

Battery Durability: Review of EVE 34 discussion

EVE 35 – WebEx meeting, 19 May 2020

Main topics of discussion

- Performance requirements
- In-service conformity
- SOH algorithms
- Normal Usage Indices
- Validation testing and development plans

Minimum performance requirement (MPR)

- What is an acceptable minimum performance requirement ?
 - Consensus needed – what percentage of range or capacity; how many years, kilometers
 - Would need some degree of validation
 - TEMA model simulations may help inform
 - Warranty survey could provide additional input
- Is the MPR set by CP or declared by OEM?
 - If declared by each OEM (and subsequently verified by ISC), is this enough to prevent substandard products?
 - If MPR is set by CP, do OEMs still have incentive to outperform the minimum?
 - Third option: CP sets an absolute minimum, and OEM has option to declare a higher performance
 - OEM declares and advertises a higher performance
 - OEM must meet their declared performance at ISC

Algorithms for SOH determination

- SOH when read from OBD must accurately represent remaining range or capacity
- Algorithms must be tailored to the battery chemistry and design (one algorithm may not fit all)
- Need to specify standard conditions prior to reading at ISC (e.g. full discharge followed by full charge?)

In-service conformity open issues

- What should the ISC focus on? What other ISC details are agreed on?
 - Is the goal to measure range or capacity?
 - Easier to measure range, but not for heavy-duty applications
 - Measuring capacity might not be reliable if the control system “opens up” capacity over time
 - Is SOH part of ISC check, or separate? Is it in phase 1, 2, or both?
 - More reporting from dealers? Perhaps more local implementations for data?
- EU wants ISC to check for compliance, not just read SOH on ECU
- Concerns that current ISC tests that do not test a significant number of vehicles (only 3 to 10) may be insufficient for battery durability ISC

Normal usage indices

- What are the most important parameters of usage/exposure?
 - JRC TEMA model provides example of some important parameters
- How should driver behavior be appropriately accounted for?
- Where is the line drawn between normal and abnormal usage?
 - Idle / storage time is distinct from calendar time (i.e. intermittent, irregular use and regular)
- Which indices are possible and practical to implement on OBD?

Validation test and development plans

- What should be the focus of validation testing?
 - Identified some areas from discussion
 - ISC may not result in sufficient sample size
 - More verification of TEMA model for characterizing normal degradation
 - Compare ageing models from Volvo with TEMA model
 - General SOH and ISC tests
 - Comparison of proprietary algorithms with SOH accuracy test vs ISC test?
 - Warranty study?
 - Japan's current SOH plans

Proposal timelines for battery durability

- (i) January 2020: Approval of mandate from GRPE
- (ii) June 2020: Approval of mandate from AC.3
- (iii) January 2020 – June 2020: EVE IWG formulates new drafting group, and begins drafting GTR with elements agreed upon by EVE IWG
- (iv) June 2020: EVE IWG provides update to GRPE outlining details of draft outline of GTR
- (v) June 2020 – December 2020: EVE begins validation testing of relevant aspects of the proposed procedure, assesses results and makes changes to GTR
- (vi) January 2021: EVE IWG submits first draft proposal for the GTR as an informal document to January 2021 session of GRPE for further discussion and recommendation.
- (vii) January 2021- March 2021
 - a. EVE revises draft proposal based on recommendations from GRPE
 - b. Transmission of the draft GTR as a working document twelve weeks before the June 2021 session of GRPE;
 - c. Endorsement of the draft GTR based on an informal document by GRPE.
- (viii) June 2021: EVE presents the final GTR to GRPE
- (ix) November 2021: establishment of the GTR by AC.3 in the Global Registry.
- (x) January 2021-January 2024: EVE IWG continues information gathering on possible modifications to the GTR and develops amendments to the GTR for consideration by WP.29 and AC.3, as deemed appropriate.

