (b): PM sampling options. Collect PM using the procedures specified in subparagraphs (b)(1) or (b)(2) or (b)(5) of 40 CFR §1066.815 (subparagraphs (b)(3) and (b)(4) are not applicable) and use the corresponding equation in section E.4.2.6 to calculate composite PM emissions. Testing must meet the requirements related to filter face velocity as described in 40 CFR §1065.170 (c)(1)(vi) [October 25, 2016], except as specified in paragraph (b)(5) of 40 CFR §1066.815 [October 25, 2016]. For procedures involving flow weighting, set the filter face velocity to a weighting target of 1.0 to meet the requirements of 40 CFR §1065.170(c)(1)(vi) [October 25, 2016]. Allow filter face velocity to decrease as a percentage of

the weighting factor if the weighting factor is less than 1.0. Use the appropriate equations in 40 CFR §1066.610 to show that you meet the dilution factor requirements of 40 CFR §1066.110 (b)(2)(iii)(B).

4.2.2.2.2 Amend subparagraphs (b)(1): A separate PM sample for transient and stabilized phases of the cold-start UDDS cycle and the hot-start UDDS cycle may be collected. This may be done by sampling with four filters.

4.2.2.2.3 Subparagraph (b)(2). [No change.]

4.2.2.2.4 Delete subparagraphs (b)(3) and (b)(4).

4.2.2.2.5 Subparagraphs (b)(5). [No change.]

4.2.2.3 Gaseous Sampling

4.2.2.3.1 Subparagraphs (c)(1) and (c)(2). [No change.]

4.2.2.3.2 Delete subparagraph (c)(3).

4.2.2.4 Test Sequence

4.2.2.4.1 Amend subparagraph (d): Test sequence. Follow the exhaust emission measurement procedures specified in 40 CFR §1066.410 through §1066.425, subject to the following exceptions and additional provisions:

4.2.2.4.2 Subparagraph (d)(1). [No change.]

4.2.2.4.3 Amend subparagraph (d)(1)(i): Precondition the vehicle as described in section E.4.2.1. Initiate the cold-start Urban Charge-Sustaining Emission Test in the driver-selectable mode to be tested following the 12 to 36 hour soak period.

4.2.2.4.4 Subparagraphs (d)(1)(ii) and (d)(1)(iii). [No change.]

4.2.2.4.5 Amend subparagraph (d)(1)(iv): Five seconds after the vehicle is turned off, stop all stabilized interval sampling and recording, including background sampling. Stop any integrating devices for the stabilized interval and indicate the end of the stabilized interval in the recorded data. Note that

the 5 second delay is intended to account for sampling system transport.

4.2.2.4.6 Subparagraph (d)(2). [No change.]

4.2.2.4.7 Amend subparagraph (d)(2)(i): Initiate the hot-start UDDS cycle in the driver-selectable mode to be tested (9 to 11 minutes) after the end of the sample period for the cold-start UDDS cycle.

4.2.2.4.8 Amend subparagraph (d)(2)(ii): Repeat the steps in paragraph (d)(1)(ii) of this section.

4.2.2.4.9 Amend subparagraph (d)(2)(iii): For bag 4 measurement or single bag per UDDS cycle measurement, operate the vehicle over the remainder of the UDDS and conclude the testing as described in paragraphs (d)(1)(iii) and (iv) of this section.

4.2.3. End-of-Test Criteria.

Amend subparagraph (3): A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10. For PHEVs that use a battery as an energy storage device, $(Amp \cdot hr_{initial})$ is the stored charge at the beginning of the cold-start UDDS cycle, and $(Amp \cdot hr_{final})$ is the stored battery charge at the end of the subsequent hot-start UDDS cycle. The final stored battery charge, $(Amp \cdot hr_{final})$, shall not exceed either $(Amp \cdot hr_{final})_{max}$ or $(Amp \cdot hr_{final})_{min}$ for a valid test. For PHEVs that use a capacitor as an energy storage device, $(V^2_{initial})$ is the square of the capacitor voltage stored at the beginning of the cold-start UDDS cycle, and (V_{final}) is the stored capacitor voltage at the end of the subsequent hot-start UDDS cycle. The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-mechanical flywheel as an energy storage device, $(rpm^2_{initial})$ is the squared flywheel rotational speed at the beginning of the cold-start UDDS cycle, and (rpm_{final}) is the flywheel rotational speed at the end of the subsequent hot-start UDDS cycle. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

4.2.4. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.4.2.3 is not satisfied after the hot-

start UDDS cycle, an Urban Charge-Sustaining Emission Test may be considered valid if:

4.2.4.1 The alternative End-of-Test criterion of ±5% SOC Net Energy Change Tolerance in Appendix C of SAE J1711 is satisfied (Note: Appendix C of SAE J1711 may not be used to correct measured values for any emissions.); or

4.2.4.2 The SOC at the end of the hot-start UDDS cycle is higher than the SOC at the beginning of the cold-start UDDS cycle.

4.2.5. Urban Charge-Sustaining Gaseous Emissions Calculations.

To be conducted pursuant to 40 CFR §1066.820 [October 25, 2016] with the following revisions:

4.2.5.1 Subparagraph (a). [No change.]

4.2.5.2 Amend subparagraph (b): Calculate the final composite gaseous test results as a mass-weighted value, $e_{[emission]\text{-}FTPcomp}$, in grams per mile using the following equation:

$$e_{[\mathrm{emission}]-\mathrm{FTPcomp}} = 0.43\left(\frac{m_{\mathrm{c}}}{D_{\mathrm{c}}}\right) + 0.57\left(\frac{m_{\mathrm{h}}}{D_{\mathrm{h}}}\right)$$

Where:

m_c = the mass emissions determined from the cold-start UDDS cycle, in grams. If the cold-start UDDS cycle consists of phase 1 cold transient emissions and phase 2 cold stabilized emissions, then sum phase 1 and phase 2 emissions to determine m_c.

D_c = the measured driving distance from the cold-start UDDS cycle, in miles. If the cold-start UDDS cycle consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

m_h = the mass emissions determined from the hot-start UDDS cycle, in grams. If the hot-start UDDS cycle consists of phase 3 hot transient emissions and phase 4 hot stabilized emissions, then sum phase 3 and phase 4 emissions to determine m_h.

D_h = the measured driving distance from the hot-start UDDS cycle, in miles. If the hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h.

4.2.5.3 Subparagraph (c). [Not applicable.]

4.2.6. Urban Charge-Sustaining Particulate Emissions Calculations.

To be conducted pursuant to 40 CFR §1066.820 with the following revisions:

4.2.6.1 Subparagraphs (a) to (b). [Not applicable.]

4.2.6.2 Amend subparagraphs (c) through (c)(1): Calculate the final composite PM test results as a mass-weighted value, $e_{PM\text{-}FTPcomp}$, in grams per mile as follows:

(1) Use the following equation for PM measured as described in §1066.815(b)(1) or (2):

$$e_{PM-FTPcomp} = 0.43\left(\frac{m_{PM-cUDDS}}{D_c}\right) + 0.57\left(\frac{m_{PM-hUDDS}}{D_h}\right)$$

Where:

$m_{PM\text{-}cUDDS}$ = the combined PM mass emissions determined from the cold-start UDDS cycle (phase 1 and phase 2), in grams, as calculated using Eq. 1066.605-2.

D_c = the measured driving distance from the cold-start UDDS cycle, in miles. If the cold start UDDS cycle consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

$m_{PM\text{-}hUDDS}$ = the combined PM mass emissions determined from the hot-start UDDS cycle (phase 3 and phase 4), in grams, as calculated using Eq. 1066.605-2.

D_h = the measured driving distance from the hot-start UDDS cycle, in miles. If the hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase

3 and phase 4 distances to determine D_h.

4.2.6.3 Subparagraph (c)(2). [Not applicable.]

4.2.6.4 Amend subparagraph (c)(3): Use the following equation for PM measured as described in §1066.815 (b)(5):

$$e_{\mathrm{PM-FTPcomp}} = \frac{m_{\mathrm{PM}}}{0.43(D_{\mathrm{c}}) + 0.57(D_{\mathrm{h}})}$$

Where:

m_{PM} = the combined PM mass emissions determined from the cold-start UDDS cycle and the hot-start UDDS cycle (phase 1, phase 2, phase 3, and phase 4), in grams, as calculated using Eq. 1066.605-4

D_c = the measured driving distance from the cold-start UDDS cycle, in miles. If the cold-start UDDS cycle consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

D_h = the measured driving distance from the hot-start UDDS cycle, in miles. If the hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h.

4.3. Urban Charge-Depleting Emission Test.

4.3.1. Vehicle Preconditioning for Urban Charge-Depleting Emission Test.

To be conducted pursuant to the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles" with the following supplemental requirements:

4.3.1.1 The vehicle shall be preconditioned in charge-sustaining operation with the vehicle in default mode or in normal mode if the vehicle does not have default mode. If, however, the vehicle is to be tested in charge-

increasing operation (this does not apply to a driver-selectable charge-increasing mode), then the initial SOC for the preconditioning drive shall be set at the lowest normal SOC level allowed by the vehicle when driving on the UDDS cycle.

4.3.1.2 The vehicle shall be pushed or towed to a work area for the initial fuel drain and fill according to section III.D.1.5 of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

4.3.1.3 Following the initial fuel drain and fill, the vehicle shall complete an initial soak period of a minimum of 6 hours.

4.3.1.4 After completing the initial soak period, the vehicle shall be pushed or towed into position on a dynamometer and preconditioned.

4.3.1.5 The preconditioning cycle shall be the UDDS cycle and performed at this time.

4.3.1.6 A fuel drain and fill shall be performed pursuant to the provisions of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

4.3.1.7 The vehicle shall be soaked for 12-36 hours. During this soak period, canister preconditioning shall be performed pursuant to the provisions of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

4.3.1.8 Charge the vehicle to full state-of-charge as specified by the vehicle manufacturer. The vehicle must be turned off during charging and charge time shall not exceed soak time.

4.3.2. Determination of Urban Charge- Depleting Emissions –Dynamometer Test Run, Gaseous and Particulate Emissions.

To be conducted pursuant to 40 CFR §1066.815 with the following revisions:

4.3.2.1 General

4.3.2.1.1 Amend subparagraph (a): The Urban Charge-Depleting Emission Test consists of the Urban All-Electric Range Test, a cold-start UDDS cycle when the engine starts followed by a 10-minute key off soak and hot-start UDDS cycle(s) as described in section E.4.1.3. The Continuous Urban Test Schedule is used for the Urban Charge-Depleting Emission Test. If driver-selectable modes are available that can be appropriately tested with charge-depleting operation, then test the appropriate driver-selectable mode(s) as required for the Urban Charge-Depleting Emission Test to determine worst-case emissions as described in section E.3.4.

4.3.2.1.2 The Alternative Continuous Urban Test Schedule may be substituted for the Continuous Urban Test Schedule if the test facility is unable to perform the Continuous Urban Test Schedule.

4.3.2.1.3 Refer to sections E.4.3.6, E.4.3.7, and E.11, for calculations of urban exhaust emissions, urban particulate emissions, and equivalent all-electric range, respectively. Emissions shall be measured for all test cycles when the engine is operating. For each test cycle during which emissions are not generated, emissions are not required to be sampled. However, the manufacturer must validate that the engine did not turn on at any time during the test cycle. If the engine starts operating toward the end of the cold-start UDDS cycle such that the vehicle does not achieve full warm-up conditions prior to the subsequent hot-start UDDS cycle, an additional hot-start UDDS cycle may be performed following the first hot-start UDDS cycle and be included in the hot-start mass summations Σm_h in the equation of section E.4.3.6.2 and $\Sigma m_{PM\text{-}hUDDS}$ of the equation in section E.4.3.7.2 along with the associated distance summations ΣD_h.

4.3.2.2 PM Sampling

4.3.2.2.1 Amend subparagraph (b): Collect PM using the procedures specified in subparagraphs (b)(1) or (b)(2) or (b)(5) of 40 CFR §1066.815 (subparagraphs (b)(3) and (b)(4) are not applicable)

and use the corresponding equation in section E.4.3.7 to calculate composite PM emissions. Testing must meet the requirements related to filter face velocity as described in 40 CFR §1065.170 (c)(1)(vi) [October 25, 2016], except as specified in paragraph (b)(5) of 40 CFR §1066.815. For procedures involving flow weighting, set the filter face velocity to a weighting target of 1.0 to meet the requirements of 40 CFR §1065.170(c)(1)(vi) [October 25, 2016]. Allow filter face velocity to decrease as a percentage of the weighting factor if the weighting factor is less than 1.0. Use the appropriate equations in 40 CFR §1066.610 to show that you meet the dilution factor requirements of 40 CFR §1066.110 (b)(2)(iii)(B).

4.3.2.2.2 Amend subparagraphs (b)(1): A separate PM sample for transient and stabilized phases of the cold-start UDDS cycle and the hot-start UDDS cycle may be collected. This may be done by sampling with four filters.

4.3.2.2.3 Subparagraph (b)(2). [No change.]

4.3.2.2.4 Delete subparagraphs (b)(3) and (b)(4).

4.3.2.2.5 Subparagraphs (b)(5) [No change.]

4.3.2.3 Gaseous Sampling

4.3.2.3.1 Subparagraphs (c)(1) and (c)(2). [No change.]

4.3.2.3.2 Delete subparagraph (c)(3).

4.3.2.4 Test Sequence

4.3.2.4.1 Amend subparagraph (d): Follow the exhaust emission measurement procedures specified in 40 CFR §1066.410 through §1066.425, subject to the following exceptions and additional provisions:

4.3.2.4.2 Subparagraph (d)(1). [No change.]

4.3.2.4.3 Amend subparagraph (d)(1)(i): Precondition the vehicle as described in section E.4.3.1. Initiate the cold-start Urban Charge-Depleting Emission Test in the appropriate driver-

selectable mode to be tested following the 12 to 36 hour soak period.

4.3.2.4.4 Subparagraphs (d)(1)(ii) and (d)(1)(iii). [No change.]

4.3.2.4.5 Amend subparagraph (d)(1)(iv): Five seconds after the vehicle is turned off, stop all stabilized interval sampling and recording, including background sampling. Stop any integrating devices for the stabilized interval and indicate the end of the stabilized interval in the recorded data. Note that the 5 second delay is intended to account for sampling system transport.

4.3.2.4.6 Subparagraph (d)(2). [No change.]

4.3.2.4.7 Amend subparagraph (d)(2)(i): Initiate the hot-start UDDS cycle in the driver-selectable mode to be tested (9 to 11 minutes) after the end of the sample period for the cold-start UDDS cycle.

