

Working Group for Amending Heavy-duty Hybrid Certification Procedures
Discussion Document
Tuesday, February 26, 2013

ARB is considering whether definition changes are warranted to better align with existing ARB vehicle definitions and federal heavy-duty vehicle test procedures. Some relevant definitions include:

1. Current definitions:

- a. **Baseline urban transit bus** means a representative, non-hybrid-electric urban transit bus selected by the Executive Officer for chassis dynamometer testing. Exhaust emissions from the selected urban transit bus, as determined by the chassis dynamometer test procedure, will be used in conjunction with the certified emissions from the engine incorporated into the baseline urban transit bus to calculate a baseline emission factor.¹
- b. **Hybrid-electric bus (HEB)** means an urban bus equipped with at least two sources of energy on board; this energy is converted to motive power using electric drive motors and an auxiliary power unit, which converts consumable fuel energy into mechanical or electrical energy. The electric drive motors must be used partially or fully to drive the vehicle's wheels.¹
- c. **Charge-depleting HEB** means an HEB that is designed to be recharged off-board under normal conditions. Under conditions of continuous operation, the [Rechargeable Energy Storage System] RESS of a charge-depleting HEB ultimately fully discharges and impairs vehicle operation when no off-board charging is performed and the consumable fuel is regularly replenished.¹
- d. **Charge-sustaining HEB** means an HEB that derives all of its energy from on-board fuel under normal usage. Under conditions of continuous operation, the RESS of a charge-sustaining HEB does not fully discharge and impair vehicle operation when no off-board charging is performed and the consumable fuel is regularly replenished.¹

2. Existing, potential definitions to model

- a. **"Baseline vehicle"** EPA has declared "heavy-duty hybrid vehicles be certified using an A to B test method using a chassis dynamometer for testing vehicles. This concept allows the hybrid manufacturer to directly quantify the benefit associated with use of their hybrid system on an application specific basis. The concept would entail exercising the conventional vehicle, identified as "A", tested over the defined cycles. The "B" vehicle would be the hybrid version of vehicle "A". To be considered an appropriate "B" vehicle it must be the same exact vehicle model as the "A" vehicle. As an alternative, if no specific "A" vehicle exists for the hybrid vehicle that is the exact vehicle model, the most similar vehicle model must be used for certification. The most similar vehicle is defined as a vehicle with the same footprint, same payload, same intended service class, and the same coefficient of drag. The baseline vehicle must be identical to the hybrid, with the exception being the presence of the hybrid vehicle. Should an identical vehicle not be available as a baseline, the baseline vehicle and hybrid vehicle must have equivalent power or the hybrid vehicle must have greater power ..."²
- b. **Urban bus** means a passenger-carrying vehicle with a load capacity of fifteen or more passengers and intended primarily for intra-city operation.³
- c. **Hybrid electric vehicle or HEV** means any vehicle that can draw propulsion energy from both 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.⁴

- d. **Plug-in hybrid electric vehicle (PHEV)** means a hybrid electric vehicle that has the capability to charge the battery from an off-vehicle electric source, such that the off-vehicle source cannot be connected to the vehicle while the vehicle is in motion.⁵
- e. **Hybrid engine or hybrid powertrain** means an engine or powertrain that includes energy storage features other than a conventional battery system or conventional flywheel. Supplemental electrical batteries and hydraulic accumulators are examples of hybrid energy storage systems.⁶
- f. **Hybrid vehicle** means a vehicle that includes energy storage features (other than a conventional battery system or conventional flywheel) in addition to an internal combustion engine or other engine using consumable chemical fuel. Supplemental electrical batteries and hydraulic accumulators are examples of hybrid energy storage systems.⁶
- g. **Hydraulic Hybrid Vehicles (HHVs)** use two sources of power to drive the wheels. In a hydraulic hybrid vehicle (HHV) a regular internal combustion engine and a hydraulic motor are used to power the wheels.⁷

¹ [ARB's California Interim Certification Procedures for 2004 and Subsequent Model Hybrid Electric Vehicles, in the Urban Bus and Heavy-Duty Vehicle Classes, October 2002](http://www.arb.ca.gov/regact/bus02/ip.pdf) (<http://www.arb.ca.gov/regact/bus02/ip.pdf>)

² [U.S. EPA and NHTSA's Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, Regulatory Impact Analysis, August 2011](http://www.epa.gov/otaq/climate/documents/420r11901.pdf) (<http://www.epa.gov/otaq/climate/documents/420r11901.pdf>)

³ [40 Code of Federal Regulations \(CFR\) 86.012-2](http://www.ecfr.gov) (www.ecfr.gov)

⁴ [ARB's California Exhaust Emission Standards and Test Procedures for 2009 Through 2017 Model Zero-Emission Vehicles and Hybrid Electric Vehicles, in the Passenger Car, Light-Duty Truck and Medium-Duty Vehicles Classes](http://www.arb.ca.gov/msprog/levprog/cleandoc/2009-2017%20my%20hevtps_clean%20complete_12-12.pdf) (http://www.arb.ca.gov/msprog/levprog/cleandoc/2009-2017%20my%20hevtps_clean%20complete_12-12.pdf)

⁵ [40 CFR 86.1803-01](http://www.ecfr.gov) (www.ecfr.gov)

⁶ [40 CFR 1037.801](http://www.ecfr.gov) (www.ecfr.gov)

⁷ [U.S. EPA's Clean Automotive Technology: Hydraulic Hybrid Research](http://www.epa.gov/otaq/technology/research/research-hhvs.htm#overview) (<http://www.epa.gov/otaq/technology/research/research-hhvs.htm#overview>)