This draft is for discussion only – do not cite or quote

Phase 1 proposal – from EVE-34 March 2020

1. Establish minimum performance requirements
 - Min PR on Range (% of initial range after “X” years and/or “Y” distance travelled)
 - Need to determine specific number of years and distance requirement
 - Perform modeling to further validate? (TEMA model)
2. Develop ISC range test to verify compliance with performance requirement
 - Based on range test used for type approval (typically WLTC)
 - Use survey to exclude vehicles with abnormal usage
 - Verify SOH is rational
3. Require SOH on OBD (OEMs use their own algorithms)
4. Establish mechanism for ongoing data collection (NUIs, SOH) from OBD
 - Identify NUIs that can be implemented now, if any
 - Formulate data collection criteria (when and how data is collected)

Action items from EVE-34

- **Normal usage indices:** Manufacturers to consider providing durability management or SOH/NUI recommendations, if available and possible
- **Performance requirements:** Volvo and JRC to look into comparing JRC TEMA modelling results with battery ageing research at Volvo
- **Establish list of data collection parameters:** Everyone to look into parameters that are influential to degradation and achievable to implement
- Hold further discussion on minimum performance requirements on capacity and range.
 - EVE IWG to consider what was discussed
 - Review JRC's list of proposed indices and provide feedback
 - Warranty study
- Review regulatory/ISC text provided by EU (Penny) and provide written comments for discussion

Presentations today

- Comments and proposal from Japan
- Proposal from European Commission
- Comments and proposal from OICA

PEV Battery Warranties – US Market (* = Europe)

Manufacturer	Model	Warranty against failure:		Includes degradation?
		Years	km	
Audi	e-tron	8	160,000	NO
BMW	i3	8	160,000	70%
Chevrolet	Bolt	8	160,000	60%
Fiat	500e	8	160,000	NO
Hyundai	Ioniq, Kona	10	160,000	NO
Jaguar	i-Pace	8	160,000	70%
Kia	Niro EV	7*	150,000*	70%
Lexus	UX300e	10*	1,000,000*	70%
Mercedes	B-Class Elec drive	8	160,000	70%
Nissan	Leaf 40, 60	10	160,000	~75%
Porsche	Taycan Turbo	8	160,000	70%
Tesla	Model 3, Y	8	160-190k	70%
Tesla	Model S, X	8	240,000	70%
Volkswagen	e-Golf	8	160,000	70%

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Next meetings

- May –WebEx meeting to continue discussion of framework
- June
 - GRPE virtual meeting (9-12 June)
 - EVE-35 – in June, after GRPE
- Fall – South Korea, or virtual?
- Spring – Europe ?

Matrix for reference

	Air pollutants	CO ₂ / Energy Consumption	Electric Driving Range
HEV	EVE group view: no consensus view yet	EVE group view: some consideration at WLTP & other areas for higher threshold EVE group view: HEV CO ₂ emission durability lifetime should always be the same as air pollutant durability lifetime	x
	EU position: HEV/PHEV pollutants should refer to useful life 160,000 km and in service conformity check requirements at 100,000 km		
	Japan position: Suggestion to use deterioration factors for degraded batteries from OVC-HEVs and NOVC-HEVs since DF's are already available for internal combustion engine type vehicles. Recommendation that manufacturers provide clear explanations that indicate that the pollutant management system can still maintain appropriate pollutant levels as the battery degrades.		
PHEV	EU position: The same position as HEVs	EVE group view: PHEV should always have the same CO ₂ emission durability lifetime requirement as HEV	EU group view: some concern about requiring durability for this value, since some manufacturers have ICE operate in certain conditions regardless of battery condition (i.e. above 80 km/h)
PEV	x	EU position: this criteria is not needed	EVE group view: There should be the same battery durability lifetime on range as other vehicle architectures. Could consider longer durability requirement for PEV range (i.e. [80% or 70%] at 150,000 km or 200,000 km; 8 or 10 years;) Could consider defining durability requirement as a function of base range, perhaps within a threshold (i.e. [80 km to 350 km] base range)
		EVE group view: The only reason to establish energy consumption requirement for PEV is if there will be an associated requirement to assess or include upstream emissions	