4.3.2.4.8 Amend subparagraph (d)(2)(ii): Repeat the steps in paragraph (d)(1)(ii) of this section.

4.3.2.4.9 Amend subparagraph (d)(2)(iii): For bag 4 measurement or single bag per UDDS cycle measurement, operate the vehicle over the remainder of the UDDS and conclude the testing as described in subparagraphs (d)(1)(iii) and (iv) of this section.

4.3.3. End-of-Test Criteria.

Amend subparagraph (3): A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10. For PHEVs that use a battery as an energy storage device, $(Amp{\cdot}hr_{initial})$ is the stored charge at the beginning of the cold-start UDDS cycle, and $(Amp{\cdot}hr_{final})$ is the stored battery charge at the end of the next hot-start UDDS cycle immediately following the cold-start UDDS cycle. The final stored battery charge, $(Amp{\cdot}hr_{final})$, shall not exceed either $(Amp{\cdot}hr_{final})_{max}$ or $(Amp{\cdot}hr_{final})_{min}$ for a valid test. For PHEVs that use a capacitor as an energy storage device, $(V^2_{initial})$ is the square of the capacitor voltage stored at the beginning of the cold-start UDDS cycle, and (V_{final}) is the stored capacitor voltage at the end of the next hot-start UDDS cycle immediately following the cold-start UDDS cycle. The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-

mechanical flywheel as an energy storage device, ($rpm^2_{initial}$) is the squared flywheel rotational speed at the beginning of the cold-start UDDS cycle, and (rpm_{final}) is the flywheel rotational speed at the end of the next hot-start UDDS cycle immediately following the cold-start UDDS cycle. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

4.3.4. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.4.3.3 is not satisfied after the hot-start UDDS cycle, an Urban Charge-Depleting Emission Test may be considered valid if:

4.3.4.1 The alternative End-of-Test criteria in Section 3.9 or Section 3.9.1 of SAE J1711 are satisfied; or

4.3.4.2 The SOC at the end of the hot-start UDDS cycle is higher than the SOC at the beginning of the cold-start UDDS cycle.

4.3.5. Vehicle Charging After Testing.

Vehicle charging shall begin within three hours after the charge-depleting emission test, and the vehicle shall be charged to the manufacturer specified full state-of-charge. During charging, all applicable requirements in section E.1 must be met, and energy consumption shall be calculated pursuant to the requirements in section E.11.2.

4.3.6. Urban Charge-Depleting Gaseous Emissions Calculations.

To be conducted pursuant to 40 CFR §1066.820 [October 25, 2016] with the following revisions:

4.3.6.1 Subparagraph (a). [No change.]

4.3.6.2 Amend subparagraph (b): Calculate the final composite gaseous test results as a mass-weighted value, $e_{[emission]\text{-}FTPcomp}$, in grams per mile using the following equation:

$$e_{[\text{emission }]-\text{FTPcomp}} = 0.43\left(\frac{m_c}{D_c}\right) + 0.57\left(\frac{\Sigma m_h}{\Sigma D_h}\right)$$

Where:

m_c = the mass emissions determined from the cold-start UDDS cycle, in grams. If the cold-start UDDS cycle consists of phase 1 cold transient emissions and phase 2 cold stabilized emissions, then sum phase 1 and phase 2 emissions to determine m_c.

D_c = the measured driving distance from the cold-start UDDS cycle, in miles. If the cold-start UDDS cycle consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

Σm_h = the summation of the mass emissions determined from each hot-start UDDS cycle, in grams. If a hot-start UDDS cycle consists of phase 3 hot transient emissions and phase 4 hot stabilized emissions, then sum phase 3 and phase 4 emissions to determine m_h for each hot-start UDDS cycle.

ΣD_h = the summation of the measured driving distances from each hot-start UDDS cycle, in miles. If a hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h for each hot-start UDDS cycle.

4.3.6.3 Subparagraphs (c). [Not applicable.]

4.3.7. Urban Charge-Depleting Particulate Emissions Calculations.

To be conducted pursuant to 40 CFR §1066.820 with the following revisions:

4.3.7.1 Subparagraph (a) to (b). [Not applicable.]

4.3.7.2 Amend subparagraphs (c) through (c)(1): Calculate the final composite PM test results as a mass-weighted value, $e_{PM\text{-}FTPcomp}$, in grams per mile, using the following equation for PM measured as described in §1066.815(b)(1) or (2):

$$e_{\mathrm{PM-FTPcomp}} = 0.43\left(\frac{m_{\mathrm{PM-cUDDS}}}{D_{\mathrm{c}}}\right) + 0.57\left(\frac{\Sigma m_{\mathrm{PM-hUDDS}}}{\Sigma D_{\mathrm{h}}}\right)$$

Where:

$m_{PM\text{-}cUDDS}$ = the combined PM mass emissions determined from the cold-start UDDS cycle (phase 1 and phase 2), in grams, as calculated using Eq. 1066.605-2.

D_c = the measured driving distance from the cold-start UDDS cycle, in miles. If the cold-start UDDS cycle consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

$\Sigma m_{PM\text{-}hUDDS}$ = the summation of the PM mass emissions determined from each hot-start UDDS cycle, in grams, as calculated using Eq. 1066.605-2. If a hot-start UDDS cycle consists of phase 3 hot transient emissions and phase 4 hot stabilized emissions, then sum phase 3 and phase 4 emissions to determine $m_{PM\text{-}hUDDS}$ for each hot-start UDDS cycle.

ΣD_h = the summation of the measured driving distances from each hot-start UDDS cycle, in miles. If a hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h for each hot-start UDDS cycle.

4.3.7.3 Subparagraph (c)(2). [Not applicable.]

4.3.7.4 Amend subparagraph (c)(3): Use the following equation for PM measured as described in §1066.815(b)(5):

$$e_{\mathrm{PM-FTPcomp}} = \frac{m_{\mathrm{PM}}}{0.43(D_{\mathrm{c}}) + 0.57(D_{\mathrm{h}})}$$

Where:

m_{PM} = the combined PM mass emissions determined from the cold-start UDDS cycle and the hot-start UDDS cycle (phase 1, phase 2, phase 3, and phase 4), in grams, as calculated using Eq. 1066.605-4.

D_c = the measured driving distance from the cold-start UDDS

cycle, in miles. If the cold-start UDDS cycle consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

D_h = the measured driving distance from the hot-start UDDS cycle, in miles. If the hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h.

4.4. Partial Soak Emission Testing.

The test sequence consists of an Urban Charge-Sustaining Emission Test as described in subsection E.4.2 followed by one, or a consecutive sequence of, Cold-Start Partial Soak Tests as described by the following procedure:

4.4.1. Vehicle Preconditioning Requirements.

Conduct an Urban Charge-Sustaining Emission Test as described in subsection E.4.2.

4.4.2. Partial Soak.

After the Urban Charge-Sustaining Emission Test is complete, the vehicle shall be soaked for 10 minutes to 12 hours. Throughout the soak period, the vehicle shall remain shut off, the engine compartment cover (i.e. hood) shall be closed, and cooling of any vehicle components is not permitted, except by ambient air. The ambient air temperature must remain between 68 to 86 degrees Fahrenheit throughout the soak period.

4.4.3. Cold-Start Partial Soak Test Run.

Following the 10 minute to 12 hour soak period, initiate a Cold-Start Partial Soak Test by following 40 CFR §1066.815 with the following revisions:

Amend subparagraph (a): General. The Cold-Start Partial Soak Test consists of one UDDS cycle. Conduct the Cold-Start Partial Soak Test in charge-sustaining vehicle operation and driver-selectable mode (e.g., normal mode, economy mode, performance mode, battery charging mode, or any other operating mode available to the driver) that represent the worst-case NMOG+NOx emissions for the Cold-Start Partial Soak Test.

Amend subparagraph (b): PM sampling options. [n/a]

Subparagraphs (c)(1) and (c)(2). [No change.]

Subparagraphs (c)(3). [n/a]

Amend subparagraph (d): Test sequence. Follow the exhaust emission measurement procedures specified in 40 CFR §1066.410 through §1066.425, subject to the following exceptions and additional provisions:

Subparagraph (d)(1). Take the following steps for the cold-start partial soak test:

Amend subparagraph (d)(1)(i): Following the 10 minute to 12 hour soak, initiate the Cold-Start Partial Soak Test in the driver-selectable mode to be tested by operating the vehicle over one UDDS cycle.

Subparagraph (d)(1)(ii) to (d)(1)(iv). [No change.]

Subparagraph (d)(2) and (d)(3). [n/a].

4.4.4. End-of-Test Criteria.

A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10. For PHEVs that use a battery as an energy storage device, $(Amp \cdot hr_{initial})$ is the stored charge at the beginning of the Cold-Start Partial Soak Test, and $(Amp \cdot hr_{final})$ is the stored battery charge at the end of the Cold-Start Partial Soak Test. The final stored battery charge, $(Amp \cdot hr_{final})$, shall not exceed either $(Amp \cdot hr_{final})_{max}$ or $(Amp \cdot hr_{final})_{min}$ for a valid test. For PHEVs that use a capacitor as an energy storage device, $(V^2_{initial})$ is the square of the capacitor voltage stored at the beginning of the Cold-Start Partial Soak Test, and (V_{final}) is the stored capacitor voltage at the end of the Cold-Start Partial Soak Test. The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-mechanical flywheel as an energy storage device, $(rpm^2_{initial})$ is the squared flywheel rotational speed at the beginning of the Cold-Start Partial Soak Test, and (rpm_{final}) is the flywheel rotational speed at the end of the Cold-Start Partial Soak Test. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

4.4.5. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.4.4.4 is not satisfied after the Cold-Start Partial Soak Test, the test may be considered valid if:

4.4.5.1 The alternative End-of-Test criterion of ±5% SOC Net Energy Change Tolerance in Appendix C of SAE J1711 is satisfied (Note: Appendix C

of SAE J1711 may not be used to correct measured values for any emissions.); or

4.4.5.2 The SOC at the end of the Cold-Start Partial Soak Test is higher than the SOC at the beginning of the Cold-Start Partial Soak Test.

4.4.6. Option to Conduct Additional Cold-Start Partial Soak Tests.

To determine compliance with the Partial Soak emission standards, the test sequence in subsections E.4.4.2 to E.4.4.5 may be repeated to measure exhaust emissions on additional Cold-Start Partial Soak Tests.

4.4.7. Partial Soak Test Emissions Calculations.

To be conducted pursuant to 40 CFR §1066.820 [October 25, 2016] with the following revisions:

4.4.7.1 Amend Subparagraph (a) as follows: Determine the mass of exhaust emissions of each pollutant for each test interval in Subsection E.4.4.7.2 as described in §1066.605.

4.4.7.2 Amend Subparagraph (b) as follows: Calculate the final composite gaseous test results as a mass-weighted value, $e_{partial\_soak}$, in grams per mile, using the following equation:

$$e_{partial\ \_soak} = 0.43\left(\frac{m_{ps}}{D_{ps}}\right) + 0.57\left(\frac{m_h}{D_h}\right)$$

Where:

m_{ps} = the mass emissions determined from the Cold-Start Partial Soak Test in subsection E.4.4.3, in grams. If the Cold-Start Partial Soak Test consists of phase 1 cold transient emissions and phase 2 cold stabilized emissions, then sum phase 1 and phase 2 emissions to determine m_{ps}.

m_h = the mass emissions determined from the hot-start UDDS cycle in subsection E.4.4.1, in grams. If the hot-start UDDS cycle consists of phase 3 hot transient emissions and phase 4 hot stabilized emissions, then sum phase 3 and phase 4 emissions to determine m_h.

D_{ps} = the measured driving distance from the Cold-Start Partial Soak Test in subsection E.4.4.3, in miles. If the Cold-Start Partial Soak Test consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_c.

D_h = the measured driving distance from the hot-start UDDS cycle in subsection E.4.4.1, in miles. If the hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h.

4.4.7.3 Subparagraph (c). [n/a.]

4.5. Quick Drive-Away Emission Testing.

4.5.1. Vehicle Preconditioning for Quick Drive-Away Emission Test.

Precondition the vehicle following the procedure outlined in subsections E.4.2.1.1 to E.4.2.1.7.

Initial SOC may be set during the soak period by discharging or charging the vehicle such that the SOC Criterion for the Quick Drive-Away Emission Test is more likely to be satisfied when applying the ±1% SOC Net Energy Change Tolerances in section E.10, except as follows:

If the Alternative End-of-Test Criterion in section E.4.5.4 is used, then initial SOC setting shall not be permitted after the preconditioning cycle nor during the soak period prior to the Quick Drive-Away Emission Test.

If testing a vehicle in a charge-increasing driver-selectable mode, then initial SOC setting shall not be permitted after the preconditioning cycle nor during the soak period prior to the Quick Drive-Away Emission Test.

4.5.2. Quick Drive-Away Test Run.

Amend §1066.815 as follows:

Amend subparagraph (a): General. The Quick Drive-Away Emission Test consists of a cold-start Quick Drive-Away UDDS cycle. Conduct the Quick Drive-Away Test in charge-sustaining vehicle operation and driver-selectable mode (e.g., normal mode, economy mode, performance mode, battery charging mode, or any other operating mode available to the driver) that represent the worst-case NMOG+NOx emissions for the Quick Drive-Away Emission Test.

Amend subparagraph (b): PM sampling options. [n/a]

Subparagraphs (c)(1) and (c)(2). [No change.]

Subparagraphs (c)(3). [n/a]

Amend subparagraph (d): Test sequence. Follow the exhaust emission measurement procedures specified in 40 CFR §1066.410 through §1066.425, subject to the following exceptions and additional provisions:

Subparagraph (d)(1). Take the following steps for the Quick Drive-Away Emission Test:

Amend subparagraph (d)(1)(i): Following the 12 to 36 hour soak, initiate the Quick Drive-Away Emission Test in the driver-selectable mode to be tested by operating the vehicle over one Quick Drive-Away UDDS cycle described in Part II subsection H of the "California 2026 and Subsequent Model Year Criteria Pollutant Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles".

Amend subparagraph (d)(1)(ii): Start sampling and recording simultaneously with starting the vehicle. Place the vehicle in gear 6 seconds after engine starting, which is 2 seconds before the first acceleration.

Amend subparagraph (d)(1)(iii): At the end of the deceleration scheduled to occur 505 seconds into the Quick Drive-Away UDDS, simultaneously switch all the sample flows from the cold-start transient interval to the stabilized interval, stopping all cold-start transient interval sampling and recording, including background sampling. Reset integrating devices for the stabilized interval and indicate the end of the cold-start interval in the recorded data. Operate the vehicle over the remainder of the Quick Drive-Away UDDS. Turn the engine off 2 seconds after the end of the last deceleration in the stabilized interval (1,369 seconds after the start of the driving schedule).

