In-vehicle Battery Durability

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In-vehicle battery durability

- Request to develop GTR, Phase 1:
  - (a) Deliver a first version of a UN GTR on in-vehicle battery durability to AC.3 by November 2021 with:
    - (i) definition of and requirements for electrified vehicle battery performance criteria
    - (ii) requirements for reading and/or displaying battery health information and usage data form the vehicle; and
    - (ii) a provisional in-service conformity test which will include generic usage criteria and a statistical method.
Verification/In-Service Conformity

- Should include the possibility to check via independent means the range (not simply reading an ECU signal)
- Testing according the WLTP is currently the only option
- Rules are obviously needed on sample size, tolerances, etc.
Previous proposal

Monitoring Phase
- SOH Indicator in vehicles
  - Requirement
- SOH Reading capabilities
  - Requirement
- TEMA or other Models

Minumum Performance Requirements: MPR
  by OEM or CP

Verification method
- Test: WLTC procedure
  - For Range Determination
  - Or alternative?
- Statistical Method
- Vehicle Selection criteria
  - Pass/Fail Criteria
    - For vehicle and sample

Information gathering
Performance Definition
Performance Verification
Issues

- Decision for the whole type of vehicles taken only based on few vehicles
- Requires that extremely used vehicles that can influence the decision unfairly are excluded
- Could potentially lead to recalls of all vehicles with the same type, even when not all vehicles might have a battery issue
- Big data (i.e. SOH) used only for information gathering and not for performance verification
Improved proposal

Monitoring Phase

- SOH Indicator in vehicles
  Requirement
- SOH Reading capabilities
  Requirement

TEMA or other Models

Information gathering

Minimum Performance Requirements: MPR by OEM or CP

Performance Definition

Verification method PART A:
Does the SOH work properly?

Test: Test Range against SOH reading

Statistical Method and vehicle selection list

Pass/Fail Criteria For each vehicle and small sample

Verification method PART B:
SOH within MPR?

Read SOH of all vehicles Of the same family

Pass/Fail Decision on big sample
PART A: SOH Verification
Does the SOH work properly?

Test: TEST Range against SOH reading

Statistical Method and vehicle selection list

Pass/Fail Criteria For each vehicle and small sample

PART B: Battery durability verification
SOH within MPR?

SOH Pass

Pass/Fail Decision on big sample Against MPR

Fleet SOH Fail

Recall and fix SOH indicators Repeat SOH verification after the fix and proceed with part B.

Fleet SOH Fail

Recall and fix batteries with low SOH

Fleet SOH Pass

Performance Verification Pass
**Benefits/ implications of new proposal**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Consequence</th>
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<tbody>
<tr>
<td>Decision on performance of SOH indicator/reading made separately on <strong>smaller number of tests</strong>, where accuracy of SOH is checked.</td>
<td>• Vehicles selection done based on the list</td>
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<td>• Small number of vehicles need to be tested for each type</td>
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<td>• Recalls on SOH might be needed</td>
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<td>Decision on the performance of batteries made on <strong>big sample</strong>, so statistically extreme use is insignificant</td>
<td>• No need for Normal Usage Indices</td>
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<td>• Recall is made when the battery has a problem (only on those vehicles with poor SOH)</td>
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<td>Less need for complex data reading</td>
<td>• SOH + some basic data reading capabilities</td>
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PART A: Elements needed

**Information Elements**

- Annual report on warranty claims, repairs for batteries to be provided by manufacturer to the authorities
- List of faulty vehicles found during ISC vehicle selection

**Definition of SOH**

- Algorithm can be OEM proprietary, but verifiable
PART A: Selection Criteria for vehicles

Vehicle examination and interview with owner

- Using the proposed list
- Regular and appropriate maintenance (with proof)
- No unauthorised major repair to engine or vehicle
- No unauthorised change or repair of battery
- No evident safety problems
PART A: Testing

- Families with similarities on their battery characteristics/drivetrain need to be defined
- Testing performed every X years throughout lifetime of vehicle
- Method of testing according to what was used for the original definition of range/capacity
  - WLTP in Europe
PART A: Sample Statistics

- 3-10 vehicles tested for range
- Tested Range/Declared Range within x% of SOH
PART B: Data collection

- Data collected yearly from all registered vehicles
  - During Periodic Technical Inspection
  - Over the air
- Appropriate yearly analysis to show if fleet SOH is above the Minimum Performance Requirements
- Might be necessary to define MPR targets that vary with the age of the vehicle, not only the final target
- Recall may be necessary for those vehicles with SOH below MPR only
Conclusion

- New method proposed is simpler and avoid taking decisions on the battery durability based on testing few vehicles
- Testing can prove whether SOH is accurate
- Collection of SOH from all vehicles can support analysis of fleet average values
- Focused decision for recall, when and where needed
Thank you for your attention!