UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
2565 PLYMOUTH ROAD
ANN ARBOR, MICHIGAN 48105-2498

OFFICE OF AIR AND RADIATION

February 7, 2022

CD-2021-12 – Revised (LDV, LDT)

SUBJECT: Additional Instructions for Preparing Battery Electric Light-Duty Vehicles and Trucks for Chassis Testing at EPA's National Vehicle and Fuel Emissions Laboratory

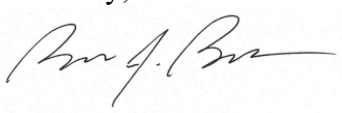
Dear Manufacturer:

The purpose of this letter is to provide revised instructions to battery electric vehicle manufacturers regarding preparation for, and the completion of, confirmatory testing of battery electric vehicles (BEV) at the National Vehicle and Fuel Emissions Laboratory (NVFEL) in Ann Arbor, Michigan. These instructions supplement EPA's Guidance Letter CD-16-03 dated February 15, 2016, for BEV's, and supersede the previously issued Guidance Letter CD-2021-12. This document has been revised for current flow direction. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

Please follow these instructions to expedite the testing of your BEV at NVFEL.

If you have questions about these instructions, please contact your assigned certification engineer.

Sincerely,



Byron J. Bunker, Director
Compliance Division
Office of Transportation and Air Quality

Enclosure

Enclosure to CD-2021-12 - Revised
Battery Electric Vehicle Testing

Vehicles should be prepared per EPA guidance CD-16-03. Vehicle instructions should be submitted at least two weeks before testing to ensure sufficient preparation time.

- Vehicle instructions should have clear directions on how to place the vehicle in dyno mode (see below), how to place the vehicle in neutral, the number of current clamps required, and how to install them, and how to read voltage. The manufacturer must include any special directions unique to the test vehicle. This may include how to use what has historically been called a "key," how to "start" the vehicle, and how to put the vehicle to "sleep." Any items that can interfere with testing like automatic vehicle disablement when doors are opened, the hood(s) are opened, or when seat belt unlatching occurs, that cannot be turned off by dyno mode or other means should be detailed and emphasized.
- Vehicle instructions should include expected time and distances achieved on both constant speed portions of the MCT. If these values are not supplied, the EPA may set expected distances for the mid-test constant speed cycle (CSC_M) and the end-of-test constant speed cycle (CSC_E) using the equations in SAE J1634-12.
- Vehicles must have tie-downs for chassis dynamometer testing as described in CD-16-03.
- The EPA must use the EPA's own current clamps for current measurement.
- Vehicles should have clearly marked locations for current clamp attachment, and voltage taps (if voltage taps are used). The vehicle instructions should include detailed instructions for safely installing the current clamps on the vehicle. Manufacturers must indicate the direction of current flow and how they want the clamps installed. The EPA lab is now using current convention of negative current flow out of the battery (discharge) and positive current flow into the battery (recharge).
- The EPA prefers Pomona #6383-02 connections on voltage taps (commonly called "sheathed banana plugs"). Please inform your certification engineer if for technical reasons you cannot install this type of connection.
- Vehicles that do not provide voltage taps and require CAN data acquisition to measure voltage may result in delays in test data calculations. Manufacturers should allot up to one week extra in their expected timing for results. EPA has the capability of reading CAN messages with their test cell controller if the manufacturer can provide a .dbc file with the parameter information. If the manufacturer will be providing a 3rd party data logger they must provide, in addition to battery voltage, vehicle speed and time align the data prior to submittal to the lab for processing.
- Please tell your certification engineer in advance of the testing if your vehicle requires more than four current clamps. In these situations, the manufacturer shall also provide detailed instructions on how to use the different clamps in the data acquisition for the test, e.g., addition, subtraction, etc.
- Please tell your certification engineer in advance of the testing if a hoist is required to install current clamps or voltage taps. Please communicate the need for any special tools

to install current clamps or voltage taps, and then provide special tools (clearly marked) with the vehicle.

- Vehicles should be delivered to the EPA with a battery state of charge set for completing a road-load dynamometer derivation to determine set coefficients. Supplying the test vehicle to the EPA with a battery that needs charging, or needs to be "driven down" may require additional dyno time, resulting in a re-scheduling of testing.

Vehicles should be able to be tested safely on a chassis dynamometer. Normally, this means they should have a "dyno mode."

- Dyno mode should lock-out automatic ride-height adjusting. This can create unsafe conditions and/or non-representative loading conditions.
- Dyno mode should allow for running repeatable coastdowns during the road-load derivation process on the chassis dynamometer. This is necessary to ensure the track coastdown can be replicated on the chassis dynamometer.
- Dyno mode should shut off any systems that are applicable to the real-world driving but can interfere with chassis dynamometer testing. Examples include, but are not limited to, emergency braking features, automatic high-beams, lane keep assist, adaptive cruise control, and collision avoidance.
- The EPA recommends that dyno mode allows for the use of cruise control on constant speed portions of the MCT.
- The EPA recommends that dyno mode disable the headlights (or DRL's). If dyno mode does not do this, the manufacturer should disable the headlights/DRL's before the EPA receives the vehicle or provide specific instructions on how to do so.