Subparagraph (d)(1)(iv). [No change.]

Subparagraph (d)(2) and (d)(3). [n/a].

4.5.3. End-of-Test Criteria.

A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10. For PHEVs that use a battery as an energy storage device, $(Amp{\cdot}hr_{initial})$ is the stored charge at the beginning of the Quick Drive-Away Emission Test, and $(Amp{\cdot}hr_{final})$ is the stored battery charge at the end of the Quick Drive-Away Emission Test. The final stored battery charge, $(Amp{\cdot}hr_{final})$, shall not exceed either $(Amp{\cdot}hr_{final})_{max}$ or $(Amp{\cdot}hr_{final})_{min}$ for a valid test. For PHEVs that use a

capacitor as an energy storage device, ($V^2_{initial}$) is the square of the capacitor voltage stored at the beginning of the Quick Drive-Away Emission Test, and (V_{final}) is the stored capacitor voltage at the end of the Quick Drive-Away Emission Test. The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-mechanical flywheel as an energy storage device, ($rpm^2_{initial}$) is the squared flywheel rotational speed at the beginning of the Quick Drive-Away Emission Test, and (rpm_{final}) is the flywheel rotational speed at the end of the Quick Drive-Away Emission Test. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

4.5.4. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.4.5.3 is not satisfied after the Quick Drive-Away Emission Test, the test may be considered valid if:

4.5.4.1 The alternative End-of-Test criterion of ±5% SOC Net Energy Change Tolerance in Appendix C of SAE J1711 is satisfied (Note: Appendix C of SAE J1711 may not be used to correct measured values for any emissions.); or

4.5.4.2 The SOC at the end of the Quick Drive-Away Emission Test is higher than the SOC at the beginning of the Quick Drive-Away Emission Test.

4.5.5. Determining Hot-Start Emissions.

Conduct an Urban Charge-Sustaining Emission Test as described in subsection E.4.2 to determine hot-start emissions.

4.5.6. Quick Drive-Away Test Emissions Calculations.

To be conducted pursuant to 40 CFR §1066.820 [October 25, 2016] with the following revisions:

4.5.6.1 Amend Subparagraph (a) as follows: Determine the mass of exhaust emissions of each pollutant for each test interval in Subsection E.4.5.6.2 as described in §1066.605.

4.5.6.2 Amend Subparagraph (b) as follows: Calculate the final composite gaseous test results as a mass-weighted value, $e_{quick\_drive\_away}$, in grams per mile, using the following equation:

$$e_{quick\_drive\_away} = 0.43\left(\frac{m_{qd}}{D_{qd}}\right) + 0.57\left(\frac{m_h}{D_h}\right)$$

Where:

m_{qd} = the mass emissions determined from the Quick Drive-Away Emission Test in subsection E.4.5.2, in grams. If the Quick Drive-Away Emission Test consists of phase 1 cold transient emissions and phase 2 cold stabilized emissions, then sum phase 1 and phase 2 emissions to determine m_{qd}.

m_h = the mass emissions determined from the hot-start UDDS cycle in subsection E.4.5.5, in grams. If the hot-start UDDS cycle consists of phase 3 hot transient emissions and phase 4 hot stabilized emissions, then sum phase 3 and phase 4 emissions to determine m_h.

D_{qd} = the measured driving distance from the Quick Drive-Away Emission Test in subsection E.4.5.2, in miles. If the Quick Drive-Away Emission Test consists of phase 1 distance and phase 2 distance, then sum phase 1 and phase 2 distances to determine D_{qd}.

D_h = the measured driving distance from the hot-start UDDS cycle in subsection E.4.5.5, in miles. If the hot-start UDDS cycle consists of phase 3 distance and phase 4 distance, then sum phase 3 and phase 4 distances to determine D_h.

4.5.6.3 Subparagraph (c). [n/a.]

5. Alternative Urban Emission Test Provisions.

5.1. Requirement to Qualify for the Alternative Urban Emission Test.

A vehicle with an Urban All-Electric Range that is equal to or greater than four UDDS cycles and has an AER/EAER ratio that is equal to or greater than 0.98 may demonstrate compliance with applicable exhaust emission standards using this section E.5 in lieu of sections E.4.2 and E.4.3. The AER and EAER values used to calculate the AER/EAER ratio must each contain three significant figures

after the decimal point. Rounding the calculated AER/EAER ratio up to 0.98 is prohibited. Use of the Alternative Urban Emission Test must be approved in advance by the Executive Officer under the procedure in subsection E.3.2.1. The manufacturer must provide information to demonstrate that the applicable vehicle test group satisfies the requirements outlined in this subsection E.5.1.

5.2. Dynamometer Run to Determine Urban All-Electric Range for Vehicles that Qualify for the Alternative Urban Emission Test.

For the purpose of measuring vehicle emissions, subparagraphs E.5.2.1 and E.5.2.2 must be performed during the initial Alternative Urban Emission Test to determine urban all-electric range; these sections may be omitted during any subsequent Alternative Urban Emission Tests.

5.2.1 The vehicle shall be charged to full state-of-charge.

5.2.2 To determine urban all-electric range, the vehicle shall be placed or pushed onto a chassis dynamometer and operated through the Continuous Urban Test Schedule or the Alternative Continuous Urban Test Schedule with the vehicle in default mode or in normal mode if the vehicle does not have default mode. When the engine first starts, record SOC, and continue driving until charge-sustaining operation is achieved. As an option, emissions may be measured so the full Urban Charge-Depleting Emission Test as described in section E.4.3 may be used to determine urban charge-depleting emissions for vehicles operating in default or normal mode. If this option is used, vehicle preconditioning according to section E.4.3.1 must be performed prior to this section E.5.2.2.

5.3. Vehicle Preconditioning.

The vehicle shall be preconditioned according to section E.4.3.1, with the following exception:

For the Alternative Urban Emission Test, only the initial dynamometer run to determine urban all-electric range as described in E.5.2.2 would require the vehicle to be charged to full state-of-charge prior to testing. For any subsequent dynamometer run to determine urban emissions for the Alternative Urban Emission Test, the initial SOC would be set according to E.5.4.1. The vehicle must be turned off during charging and charge time shall not exceed soak time.

5.4. Determination of Alternative Urban Test Emissions – Dynamometer Test Run, Gaseous and Particulate Emissions.

5.4.1 After the cold soak period, using the engine start SOC data from the previous section E.5.2.2, set the SOC so that the engine starts at or before the first 45 seconds of the cold-start UDDS cycle. The SOC shall not be set below the normal operating SOC threshold of the vehicle as observed during the UDDS cycle when driving in default mode or in normal mode if the vehicle does not have default mode. If testing a vehicle in driver-selectable, charge-increasing mode: first set SOC in accordance with the conditions set forth in the first two sentences of this section E.5.4.1 with the vehicle in default mode or in normal mode if the vehicle does not have default mode, then activate the charge-increasing mode at the start of the cold-start UDDS cycle. For all tests, the engine must start at or before the first 45 seconds of the cold-start UDDS cycle to be valid.

5.4.2 The vehicle shall be placed or pushed onto a dynamometer and operated through a cold-start UDDS cycle followed by a 10 minute key-off soak and then a hot-start UDDS cycle. At the completion of the hot-start UDDS cycle, the test is completed. For additional testing information, the testing parameters for the Urban Charge-Sustaining Emission Test in section E.4.2 are applicable. However, the Alternative Urban Emission Test does not require satisfying the SOC Net Energy Change Tolerance to be a valid test.

5.5. Optional Vehicle Charging After Testing.

Vehicle may be fully charged following the Urban All-Electric Range Test in section E.5.2.2. If this option is performed, vehicle charging shall begin within three hours after completing the Urban All-Electric Range Test in section E.5.2.2, and the vehicle shall be charged to the manufacturer specified full state-of-charge. During charging, all applicable requirements in section E.1 must be met, and energy consumption shall be calculated pursuant to the requirements in section E.11.2.

5.6. Alternative Urban Test Emissions Calculations.

Refer to sections E.4.2.5 and E.4.2.6, for calculating urban gaseous emissions and urban particulate emissions, respectively.

6. Highway Emission Test Provisions.

6.1. Highway Emission Test.

To be conducted pursuant to 40 CFR §1066.840 with the following revisions:

6.2. Vehicle Preconditioning and Emission Testing.

6.2.1 Amend subparagraph (a): Perform the Highway Emission Test immediately following any of the urban emission tests, the Highway Charge-Depleting All-Electric Range Test, or a previous Highway Emission Test when this is practical. If the Highway Emission Test starts more than 3 hours after any of the urban emission tests (including evaporative emission measurements, if applicable), Highway Charge-Depleting All-Electric Range Test, or a previous Highway Emission Test, operate the vehicle over one UDDS cycle in charge-sustaining operation to precondition the vehicle. If driver-selectable modes are available, do not activate the driver-selectable mode to be tested for the UDDS preconditioning drive, but set the vehicle in default mode or normal mode for the UDDS preconditioning drive with the vehicle in charge-sustaining operation.

6.2.2 Amend subparagraph (b): Operate the vehicle over the HFEDS cycle in charge-sustaining operation for preconditioning. If driver-selectable modes are available, do not activate the driver-selectable mode to be tested for the preconditioning drive, but set the vehicle in default mode or normal mode for the preconditioning drive with the vehicle in charge-sustaining operation. If, however, the vehicle is to be tested in charge-increasing operation (this does not apply to a driver-selectable charge-increasing mode), then the initial SOC shall be set at the lowest normal SOC level allowed by the vehicle when driving on the UDDS cycle. After the preconditioning drive, allow the vehicle to idle for 15 seconds (with the vehicle in gear), then start a repeat run of the HFEDS cycle and simultaneously start sampling and recording. If a driver-selectable mode is to be tested after the preconditioning drive, allow the vehicle to idle for 15 seconds (with the vehicle in gear), activate the driver-selectable mode to be tested, then start a repeat run of the HFEDS cycle and simultaneously start sampling and recording.

6.2.3 Amend subparagraph (c): Turn the vehicle off at the end of the final HFEDS cycle and stop all sampling and recording, including background.

Stop any integrating devices and indicate the end of the test cycle in the recorded data.

6.3. End-of-Test Criteria.

A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10 for the HFEDS cycle with emission sampling. For PHEVs that use a battery as an energy storage device, $(Amp \cdot hr_{initial})$ is the stored charge at the beginning of the HFEDS cycle with emission sampling, and $(Amp \cdot hr_{final})$ is the stored battery charge at the end of the same HFEDS cycle with emission sampling. The final stored battery charge, $(Amp \cdot hr_{final})$, shall not exceed either $(Amp \cdot hr_{final})_{max}$ or $(Amp \cdot hr_{final})_{min}$ for a valid test. For PHEVs that use a capacitor as an energy storage device, $(V^2_{initial})$ is the square of the capacitor voltage stored at the beginning of the HFEDS cycle with emission sampling, and (V_{final}) is the stored capacitor voltage at the end of the same HFEDS cycle with emission sampling. The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-mechanical flywheel as an energy storage device, $(rpm^2_{initial})$ is the squared flywheel rotational speed at the beginning of the HFEDS cycle with emission sampling, and (rpm_{final}) is the flywheel rotational speed at the end of the same HFEDS cycle with emission sampling. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

6.4. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.6.3 is not satisfied for the HFEDS cycle with emission sampling, a Highway Emission Test may be considered valid if:

6.4.1 The alternative End-of-Test criterion of ±5% SOC Net Energy Change Tolerance in Appendix C of SAE J1711 is satisfied (Note: Appendix C of SAE J1711 may not be used to correct measured values for any emissions.); or

6.4.2 The SOC at the end of the HFEDS cycle with emission sampling is higher than the SOC at the beginning of the same HFEDS cycle with emission sampling.

7. SFTP Emission Test Provisions.

7.1. US06 Charge-Sustaining Emission Test.

To be conducted pursuant to 40 CFR §1066.831 with the following revisions:

7.1.1. Vehicle Preconditioning and Emission Testing.

7.1.1.1 Subparagraphs (a) through (b)(1). [No change.]

7.1.1.2 Amend subparagraph (b)(1)(i): For aggressive-driving tests that do not follow any urban emission test or the Highway Emission Test.

7.1.1.3 Amend subparagraph (b)(1)(ii): For a test element that starts more than 72 hours after any most recent urban emission test or the Highway Emission Test (with or without evaporative emission measurements).

7.1.1.4 Amend subparagraph (b)(1)(iii): For testing in which the test vehicle has not remained in an area where ambient temperatures were within the range specified for testing since any previous urban emission test or the Highway Emission Test.

7.1.1.5 Subparagraphs (b)(2) through (b)(3)(i). [No change.]

7.1.1.6 Amend subparagraph (b)(3)(ii): Delete the following "For our testing, we will generally operate the vehicle over the same preconditioning cycle that will be used for testing in this section.", and add the following " The vehicle shall be in charge-sustaining operation for this preconditioning drive. If driver-selectable modes are available, do not activate the driver-selectable mode to be tested for the preconditioning drive, but set the vehicle in default mode or normal mode for the preconditioning drive with the vehicle in charge-sustaining operation. If, however, the vehicle is to be tested in charge-increasing operation (this does not apply to a driver-selectable charge-increasing mode), then the initial SOC shall be set at the lowest normal SOC level allowed by the vehicle when driving on the UDDS cycle.".

7.1.1.7 Subparagraphs (b)(3)(ii)(A) through (b)(3)(ii)(B). [No change.]

7.1.1.8 Amend subparagraph (b)(3)(ii)(C): The HFEDS cycle.

7.1.1.9 Subparagraphs (b)(3)(ii)(D) through (e). [No change.]

7.1.1.10 Amend subparagraph (e)(1): Following the preconditioning specified in paragraph (b) of this section, place the vehicle in gear and simultaneously start sampling and recording. If a driver-selectable mode is to be tested following the preconditioning, activate the driver-selectable mode, place the vehicle in gear, and simultaneously start

sampling and recording. Begin the first acceleration 5 seconds after placing the vehicle in gear.

7.1.1.11 Subparagraphs (e)(2) through (e)(2)(iii). [No change.]

7.1.1.12 Amend subparagraph (e)(3): Turn the vehicle off 2 seconds after the end of the last deceleration. Five seconds after the vehicle stops running, stop all sampling and recording, including background sampling. Stop any integrating devices and indicate the end of the test cycle in the recorded data. Note that the 5 second delay is intended to account for sampling system transport.

