

OICA Comments, part A

Introduction:

“The design goals for xEVs, which includes Battery Electric Vehicles (BEVs) along with Hybrid Electric Vehicles (HEVs) and subset thereof, the Plug-In Hybrid Electric Vehicle (PHEV), drive the selection and utilization of battery technology, and as such we will also explore the various types of batteries used in xEV applications. It is also of value to note that the *end-of-life* (EOL) criteria are also driven by the xEV application.”

Comment:

It is very important to understand the battery deterioration mechanism and its state of the art in order to discuss the EV environmental performance and technical issues. It may depend on design level of vehicle system and battery management system what degrees vehicles may exhaust pollutant gas emission (CO, HC and NOx) and greenhouse gas emission (CO₂) according to the long time deterioration of onboard battery.

At first, most common hybrid electric vehicles does not seem to have significant performance deterioration caused by battery life cycle, because HV battery are designed to operate charge/discharge cycle in very narrow range (SOC window) during most frequent driving condition for battery longer life (capacity and power performance).

For plugin hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) depend their EV driving range on onboard battery performance rather than HEVs. However, such vehicles should be designed to accomplish their performance target including adaption to environmental regulatory requirements. For example, United States set the Federal Regulation on Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for all the vehicles including xEVs.

Existing Definitions of Battery Durability and End-of-Life Criteria:

In the page 21, the authors describe about the definition of battery durability and end-of life criteria as “for determining definitions of durability with respect to xEVs, we may turn our attention toward the requirements which are set for vehicle End-of-Life (EOL). A number of parameters which are to be met upon reaching EOL conditions are defined by the USABC (United States Advanced Battery Consortium). The requirements for HEVs, PHEVs, and BEVs are given for year 2018 and 2020 commercialization. These requirements are shown in Table 17 - Table 19 in the Appendix. If we treat battery durability as being intrinsically linked to battery life.”

Comment:

We recognize that the USABC battery performance targets have been set for research and development of advanced battery cells and its material. It is not directly reflected the performance requirement from neither vehicle system design requirement nor technical requirement from vehicle regulations.

Definition of xEV Battery Durability:

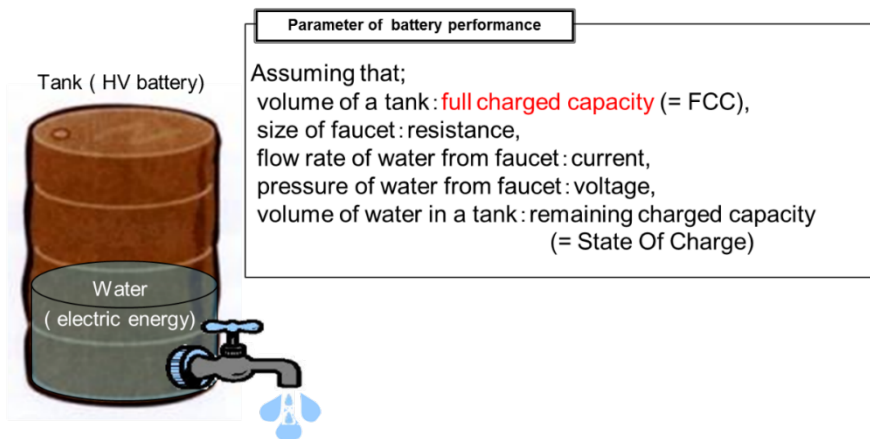
The authors set out the definition of xEV Battery Durability that “The ability of an electrified vehicle battery to withstand degradation of functionality such that power & energy performance targets are met during typical drive cycles, consumer usage, and storage conditions without exceeding its end-of-life cycle and calendar life specifications.”

In testing for battery durability using the above definition, xEVs and their battery systems will be subjected to drive cycles featuring various charge and discharge scenarios along with storage such that a vehicle will be able to (using USABC BEV goals [14] as an example) achieve either ≥ 15 years of calendar (storage) life or continue operating beyond 1000 cycles while maintaining $\geq 80\%$ of its rated capacity and power.

Comment:

In general, the proposal concept of definition of xEV battery durability is assumed correct, however, it should be added that battery system should be designed by OEM product quality requirement. It means that actual performance target should be determined by OEM in order to adapt required performance.

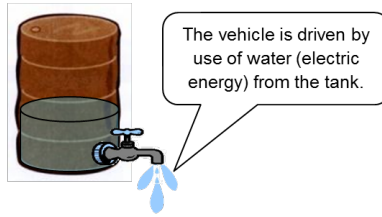
Parameter of battery performance



Function of xEV battery and Definition of SOH

Function of HV battery

A function of xEV battery is that it supplies water (electric energy) for driving the vehicle.



Definition of SOH

SOH for xEV battery means a water (electric energy) supplying performance. The performance depends on the tank's volume (FCC) and the faucet's size (battery resistance). Hence, the SOH can be defined by percentages of the FCC and battery resistance of a new battery.