The regulations in 40 CFR part 86 and part 1066 guide how vehicles are to be tested for MPGe and range. These regulations reference the SAE-J1634 version 2012. It is important to understand that the regulations are the "roadmap" for vehicle testing, and reference parts of the SAE standard as guidelines. Where the regulations and the SAE standard differ, the regulations take precedence.

- For example, unless the manufacturer presents an engineering report showing that the test vehicle is stabilized for MPGe and range determination at 1,000 miles, the manufacturer must age the test vehicle to 2,000 miles. [See 40 CFR 86.1831-01]
- The EPA will not adjust MPGe and Range for BEV test vehicles with over 6,200 miles per the regulations [40 CFR 600.006(g)(5)]. All range effecting components on the vehicle should be appropriately aged.
- The regulations at 40 CFR 86.1831-01 direct the manufacturer to use the SRC cycle, or "Durability Driving Schedule," found in the appendices to part 86 for test vehicle mileage accumulation. Paragraph 2 of that section allows for other representative cycles if they are described in the application.
- The test vehicle and the battery that powers the test vehicle during the testing should be aged as one unit at the same time for the same number of miles. Ageing the chassis and installing a battery with fewer miles than the test vehicle is not allowed. The regulations at 40 CFR 86.1834-01 discuss what maintenance can be done on test vehicles.

As stated above SAE J1634, version 2012 is currently referenced in the regulations. Manufacturers may use processes from other versions of SAE J1634 with prior approval under certain parts of the regulations [See 40 CFR 600.116-12(a)(5)].

- Broadly, the EPA allows manufacturers to run the constant speed sections of the MCT test at 65 mph rather than 55 mph. Please tell the EPA which speed will be used when submitting test data.
- The manufacturer may use "five cycle" testing to determine the 5-cycle adjustment factor referenced in the appendix of the SAE J1634 version 2017 standard with prior approval. The EPA must approve the test plan for such testing prior to the testing, particularly the plan for 20°F UDDS testing.
- If the manufacturer needs to run MPGe and range testing in two modes (see mode selection below), then the five-cycle testing must also be done in two modes unless the manufacturer seeks Administrator approval and EPA approves the manufacturer's data demonstrating that testing in both modes is not necessary.

Almost all BEVs have different driving "modes." Examples of different modes include one pedal driving, different levels of regeneration, "sport" modes, weather-related modes, and off-road modes. For a vehicle that can latch in multiple mode after a vehicle restart, that likely means testing in two different modes and averaging values for MPGe and range.

The EPA reserves the right to test (confirm) the manufacturer's results for any vehicle. Manufacturers should allot time for EPA confirmatory testing in their plans, especially for new vehicles with extended range (more than 200 miles per charge).

- The EPA will make confirmatory test confirmation decisions based on unadjusted combined range. That is, the EPA's projected CD UDDS range and CD HWFE range will be combined per the regulations, and compared with the manufacturer's determined value. If the values are within 3%, the test will be considered "confirmed." If the results are not within 3%, the manufacturer will be given the option to request a retest.

EPA does not charge test vehicles in the chassis dynamometer cell. As a result, EPA does not sample energy draw that occurs from the time the vehicle is removed from charge prior to testing to the start of the drive schedule, and thus does not count the energy consumed during this time in the calculations of MPGe and range. As stated earlier in this letter, please provide instructions on best practices to avoid unnecessary battery draw during this activity. During the testing, as directed in the SAE J1634, the EPA takes breaks. EPA breaks nominally occur every 60 minutes during the constant speed cycle of the MCT. The EPA does not consider energy drawn from the vehicle's battery while the vehicle is turned off to be usable battery energy (UBE), and thus does not count this energy in the calculations of MPGe and range. To clarify, EPA uses human drivers to perform tests.

The EPA uses a Level 2 Electric Vehicle Supply Equipment (EVSE) to charge the vehicle after the testing is complete.

- The EVSE is not located in the chassis dynamometer cell, and thus the vehicle will be driven until it cannot keep up with the trace (as stated in the SAE J1634), and then transported to the charger,

where it will be charged. Therefore, the EPA must be able to place the vehicle in neutral once the battery has been drained at the end of the MCT.

- The EPA's EVSE operates at 240V, not the 208V that is standard in many industrial sites.
- If the manufacturer wants to supply their own vehicle EVSE, the EPA has NEMA 6-50 and NEMA 14-50 outlets available. The NEMA 6-50 is normally installed. Please advise your certification engineer in advance of testing if you will be supplying an EVSE, and what outlet it requires.

The EPA expects 12V batteries on the vehicle will be kept at the proper charge level by the vehicle's onboard charging and battery management system. The EPA will not put secondary charging (i.e. trickle charing) systems on the vehicle unless that is how the vehicle is designed to operate for the end user