7.1.1.13 Subparagraph (e)(4). [No change.]

7.1.2. End-of-Test Criteria.

A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10 for the US06 cycle with emission sampling. For PHEVs that use a battery as an energy storage device, $(Amp{\cdot}hr_{initial})$ is the stored charge at the beginning of the US06 cycle with emission sampling, and $(Amp{\cdot}hr_{final})$ is the stored battery charge at the end of the same US06 cycle with emission sampling. The final stored battery charge, $(Amp{\cdot}hr_{final})$, shall not exceed either $(Amp{\cdot}hr_{final})_{max}$ or $(Amp{\cdot}hr_{final})_{min}$ for a valid test. For PHEVs that use a capacitor as an energy storage device, $(V^2_{initial})$ is the square of the capacitor voltage stored at the beginning of the US06 cycle with emission sampling, and (V_{final}) is the stored capacitor voltage at the end of the same US06 cycle with emission sampling. The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-mechanical flywheel as an energy storage device, $(rpm^2_{initial})$ is the squared flywheel rotational speed at the beginning of the US06 cycle with emission sampling, and (rpm_{final}) is the flywheel rotational speed at the end of the same US06 cycle with emission sampling. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

7.1.3. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.7.1.2 is not satisfied for the US06 cycle with emission sampling, a US06 Charge-Sustaining Emission Test may be considered valid if:

7.1.3.1 The alternative End-of-Test criterion of ±5% SOC Net Energy Change Tolerance in Appendix C of SAE J1711 is satisfied (Note: Appendix C of SAE J1711 may not be used to correct measured values for any emissions.); or

7.1.3.2 The SOC at the end of the US06 cycle with emission sampling is higher than the SOC at the beginning of the same US06 cycle with emission sampling.

7.2. US06 Charge-Depleting Emission Test.

7.2.1. Vehicle Preconditioning for US06 Charge-Depleting Emission Test.

7.2.1.1 The vehicle shall be preconditioned in charge-sustaining operation with the vehicle in default mode or in normal mode if the vehicle does not have default mode.

7.2.1.2 Precondition the vehicle following the procedure outlined in subsections E.4.3.1.2 to E.4.3.1.8.

7.2.2. Determination of US06 Charge-Depleting Emissions –Dynamometer Test Run, Gaseous Emissions.

7.2.2.1 The US06 Charge-Depleting Emission Test consists of the Continuous US06 Test Schedule that includes the cold-start US06 cycle when the engine first starts.

7.2.2.2 Emissions shall be measured for all test cycles when the engine is operating. Collect emissions over the full US06 cycle as a single test interval. For each test cycle during which emissions are not generated, emissions are not required to be sampled. However, the manufacturer must validate that the engine did not turn on at any time during the test cycle.

7.2.2.3 PM sampling is not required.

7.2.2.4 Following the preconditioning specified in paragraph E.7.2.1 of this section, place or push the vehicle onto a dynamometer.

7.2.2.5 Place the vehicle in default mode or in normal mode if the vehicle does not have a default mode, place the vehicle in gear, and simultaneously

start emission sampling and recording. Begin the first acceleration 5 seconds after placing the vehicle in gear.

7.2.2.6 Drive the vehicle on a Continuous US06 Test Schedule until the engine first starts. Continue driving until completion of the cold-start US06 cycle.

7.2.2.7 At the completion of the cold-start US06 cycle, the US06 Charge-Depleting Emission Test is completed. The US06 Charge-Depleting Emission Test does not require satisfying the SOC Net Energy Change Tolerance to be a valid test.

7.2.2.8 Turn the vehicle off 2 seconds after the end of the last deceleration. Five seconds after the vehicle stops running, stop all sampling and recording, including background sampling. Stop any integrating devices and indicate the end of the test cycle in the recorded data. Note that the 5 second delay is intended to account for sampling system transport.

7.2.3. Vehicle Charging After Testing.

The vehicle may be fully charged following the US06 Charge-Depleting Emission Test in section E.7.2.2. If this option is performed, vehicle charging shall begin within three hours after completing the US06 Charge-Depleting Emission Test and the vehicle shall be charged to the manufacturer specified full state-of-charge. During charging, all applicable requirements in section E.1 must be met, and energy consumption shall be calculated pursuant to the requirements in section E.11.2.

7.3. SC03 Emission Test.

To be conducted pursuant to 40 CFR §1066.835 with the following revisions:

7.3.1. Vehicle Preconditioning and Emission Testing.

7.3.1.1 Subparagraphs (a) through (c)(4). [No change.]

7.3.1.2 Amend subparagraph (c)(5): Perform a preconditioning drive by operating the test vehicle in charge-sustaining operation over the first 505 seconds of the UDDS cycle (phase 1), the last 867 seconds of the UDDS cycle (phase 2), or the SC03 driving schedule. If driver-selectable modes are available, do not activate the driver-selectable mode to be

tested for the preconditioning drive, but set the vehicle in default mode or normal mode for the preconditioning drive with the vehicle in charge-sustaining operation.

If, however, the vehicle is to be tested in charge-increasing operation (this does not apply to a driver-selectable charge-increasing mode), then the initial SOC shall be set at the lowest normal SOC level allowed by the vehicle when driving on the UDDS cycle. If the air conditioning test sequence starts more than 2 hours after a different exhaust emission test, the vehicle may be driven over one full UDDS cycle for the preconditioning drive instead of over one of the cycles listed previously in this section (c)(5).

7.3.1.3 Subparagraphs (c)(6) through (d). [No change.]

7.3.1.4 Amend subparagraph (d)(1): Place the vehicle in gear 15 seconds after starting vehicle, which is 3 seconds before the first acceleration. If a driver-selectable mode is to be tested, start the vehicle, activate the driver-selectable mode, and place the vehicle in gear 15 seconds after starting vehicle. Follow the SC03 driving schedule.

7.3.1.5 Amend subparagraph (d)(2): Turn the vehicle off 2 seconds after the end of the last deceleration. Five seconds after the vehicle stops running, stop all sampling and recording, including background sampling. Stop any integrating devices and indicate the end of the test cycle in the recorded data. Note that the 5 second delay is intended to account for sampling system transport.

7.3.1.6 Subparagraphs (d)(3) through (f)(3)(iv). [No change.]

7.3.2. End-of-Test Criteria.

A valid test shall satisfy the SOC Net Energy Change Tolerances in section E.10 for the SC03 cycle with emission sampling. For PHEVs that use a battery as an energy storage device, $(Amp{\cdot}hr_{initial})$ is the stored charge at the beginning of the SC03 cycle with emission sampling, and $(Amp{\cdot}hr_{final})$ is the stored battery charge at the end of the same SC03 cycle with emission sampling. The final stored battery charge, $(Amp{\cdot}hr_{final})$, shall not exceed either $(Amp{\cdot}hr_{final})_{max}$ or $(Amp{\cdot}hr_{final})_{min}$ for a valid test. For PHEVs that use a capacitor as an energy storage device, $(V^2_{initial})$ is the square of the capacitor voltage stored at the beginning of the SC03 cycle with emission sampling, and (V_{final}) is the stored capacitor voltage at the end of the same SC03 cycle with emission sampling.

The final stored capacitor voltage, (V_{final}), shall not exceed either $(V_{final})_{max}$ or $(V_{final})_{min}$ for a valid test. For PHEVs that use an electro-mechanical flywheel as an energy storage device, ($rpm^2_{initial}$) is the squared flywheel rotational speed at the beginning of the SC03 cycle with emission sampling, and (rpm_{final}) is the flywheel rotational speed at the end of the same SC03 cycle with emission sampling. The final flywheel rotational speed, (rpm_{final}), shall not exceed either $(rpm_{final})_{max}$ or $(rpm_{final})_{min}$ for a valid test.

7.3.3. Alternative End-of-Test Criteria.

With approval from the Executive Officer under the procedure in subsection E.3.2.2, if the End-of-Test Criteria in section E.7.3.2 is not satisfied for the SC03 cycle with emission sampling, an SC03 Emission Test may be considered valid if:

7.3.3.1 The alternative End-of-Test criterion of ±5% SOC Net Energy Change Tolerance in Appendix C of SAE J1711 is satisfied (Note: Appendix C of SAE J1711 may not be used to correct measured values for any emissions.); or

7.3.3.2 The SOC at the end of the SC03 cycle with emission sampling is higher than the SOC at the beginning of the same SC03 cycle with emission sampling.

8. 50°F And 20°F Emission Test Provisions.

8.1. 50°F and 20°F Emission Test.

8.1.1 50°F testing shall be conducted pursuant to subsections E.4.1 to E.4.3 with the modifications in Part II, Section C in the "California 2026 and Subsequent Model Year Criteria Pollutant Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" and the additional following revisions in section E.8.2.

8.1.2 20°F testing shall be conducted pursuant to subsections E.4.1 to E.4.3 with the modifications in Part II, Section B Subpart H in the "California 2026 and Subsequent Model Year Criteria Pollutant Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" and the additional following revisions in section E.8.2.

8.2. Revisions for 50°F and 20°F Testing.

8.2.1. Vehicle Charging

For 50°F and 20°F charge-depleting testing, vehicle charging, prior to emissions testing, shall be performed during the soak period at 50°F and 20°F, respectively.

8.2.2. SOC Net Energy Change Tolerances.

For the 50°F and 20°F emission tests, a vehicle is not required to meet SOC net energy change tolerances.

8.2.3. 50°F and 20°F Charge-Depleting Emission Test.

If measurement of worst-case emissions requires the Urban Charge-Depleting Emission Test to be performed, the vehicle shall be preconditioned and fully charged. The Continuous Urban Test Schedule shall then be performed. The UDDS cycle, in which the auxiliary power unit first starts, shall be the cold UDDS cycle. Emissions shall be sampled according to one of the options in section E.8.2.4. For the three phase test option, if the auxiliary power unit starts in phase two of the UDDS cycle, phase one emissions are considered zero for emission calculation purposes. Emissions are weighted according to section E.8.2.4.

8.2.4. 50°F and 20°F Charge-Sustaining Emission Test.

If the worst-case for emissions is charge-sustaining operation, the vehicle shall be preconditioned, and one of the following two emission test options must be performed.

8.2.4.1 A three phase test that includes phase one as the first 505 seconds of the UDDS cycle, phase two as 506 seconds to the end of the UDDS cycle, a 10 minute key-off soak period, and phase three the first 505 seconds of the UDDS cycle. The first two phases test shall be counted as the first UDDS cycle and the second and third phases will constitute the second UDDS cycle. Emission weighting is as follows:

$$Y_{wm} = 0.43 * \left(\frac{Y_1 + Y_2}{D_1 + D_2} \right) + 0.57 * \left(\frac{Y_2 + Y_3}{D_2 + D_3} \right)$$

Where:

Y_{wm} = Weighted mass emissions of each pollutant, i.e., THC, CO, THCE, NMOG, NMHCE, CH_4, NO_x, or CO_2, in grams per vehicle mile.

Y_1 = Mass emissions as calculated from phase one of the three phase test, in grams.

Y_2 = Mass emissions as calculated from phase two of the three phase test, in grams.

Y_3 = Mass emissions as calculated from phase three of the three phase test, in grams.

D_1 = The measured driving distance from phase one of the three phase tests, in miles.

D_2 = The measured driving distance from phase two of the three phase tests, in miles.

D_3 = The measured driving distance from phase three of the three phase tests, in miles.

8.2.4.2 A two phase test that includes phase one as a UDDS cycle, a 10 minute key-off soak period, and phase two as a UDDS cycle. Emission weighting will follow the procedure outlined in section E.4.2.5 or section E.4.3.6.

8.2.5. 50°F and 20°F Alternative Urban Emission Test.

If a vehicle qualifies for the Alternative Urban Emission Test, the 50°F and 20°F emission test shall be performed using the Alternative Urban Emission Test in section E.5 in lieu of the Urban Charge-Depleting Emission Test or Urban Charge-Sustaining Emission Test.

9. Confirmatory And In-Use Compliance Testing.

9.1. Testing Provisions.

9.1.1. Driver Selectable Modes.

For all emission tests, confirmatory testing and in-use compliance testing may be performed in any driver-selectable mode to ensure compliance with emission standards.

9.1.2. Vehicle Operation.

9.1.2.1 For urban emission tests, confirmatory testing and in-use compliance testing may be performed in charge-depleting, charge-sustaining, or charge-increasing operation to ensure compliance with urban emission standards.

9.1.2.2 For Highway, US06 Charge-Sustaining and SC03 emission tests, confirmatory testing and in-use compliance testing may be performed in charge-sustaining or charge-increasing operation to ensure compliance with Highway, US06 Charge-Sustaining, and SC03 emission standards.

9.1.2.3 For the US06 Charge-Depleting Emission Test, confirmatory testing and in-use compliance testing shall be performed in charge-depleting operation to ensure compliance with High Power Cold-Start Emission Standards.

9.1.2.4 For vehicles that qualify for and are certified on the Alternative Urban Emission Test in section E.5, confirmatory testing and in-use compliance testing may be performed solely using the Alternative Urban Emission Test to ensure compliance with urban emission standards.

9.1.2.5 For the Partial Soak Emission Test and the Quick Drive-Away Emission Test, confirmatory testing and in-use compliance testing shall be performed in charge-sustaining operation to ensure compliance with the Partial Soak and the Quick Drive-Away emission standards.

9.1.3. SOC Provisions.

Confirmatory testing and in-use compliance testing may be performed on all tests to establish if higher emissions occur at different states-of-charge in charge-depleting mode. This is to ensure that cold start and other emissions standards are not exceeded at other operating states-of-charge.

9.2. Urban Charge-Depleting Emission Test.

For the Urban Charge-Depleting Emission Test in section E.4.3, confirmatory and in-use compliance testing shall use two hot-start UDDS cycles to ensure that the vehicle has achieved full warm-up conditions in accordance with section E.4.3.2.1.

If, based on the last cycle or series of cycles, the Alternative End-of-Test criteria in section E.4.3.4.1 are not satisfied at the end of the second hot-start, then a third hot-start UDDS cycle shall be performed. If criteria are still not satisfied at the end of the third hot-start UDDS cycle, then additional hot-start UDDS cycles shall be performed until:

(1) based on the last cycle or series of cycles, the Alternative End-of-Test criteria in section E.4.3.4.1 are satisfied; or
(2) the Alternative End-of-Test criteria in section E.4.3.4.2 are satisfied.

9.3. Alternative Urban Emission Test.

For the Alternative Urban Emission Test, confirmatory and in-use compliance testing shall use one hot-start UDDS cycle as specified in section E.5.

10. State-Of-Charge Net Energy Change Tolerances.

10.1. General Provisions.

When determining the SOC Net Energy Change tolerance during testing, the current drive cycle may be aborted if the SOC Net Energy Change tolerance is met for the previous drive cycle.

