

EVE work on in-vehicle battery durability

EVE-34 Teleconference – March 2020

GTR on battery durability

- ❖ General goals of a durability GTR:
 - Establish **minimum durability requirements**
 - **Prevent substandard products** from entering the market
 - Allow **continued development of the GTR** as the industry evolves
 - Implement a **data collection mechanism** for improving the GTR in the future
- ❖ Near-term approach could be some combination of 4 elements:
 - 1) Performance requirement (PR) – e.g. X % energy capacity at Y years (or Y km)
 - 2) OBD requirements for SOH
 - 3) OBD requirements for battery usage history
 - 4) Confirmation via in-service conformity (ISC) – read OBD and/or perform test
- ❖ European Commission desires preliminary GTR as soon as possible

(1) Performance requirement

- ❖ Battery durability is difficult to “prove” by any conceivable certification test prior to market entry
- ❖ But we may know enough about how batteries have aged in service to find consensus on what is “substandard” durability
- ❖ A first phase could incorporate a consensus PR, for example, 80% energy capacity remaining after 8 years
- ❖ The PR could be tightened later, using gathered data and additional modeling

(2) State of health (SOH) on OBD

- ❖ Japan is moving forward with guideline for SOH on OBD
 - SOH envisioned as a measure of either:
 - Remaining electric driving range, compared to original range (CoC)
 - Remaining energy capacity, compared to original capacity (catalogue)
 - SOH readable by customer on dash, and from OBD
- ❖ GTR will likely leverage Japan's work
 - This week, Japan will present more details on the guideline
 - Validation testing is also planned

(3) Usage Indices (UI) on OBD

- ❖ A way to account for actual usage of vehicle at ISC
- ❖ Concept: ECU monitors actual usage and exposure of vehicle over time
 - Converts it to a UI value (e.g. 0 to 1) that is stored in OBD
 - UI to be collected for each of several parameters that affect battery health:
 - Temperature history of battery cells
 - Charge rates
 - Discharge rates
 - Ampere-hour throughput
 - Elapsed time since manufacture
 - Others?
- ❖ Vehicles with extreme UI values at ISC are eliminated, or adjusted
- ❖ Manufacturers are almost certainly already recording many of these parameters, to help with warranty claim assessment

(4) In-service conformity (ISC)

- ❖ An ISC concept needs to be selected and designed
 - Japan would prefer a test based on OBD SOH reading only
 - European Commission prefers a range test
- ❖ Many other details of the ISC program need to be worked out
 - Selection criteria, pass/fail criteria, sample size, statistical methods
 - Criteria for judging “normal” usage and eliminating “extreme”
 - Proposed collection of SOH and UI data at ISC needs to be assessed in context of regional privacy laws

“Durability toolbox”

Tool	What it does	Tasks
PRs	<ul style="list-style-type: none"> Establishes performance requirement, e.g. X% capacity at Y years (or Y km) 	<ul style="list-style-type: none"> Define preliminary “substandard” baseline PR Refine using incoming SOH data Refine using TEMA and incoming EI data
SOH on OBD (Japan proposal)	<ul style="list-style-type: none"> Represents actual performance Provides data (to refine PRs) 	<ul style="list-style-type: none"> Define basis for determining SOH Validate via testing
UIs on OBD (US proposal)	<ul style="list-style-type: none"> Represents actual usage Distinguishes between normal and extreme usage Provides data to define normal usage 	<ul style="list-style-type: none"> Identify exposures to be indexed (temp, etc) Define how to compute UI index value for each Define “normal” UI values using incoming data
TEMA model (JRC modeling tool)	<ul style="list-style-type: none"> Relates usage to SOH (to suggest or refine PRs) 	<ul style="list-style-type: none"> Use TEMA to correlate usage with SOH

Proposed framework – two phases

- ❖ Phase 1 *(implements data collection mechanism and PR/ISC framework)*
 - Limited scope GTR with consensus PR, OBD requirements, simple ISC
 - ISC consideration of usage might be reliant on manufacturer metrics
- ❖ Phase 2 *(tightens PR and considers usage at ISC)*
 - SOH and UI data continues to be collected; “Normal” usage defined
 - PR refined based on modeling of “normal” usage
 - ISC focuses on vehicles with “normal” UI values from OBD
- ❖ Ultimate goal:
 - Data-based PR, derived from SOH and UI data from Phases 1 and 2
 - Vehicles with “extreme” UI values either eliminated or adjusted

Proposed mandate tasks

- ❖ (a) Deliver a Phase 1 GTR to AC.3 by May 2022 with:
 - (i) electrified vehicle battery performance requirement,
 - (ii) OBD requirements on battery health information and usage data; and
 - (iii) a provisional in-service conformity test.
- ❖ (b) Phase 2: Use modeling and data collected during Phase 1 to:
 - Refine performance requirement
 - Improve GTR and in-service conformity program

Possible timeline

👍 approval

★ informal

★ formal