10.2. Vehicles That Use a Battery as an Energy Storage Device.

The following state-of-charge net energy change tolerance shall apply for vehicles that use a battery as an energy storage device:

$$(Amp \cdot hr_{final})_{max} = (Amp \cdot hr_{initial}) + 0.01 * \left(\frac{NHV_{fuel} * m_{fuel}}{V_{system} * K_1} \right)$$

$$(Amp \cdot hr_{final})_{min} = (Amp \cdot hr_{initial}) - 0.01 * \left(\frac{NHV_{fuel} * m_{fuel}}{V_{system} * K_1} \right)$$

Where:

$(Amp \cdot hr_{final})_{max}$ = Maximum allowed Amp·hr stored in battery at the end of the test

$(Amp{\cdot}hr_{final})_{min}$ = Minimum allowed Amp·hr stored in battery at the end of the test

$(Amp{\cdot}hr_{initial})$ = Battery Amp·hr stored at the beginning of the test

NHV_{fuel} = Net heating value of consumable fuel, in Joules/kg

m_{fuel} = Total mass of fuel consumed during test, in kg

K_1 = Conversion factor, 3600 seconds/hour

V_{system} = Open circuit voltage (OCV) that corresponds to the SOC of the target SOC during charge sustaining operation. This value shall be submitted for testing purposes, and it shall be subject to confirmation by the Air Resources Board.

10.3. Vehicles That Use a Capacitor as an Energy Storage Device.

For vehicles that use a capacitor as an energy storage device, the following state-of-charge net energy change tolerance shall apply:

$$(V_{final})_{max} = \sqrt{V_{initial}^2 + 0.01 * \frac{\left(2 * NHV_{fuel} * m_{fuel}\right)}{C}}$$

$$(V_{final})_{min} = \sqrt{V_{initial}^2 - 0.01 * \frac{\left(2 * NHV_{fuel} * m_{fuel}\right)}{C}}$$

Where:

$(V_{final})_{max}$ = The maximum stored capacitor voltage allowed at the end of the test

$(V_{final})_{min}$ = The minimum stored capacitor voltage allowed at the end of the test

$V^2_{initial}$ = The square of the capacitor voltage stored at the beginning of the test

NHV_{fuel} = Net heating value of consumable fuel, in Joules/kg

m_{fuel} = Total mass of fuel consumed during test, in kg

C = Rated capacitance of the capacitor, in Farads

10.4. Vehicles That Use an Electro-Mechanical Flywheel as an Energy Storage Device.

For vehicles that use an electro-mechanical flywheel as an energy storage device, the following state-of-charge net energy change tolerance shall apply:

$$(rpm_{final})_{max} = \sqrt{rpm^2_{initial} + 0.01 * \frac{\left(2 * NHV_{fuel} * m_{fuel}\right)}{I * K_3}}$$

$$(rpm_{final})_{min} = \sqrt{rpm^2_{initial} - 0.01 * \frac{\left(2 * NHV_{fuel} * m_{fuel}\right)}{I * K_3}}$$

Where:

$(rpm_{final})_{max}$ = The maximum flywheel rotational speed allowed at the end of the test

$(rpm_{final})_{min}$ = The minimum flywheel rotational speed allowed at the end of the test

$rpm^2_{initial}$ = The squared flywheel rotational speed at the beginning of the test

NHV_{fuel} = Net heating value of consumable fuel, in Joules/kg

m_{fuel} = Total mass of fuel consumed during test, in kg

K_3 = Conversion factor, $4\pi^2$ / (3600 sec^2-rpm^2)

I = Rated moment of inertia of the flywheel, in kg·m^2

11. Calculation Of Equivalent All-Electric Range And Related Formulas.

11.1. Equivalent All-Electric Range Formula.

11.1.1. Urban Equivalent All-Electric Range Formula.

Urban Equivalent All-Electric Range ($EAER_u$) shall be calculated as follows:

$$EAER_u = \left(\frac{M_{cs} - M_{cd}}{M_{cs}} \right) * R_{cdcu}$$

Where:

M_{cs} is as defined in E.11.4.1.

M_{cd} is as defined in E.11.3, using the UDDS test cycle.

R_{cdcu} is as defined in E.11.5.1.

11.1.2. Urban Equivalent All-Electric Range Formula for Vehicles with Long Charge-Depleting Actual Range.

The Urban Equivalent All Electric Range, $EAER_{u40}$, for vehicles with an urban charge-depleting actual range, R_{cda}, greater than 40 miles is determined through the following equation:

$$EAER_{u40}\ (miles) = \left(\frac{ERF_u \times 40\,mi}{100} \right)$$

Where:

ERF_u is as defined in E.11.9.1.

R_{cda} is defined in E.11.6.

11.1.3. Highway Equivalent All-Electric Range Formula.

Highway Equivalent All-Electric Range ($EAER_h$) shall be calculated as follows:

$$EAER_h = \left[\frac{M_{cs} - M_{cd}}{M_{cs}}\right] * R_{cdch}$$

Where:

M_{cs} is as defined in E.11.4.2.

M_{cd} is as defined in E.11.3, using the HFEDS test cycle.

R_{cdch} is as defined in E.11.5.2.

11.2. Equivalent All-Electric Range Energy Consumption.

11.2.1. Urban Equivalent All-Electric Range Energy Consumption.

The Urban Equivalent All-Electric Range Energy Consumption ($EAEREC_u$) shall be calculated as follows:

$$EAEREC_u \text{ (Wh/mi)} = \frac{E_{cd}}{EAER_u}$$

Where:

E_{cd} = Total AC electrical energy used to fully charge the vehicle battery from an external power source after the charge-depleting test has been completed.

11.2.2. Highway Equivalent All-Electric Range Energy Consumption.

The Highway Equivalent All-Electric Range Energy Consumption ($EAEREC_h$) shall be calculated as follows:

Where:

$$EAEREC_h \text{ (Wh/mi)} = \frac{E_{cd}}{EAER_h}$$

E_{cd} = Total AC electrical energy used to fully charge the vehicle battery from an external power source after the charge-depleting test has been completed.

11.3. Charge-Depleting CO_2 Produced.

Charge-Depleting CO_2 Produced means the cumulative tailpipe CO_2 emissions produced, M_{cd}, in grams per mile during the charge-depleting cycle range.

$$M_{cd} = \frac{\sum Y_i}{\sum D_i}$$

Where:

ΣY_i = The sum of the mass emissions of CO_2, in grams, in the charge-depleting mode from each test cycle (UDDS cycles or HFEDS cycles)

ΣD_i = The sum of the measured driving distance, in miles, from each test cycle (UDDS cycles or HFEDS cycles)

i = Number (UDDS cycles or HFEDS cycles) of the test over the charge-depleting cycle range, R_{cdc}

11.4. Charge-Sustaining CO_2 Produced.

11.4.1. Urban Charge-Sustaining CO_2 Produced.

Charge-Sustaining CO_2 Produced - urban means the cumulative tailpipe CO_2 emissions produced, M_{cs}, in grams per mile, during the cold start charge-sustaining urban test.

$$M_{cs} = Y_c + Y_h * \left[\frac{\left(R_{cdcu} - D_c\right)}{D_c} \right]$$

Where:

R_{cdcu} = Urban Charge-Depleting Cycle Range, in miles

D_c = The measured driving distance from the cold start UDDS cycle, in miles

Y_c = Grams per mile CO_2 emissions as calculated from the cold start UDDS cycle

Y_h = Grams per mile CO_2 emissions as calculated from the hot start UDDS cycle

11.4.2. Highway Charge-Sustaining CO_2 Produced.

Charge-Sustaining CO_2 Produced - highway means the grams per mile tailpipe CO_2 emissions produced, M_{cs}, during the hot start charge-sustaining highway test.

$$M_{CS} = \left(\frac{R_{cdch}}{D_h} \right) * Y_h$$

Where:

R_{cdch} = Highway Charge-Depleting Cycle Range, in miles

D_h = The measured driving distance from the hot start HFEDS cycle, in miles

Y_h = Grams per mile emissions as calculated from the hot start HFEDS cycle

11.5. Charge-Depleting Cycle Range.

11.5.1. Urban Charge-Depleting Cycle Range.

The Urban Charge-Depleting Cycle Range, R_{cdcu}, (see section F for an illustration of R_{cdcu}) shall be defined as the distance traveled on the Urban Charge-Depleting Emission Test up to the UDDS cycle prior to where the state-of-charge is above the lower bound state-of-charge tolerance for one test cycle given by:

$$(Amp{\cdot}hr_{final})_{min} = (Amp{\cdot}hr_{initial}) - 0.01 * \left(\frac{NHV_{fuel} * m_{fuel}}{V_{system} * K_1} \right)$$

Where:

$(Amp{\cdot}hr_{final})_{min}$ = Minimum allowed Amp·hr stored in battery at the end of the test

$(Amp{\cdot}hr_{initial})$ = Battery Amp·hr stored at the beginning of the test

NHV_{fuel} = Net heating value of consumable fuel, in Joules/kg

m_{fuel} = Total mass of fuel consumed during test, in kg

K_1 = Conversion factor, 3600 seconds/hour

V_{system} = Open circuit voltage (OCV) that corresponds to the SOC of the target SOC during charge-sustaining operation. This value shall be submitted for testing purposes, and it shall be subject to confirmation by the Air Resources Board.

11.5.2. Highway Charge-Depleting Cycle Range.

The Highway Charge-Depleting Cycle Range, R_{cdch}, shall be defined as the sum of the distance traveled on the Highway Charge-Depleting All-Electric Range Test up to the HFEDS cycle prior to where the state-of-charge is above the lower bound state-of-charge tolerance for one test cycle given by:

$$(Amp{\cdot}hr_{final})_{min} = (Amp{\cdot}hr_{initial}) - 0.01 * \left(\frac{NHV_{fuel} * m_{fuel}}{V_{system} * K_1} \right)$$

Where:

$(Amp{\cdot}hr_{final})_{min}$ = Minimum allowed Amp·hr stored in battery at the end of the test

$(Amp \cdot hr_{initial})$	=	Battery Amp·hr stored at the beginning of the test
NHV_{fuel}	=	Net heating value of consumable fuel, in Joules/kg
m_{fuel}	=	Total mass of fuel consumed during test, in kg
K_1	=	Conversion factor, 3600 seconds/hour
V_{system}	=	Open circuit voltage (OCV) that corresponds to the SOC of the target SOC during charge sustaining operation. This value shall be submitted for testing purposes, and it shall be subject to confirmation by the Air Resources Board.

11.6. Charge-Depleting Actual Range.

The Charge-Depleting Actual Range, R_{cda}, means the distance traveled from start of the Urban Charge-Depleting Emission Test to the point at which the state-of-charge is first equal to the average state-of-charge of the one or two UDDS cycles used to end the Urban Charge-Depleting Emission Test. This range must be reported to the nearest 0.1 miles. For an illustration of R_{cda} see section F.

11.7. Charge-Depleting Actual Range, Highway

The Charge-Depleting Actual Range, Highway or "R_{cdah}" means the distance traveled from start of the Highway Charge-Depleting All-Electric Range Test to the point at which the state-of-charge is first equal to the average state-of-charge of the HFEDS cycle used to end the Highway Charge-Depleting All-Electric Range Test. This range must be reported to the nearest 0.1 miles.

11.8. Charge-Depleting to Charge-Sustaining Range.

11.8.1. Urban Charge-Depleting to Charge-Sustaining Range.

The Charge-Depleting to Charge-Sustaining Urban Range shall be defined as the distance driven in miles from the start of the Urban Charge-Depleting Emission Test through the UDDS cycle preceding the one or two UDDS cycles used to end the Urban Charge-Depleting Emission Test.

11.8.2. Highway Charge-Depleting to Charge-Sustaining Range.

The Charge-Depleting to Charge-Sustaining Highway Range shall be defined as the distance driven in miles from the start of the Highway Charge-Depleting All-Electric Range Test through the HFEDS cycle preceding the final HFEDS cycle.

11.9. Electric Range Fraction (%).

The Electric Range Fraction means the fraction of the total miles driven electrically (with the engine off) during charge-depleting operation.

11.9.1. Urban Electric Range Fraction (%).

The Urban Electric Range Fraction (ERF_u) is calculated as follows:

$$ERF_u\ (\%) = \left(\frac{EAER_u}{R_{cda}}\right) * 100$$

11.9.2. Highway Electric Range Fraction (%).

The Highway Electric Range Fraction (ERF_h) is calculated as follows:

$$ERF_h\ (\%) = \left(\frac{EAER_h}{R_{cdah}}\right) * 100$$

12. Calculations Of The Combined Greenhouse Gas Regulatory Rating.

12.1. Combined Greenhouse Gas Emissions.

The combined Greenhouse Gas (GHG) emissions value is determined by the following equation.

$$GHG_{PHEV,\ combined} = 0.55 * (GHG_{urban}) + 0.45 * (GHG_{highway})$$

12.2. Urban Greenhouse Gas Emissions.

The urban GHG emissions value is calculated using the following equations.

$$GHG_{urban} = \sum_{i=1}^{N_{urban}} \left[(UF_i) * \left(\frac{Y_{cd.i}}{D_i} + GHG_{cd.AC.i} \right) \right] - G_{upstream} * \sum_{i=1}^{N_{urban}} (UF_i) + Y_{cs.urban} * \left[1 - \sum_{i=1}^{N_{urban}} (UF_i) \right]$$

Where:

GHG_{urban} = Rated urban GHG emissions for PHEV, in gCO_2e/mile

i = Number of charge-depleting urban test cycle

N_{urban} = Total number of urban test cycles in charge-depleting to charge-sustaining range (R_{cdtcsu})

UF_i = Utility factor for urban test cycle i (see section E.12.5)

$Y_{cd.i}$ = Mass emissions of CO_2 in grams, for the "i"th test in the charge-depleting test

D_i = Distance of the "i"th urban test cycle, in miles.

$GHG_{cd.AC.i}$ = Rated GHG emissions for test cycle i, in gCO_2e/mile (see section E.12.6)

$Y_{cs.urban}$ = Weighted mass emissions of CO_2 in grams/mi of the charge-sustaining test. (see section E.12.8)

$G_{upstream}$ = Gasoline upstream factor = $0.25 * GHG_{target}$

GHG_{target} = CO_2 target value in grams/mile as defined in § 1961.3 (a) "Greenhouse Gas Exhaust Emission Standards and Test Procedures - 2017 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles."

12.3. Highway Greenhouse Gas Emissions.

The highway GHG emissions value is calculated using the following equation.

$$GHG_{highway} = \sum_{j=1}^{N_{highway}} \left[(UF_j) * \left(\frac{Y_{cd.j}}{D_j} + GHG_{cd.AC.j} \right) \right] - G_{upstream} * \sum_{j=1}^{N_{highway}} (UF_j) + Y_{cs.highway} * \left[1 - \sum_{j=1}^{N_{highway}} (UF_j) \right]$$

Where:

$GHG_{highway}$ = Rated highway GHG emissions for PHEV, in gCO_2e/mile

j = Number of charge-depleting highway test cycle

$N_{highway}$ = Total number of highway test cycles in charge-depleting to charge-sustaining range (R_{cdtcsh})

UF_j = Utility factor for highway test cycle j (see section E.12.5)

$Y_{CD.j}$ = Mass emissions of CO_2 in grams, for the "j"th test in the charge depleting test

D_j = Distance of the HFEDS cycle, in miles.

$GHG_{cd.AC.j}$ = Rated GHG emissions for test cycle j, in gCO_2e/mile (see section E.12.6)

$Y_{cs.highway}$ = Mass emissions of CO_2 in grams/mi of the highway charge-sustaining emission test.

$G_{upstream}$ = Gasoline upstream factor = $0.25 * GHG_{target}$

GHG_{target} = CO_2 target value in grams/mile as defined in § 1961.3 (a) "Greenhouse Gas Exhaust Emission Standards and Test Procedures - 2017 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles."

12.4. Charge-Depleting to Charge-Sustaining Range.

The Charge-Depleting to Charge-Sustaining Range ($R_{cdtcsu\ and}\ R_{cdtcsh}$) is the total number of cycles driven at least partially in charge-depleting mode times the cycle distance. Cycles that meet charge-sustaining criterion are not included in the $R_{cdtcsu\ and}\ R_{cdtcsh}$. The $R_{cdtcsu\ and}\ R_{cdtcsh}$ include the transitional cycle, where the vehicle may have operated in both depleting and sustaining modes.

12.5. Utility Factors for Urban and Highway Cycles.

The utility factors for urban and highway cycles are provided in the following table.

Utility factors for each PHEV drive cycle test with charge-depletion operation

Test cycle number	Test cycle utility factor	
	Urban, UF_i	Highway, UF_j
1	0.176	0.233
2	0.141	0.172
3	0.112	0.127
4	0.091	0.095
5	0.074	0.071
6	0.059	0.054
7	0.049	0.041
8	0.039	0.032
9	0.033	0.025
10	0.027	0.020
11	0.023	0.017
12	0.019	0.013

12.6. Charge-Depleting GHG Emissions from Electricity Use.

The charge-depleting GHG rate from electricity use in each test cycle is defined by the following equation:

$$GHG_{cd.AC.i} = GHG_{grid} * \left(\frac{E_{cd.AC.i}}{D_i}\right)$$

Where:

$GHG_{cd.AC.i}$ = Rated GHG emissions for charge-depleting PHEV, in gCO_2e/mile

$E_{cd.AC.i}$ = Urban or highway AC energy use, in kWh, in the "i"th cycle of the charge-depleting test.

GHG_{grid} = Lifecycle California electricity GHG intensity, 270 gCO_2e/kWh

D_i = Distance driven, in miles, in the "i"th cycle of the charge-depleting test.

12.7. Charge-Depleting Electricity Use.

The urban or highway charge-depleting electricity use is defined by the following formula:

$$E_{cd.AC.i} = \frac{E_{cd.DC.i}}{\sum_{i=1}^{N} E_{cd.DC.i}} * E_{cd.AC.total}$$

Where:

N = Total number of test cycles in the charge-depleting to charge-sustaining range (R_{cdtcs}) of the urban or highway charge-depleting range test.

$E_{cd.AC.i}$ = Urban or highway AC energy use, in kWh, in the "i"th cycle of the charge-depleting test.

$E_{cd.DC.i}$ = Depleted DC energy, in kWh, for the "i"th cycle in the charge-depleting test. It is defined in section E.1.4.1 of these test procedures.

$E_{cd.AC.total}$ = Charge-depleting net AC energy consumption, in kWh, is determined according to section E.1.4.2 of these test procedures.

12.8. Charge-Sustaining Weighted CO2 Mass Emissions.

The $Y_{cs.urban}$, which is the weighted CO_2 mass emissions of the charge-sustaining test, is determined by the following equation, which can be found in section E.4.2.5 of these test procedures.

$$Y_{CS.Urban} = 0.43 * \frac{Y_C}{D_C} + 0.57 * \frac{Y_H}{D_H}$$

Where:

$Y_{CS.Urban}$ = Weighted mass emissions of CO_2 in grams/mi of the charge-

sustaining test.

Y_C = Mass emissions as calculated from the cold start UDDS cycle, in grams.

Y_H = Mass emissions as calculated from the hot start UDDS cycle, in grams.

D_C = The measured driving distance from the cold start UDDS cycle, in miles.

D_H = The measured driving distance from the hot start UDDS cycle, in miles.

13. Additional Provisions.

13.1. Fuel Fired Heater Emission Testing

The exhaust emissions result of the fuel-fired heater shall be determined by operating at a maximum heating capacity with a cold start between 68°F and 86°F for a period of 20 minutes and dividing the grams of emissions by 20. The resulting grams per minute shall be multiplied by 3.0 minutes per mile to obtain a grams per mile value.

13.2. Example Diagrams of Charge-Depleting Actual Range, Charge-Depleting Cycle Range, and Transitional Range.

For an example of a vehicle with all-electric range and blended operation that has charge-depleting actual range and charge-depleting cycle range, please see section F.2.

For an example of charge-depleting to charge-sustaining range with and without transitional range and end of test conditions, please see section F.3.

13.3. Insufficient Fuel.

If the manufacturer determines there is insufficient fuel to run the subsequent test, the manufacturer may perform a fuel drain and fill or add fuel pursuant to the provisions of the "California Evaporative Emission Standards and Test Procedures for 2026 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles."

F. Examples of Plug-In Hybrid Electric Vehicle Exhaust Emission Test Sequences and Terminology.

The figures in this section F are for illustrative purposes only. If any discrepancies exist between the language in sections B and E and the figures in this section F, the requirements in sections B and E shall apply. The acronym "NEC" as used in this section F means "Net Energy Change."

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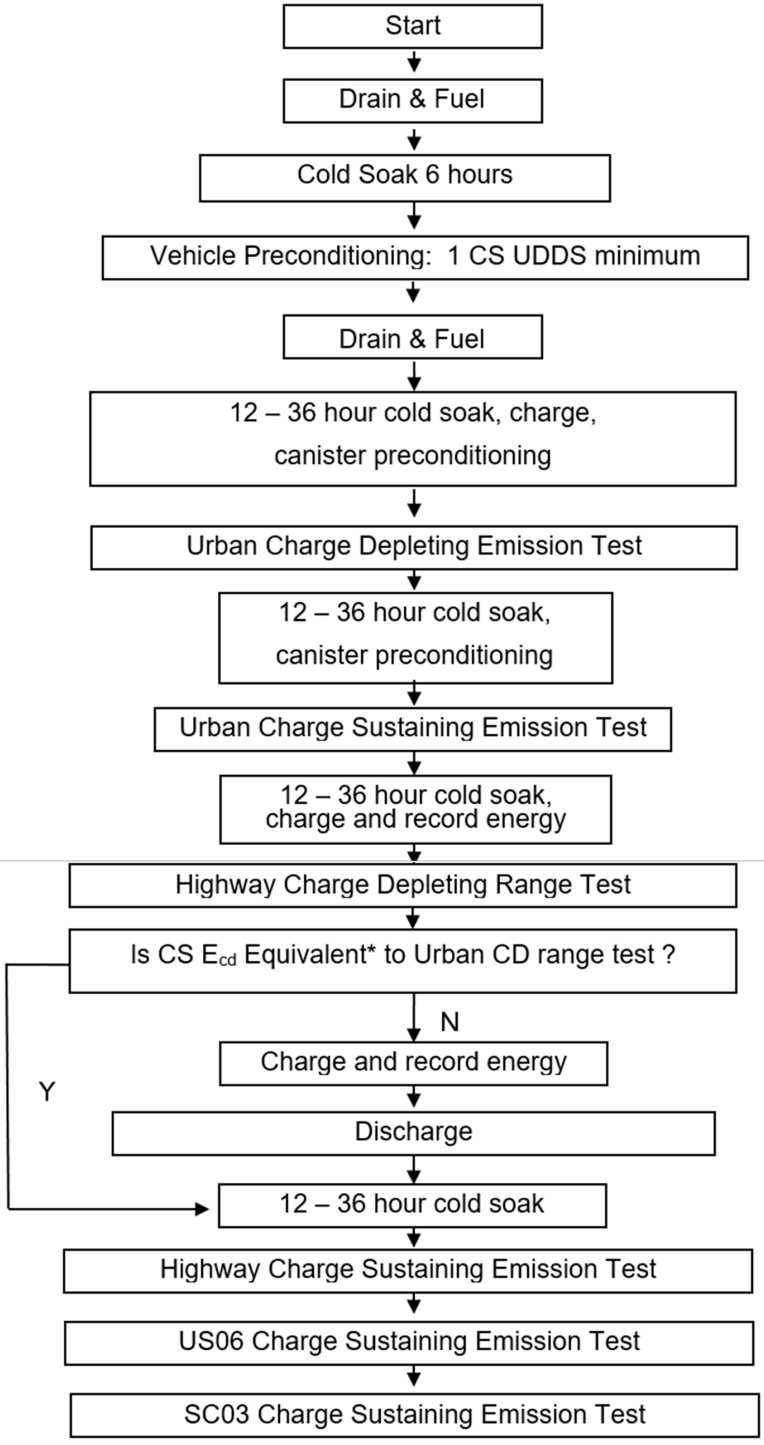
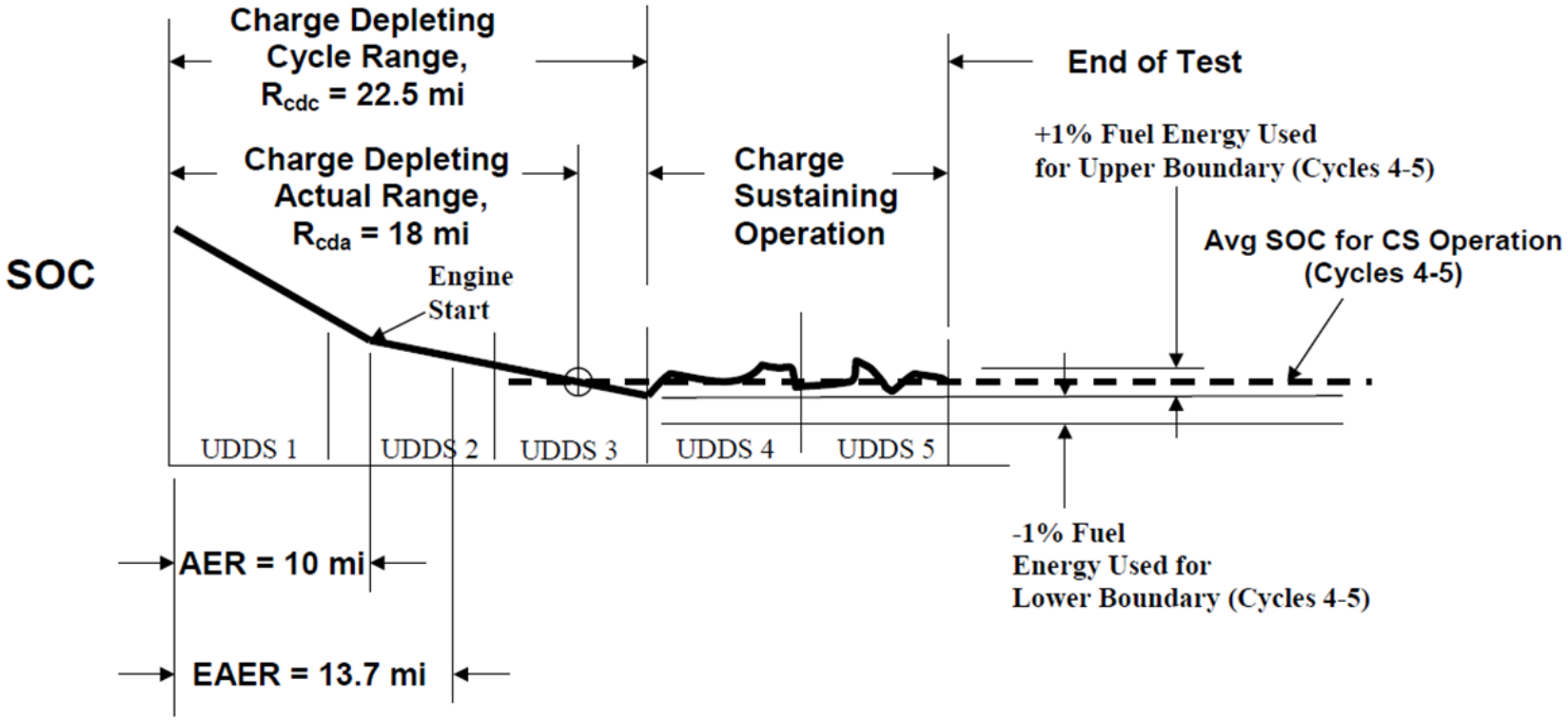
1. Plug-In Hybrid Electric Vehicle Exhaust Emissions Test Sequence.

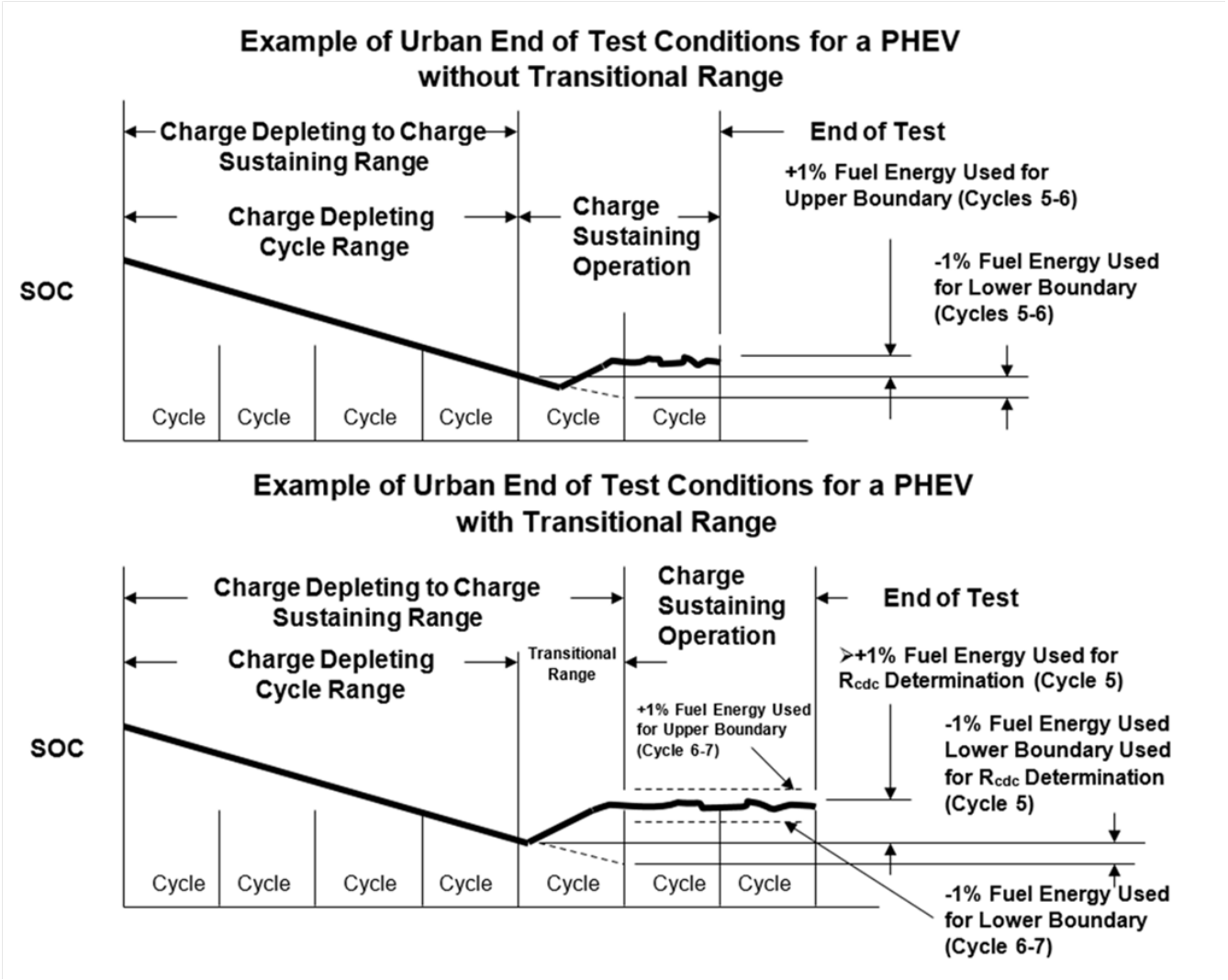
* Equivalent to within ± 1% of AC energy used to charge battery to full state of charge



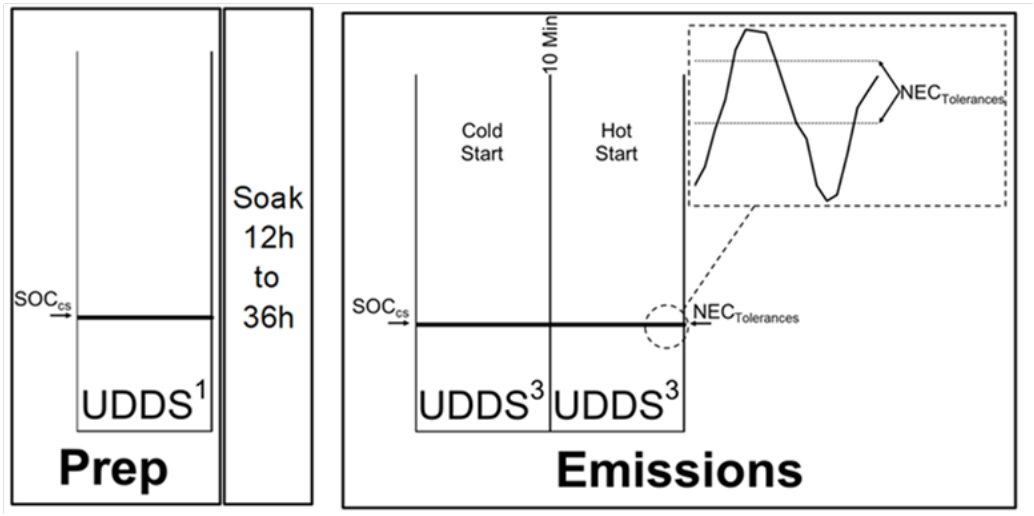
2. Example of an Off-Vehicle Charge Capable HEV with AER and Blended Operation Undergoing the Urban Charge Depleting Range Test.



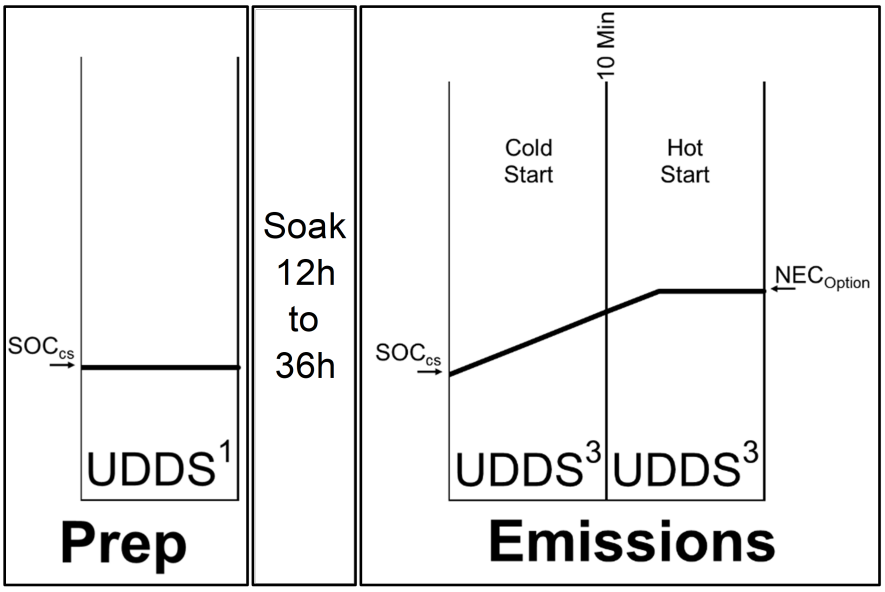
3. Example of Urban End of Test Conditions for a Plug-in Hybrid Electric Vehicle with and without Transitional Range.



4. Urban Charge-Sustaining Emission Test.

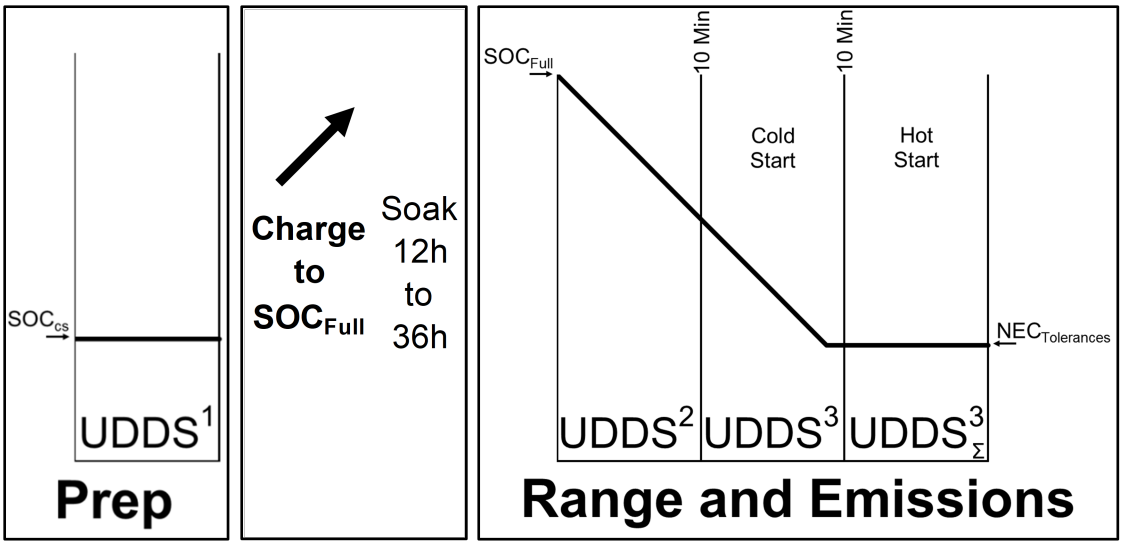


5. Urban Charge-Sustaining Emission Test with Charge-Increasing Driver-Selectable Mode Activated.

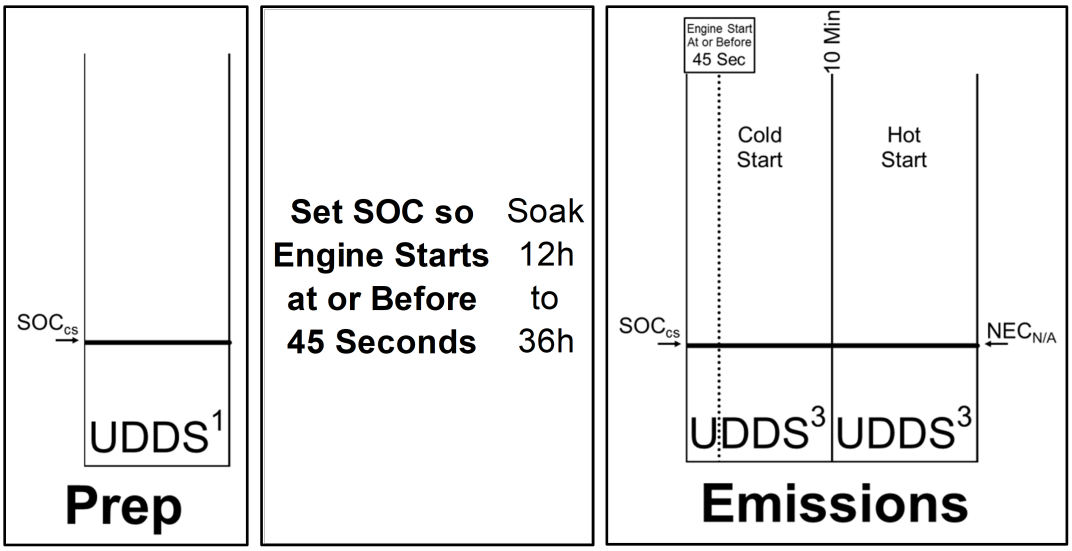


[1] Emission sampling not required
[2] Emission sampling optional
[3] Emission sampling required
SOC_{cs}: State-of-Charge at charge-sustaining level
$NEC_{Tolerances}$: Net Energy Change Tolerances required
NEC_{Option}: NEC Tolerances apply; however, option available to validate test when SOC final > SOC initial.

6. Urban Charge-Depleting Emission Test.

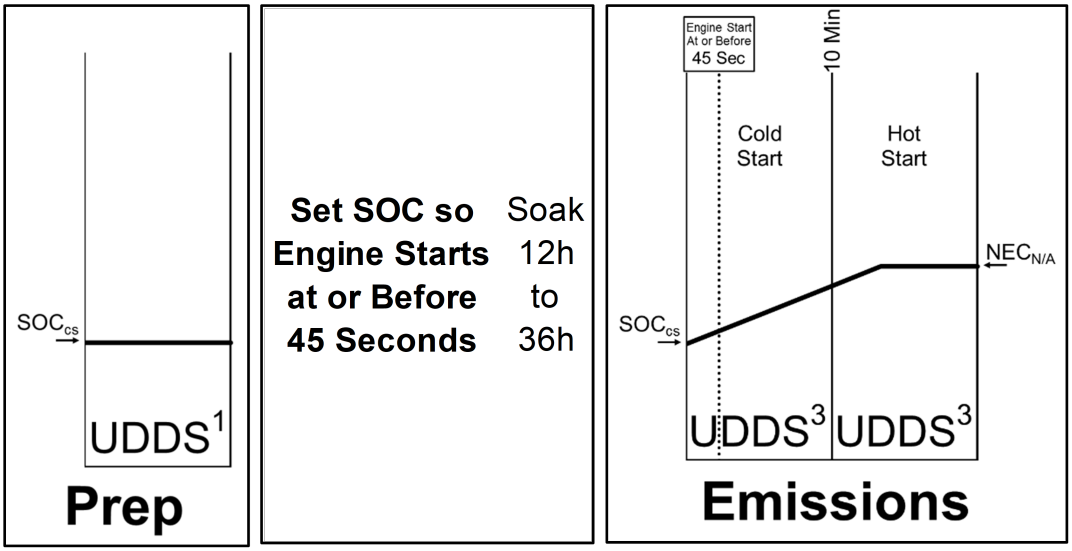


7. Alternative Urban Emission Test.

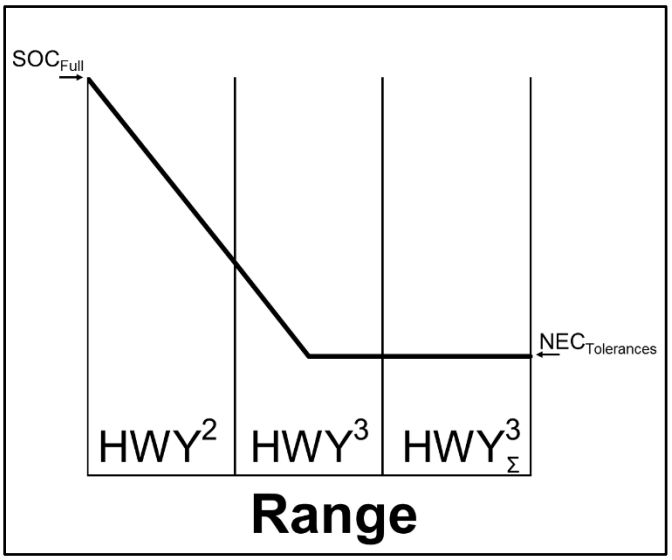


[1] Emission sampling not required
[2] Emission sampling optional
[3] Emission sampling required
$UDDS_S$: Multiple Hot Start UDDS cycles may be required to satisfy NEC Tolerances
SOC_{cs}: State-of-Charge at charge-sustaining level
SOC_{Full}: State-of-Charge at full charge
$NEC_{Tolerances}$: Net Energy Change Tolerances required
$NEC_{N/A}$: Net Energy Change Tolerances not applicable

8. **Alternative Urban Emission Test with Charge-Increasing Driver-Selectable Mode Activated.**

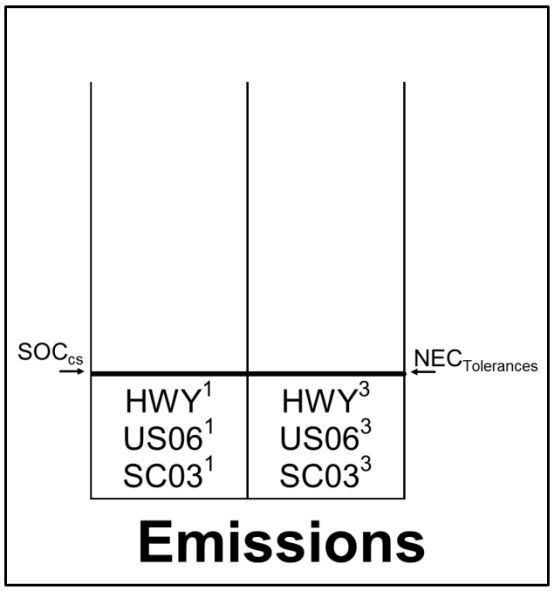


9. **HWY AER and EAER Test.**

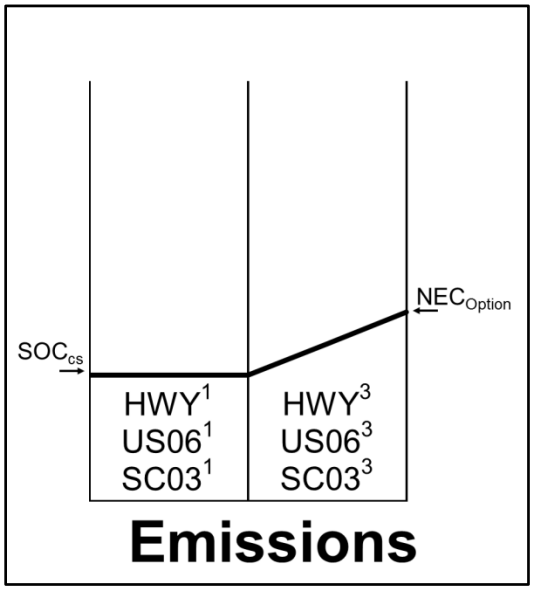


[1] Emission sampling not required
[2] Emission sampling optional
[3] Emission sampling required
HWY$_S$: Multiple HFEDS cycles may be required to satisfy NEC Tolerances
SOC$_{cs}$: State-of-Charge at charge-sustaining level
SOC$_{Full}$: State-of-Charge at full charge
NEC$_{Tolerances}$: Net Energy Change Tolerances required
NEC$_{N/A}$: Net Energy Change Tolerances not applicable

10. HWY and SFTP Emission Test.

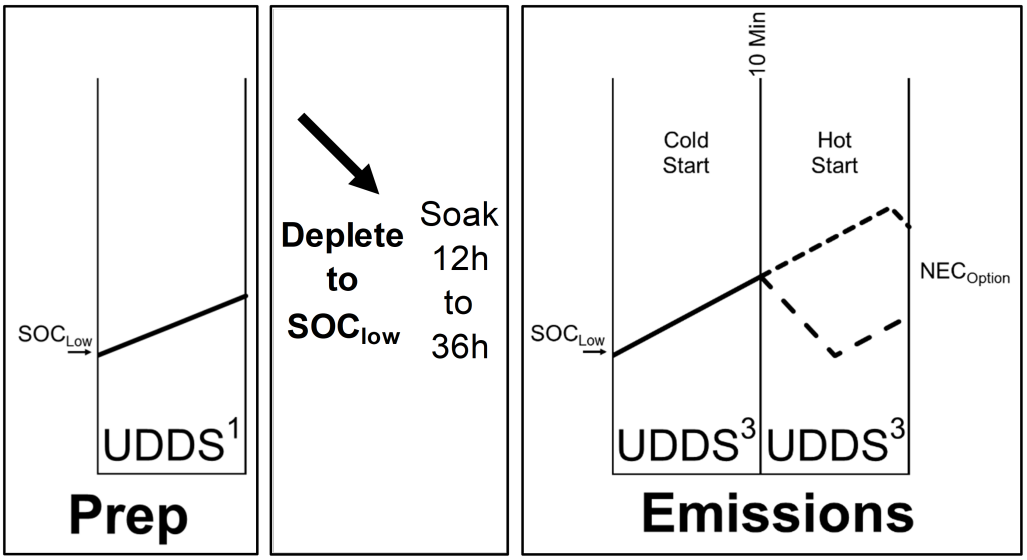


11. HWY and SFTP Emission Test with Charge-Increasing Driver-Selectable Mode Activated.

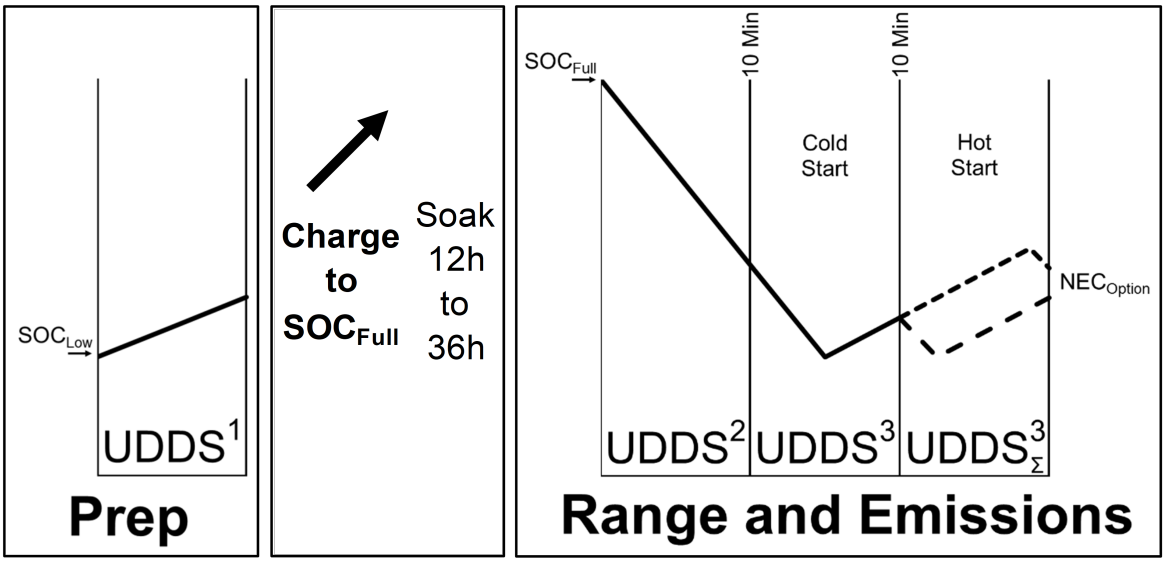


[1] Emission sampling not required
[2] Emission sampling optional
[3] Emission sampling required
SOC_{cs}: State-of-Charge at charge-sustaining level
$NEC_{Tolerances}$: Net Energy Change Tolerances required
NEC_{Option}: NEC Tolerances apply; however, option available to validate test when SOC final > SOC initial.

12. Urban Charge-Sustaining Emission Test with Charge-Increasing Operation (not for charge-increasing driver-selectable mode testing).

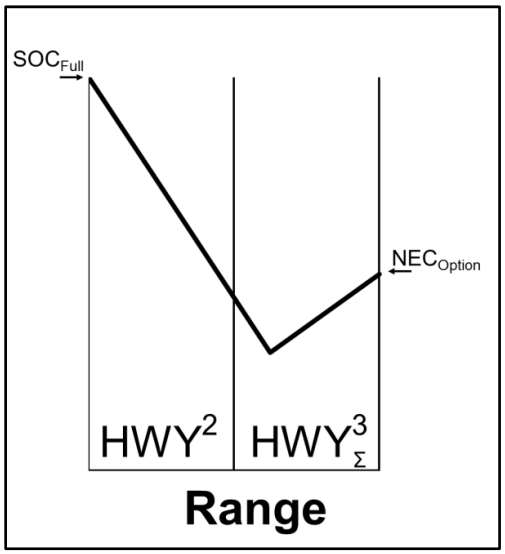


13. Urban Charge-Depleting Emission Test with Charge-Increasing Operation (not for charge-increasing driver-selectable mode testing).

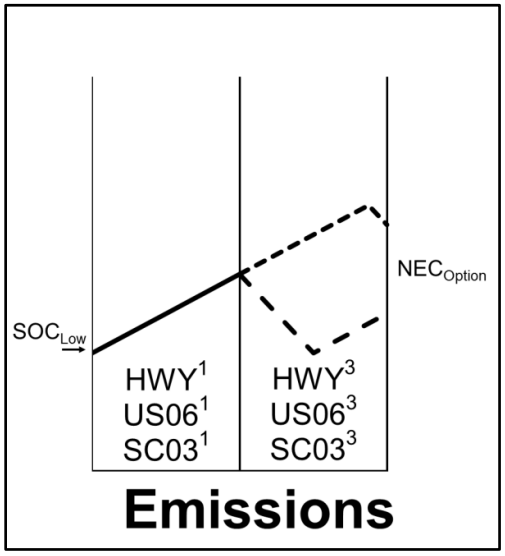


[1] Emission sampling not required
[2] Emission sampling optional
[3] Emission sampling required
$UDDS_S$: Multiple Hot Start UDDS cycles may be required to satisfy NEC Tolerances
SOC_{Low}: Initial State-of-Charge set at lowest normal SOC allowed by vehicle when driving on UDDS
NEC_{Option}: NEC Tolerances apply; however, option available to validate test when SOC final > SOC initial.

14. HWY AER and EAER Test with Charge-Increasing Operation (not for charge-increasing driver-selectable mode testing).

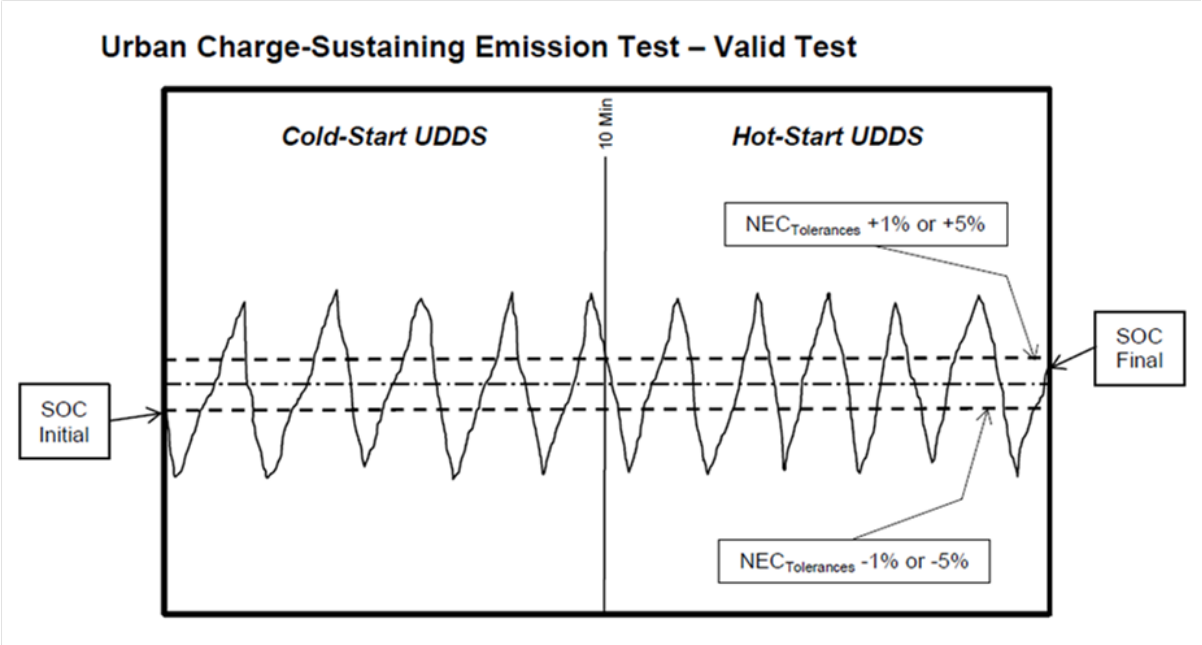


15. HWY and SFTP Emission Test with Charge-Increasing Operation (not for charge-increasing driver-selectable mode testing).



[1] Emission sampling not required
[2] Emission sampling optional
[3] Emission sampling required
HWY_S: Multiple HFEDS cycles may be required to satisfy NEC Tolerances
SOC_{Full}: State-of-Charge at full charge
SOC_{Low}: Initial State-of-Charge set at lowest normal SOC allowed by vehicle when driving on UDDS
NEC_{Option}: NEC Tolerances apply; however, option available to validate test when SOC final > SOC initial.

16. Urban Charge-Sustaining Emission Test – Valid Test.



17. Highway and SFTP Emission Tests – Valid Test.

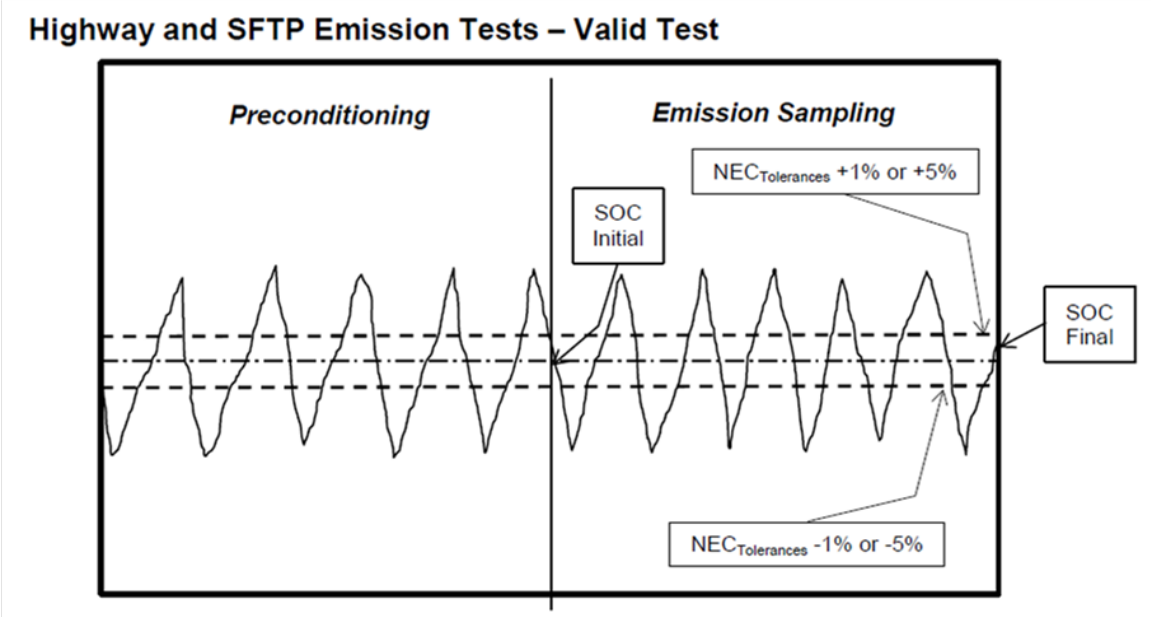


Figure 9