EV Battery Durability GTR

UNECE EVE #43

February 3-4, 2021
Data Analysis

• Current Datasets
  • Warranty
  • TEMA Model
  • Geotab

• Next Steps

• Recommendations
Warranty Analysis

- Warranties are a contract between the customer and the manufacturer based on technical, commercial, and competitive analysis.
  - Customers can compare warranties and make the decision most appropriate for their circumstance

- Warranties provide customers assurance that their product will function within a given timeframe
  - It is not intended to be used to set performance requirements for the fleet

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Warranty against failure:</th>
<th>Includes degradation?</th>
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<tbody>
<tr>
<td>Audi</td>
<td>e-tron</td>
<td>8</td>
<td>160,000</td>
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<td>BMW</td>
<td>i3</td>
<td>8</td>
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<td>Bolt</td>
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<td>500e</td>
<td>8</td>
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<td>Hyundai</td>
<td>Ioniq, Kona</td>
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<td>i-Pace</td>
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<td>Niro EV</td>
<td>7*</td>
<td>150,000*</td>
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<td>UX300e</td>
<td>10*</td>
<td>1,000,000*</td>
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<td>B-Class Elec drive</td>
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</tbody>
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TEMA Analysis

- TEMA model assumed high-capacity reserve in its analysis

- Reserve should not be included in MPR development. This is a theoretical value in the model, which leaves no margin for implementation and engineering.

- Reserve should be eliminated to allow for engineering tolerances
Geotab: Raw Data from EV SOH Database

- Number of vehicle models used in this study – 21
- Number of vehicle models with different model year (sample size) – 51
- All 51 have either the end of year 2 or the end of 1 year + 8 month data.
- For those that have 1 year + 8 month data, the end of year 2 was extrapolated by using 1 year 4 month and 1 year 8 month data (They are deemed as “actual” or “raw” data in this study).
- Only year 1 and year 2 data were used to estimate 5-year and 8-year SOH (in order to provide an acceptable sample size).
The term “HEV” and “PHEV” are being used interchangeably.
- Point (0 @ 100%) was used for all the vehicles.
- The line was obtained by using 3 data points.
- Year 5 and year 8 estimations are determined from the line for each individual vehicle.
Geotab: Fleet Mean and Two/Three Standard Deviation Range for year 5 and Year 8

Estimated SOH @ the End of Year 5 (Mean&2 Standard Deviation)

Estimated SOH @ the End of Year 8 (Mean&2 Standard Deviation)

Estimated SOH @ the End of Year 5 (Mean&3 Standard Deviation)

Estimated SOH @ the End of Year 8 (Mean&3 Standard Deviation)
Geotab: Probability Estimates

- 5-year probability that ~3% of population is at or below 70% SOH.
The two sets of results are very close for almost all the available data.
Geotab: Limitations & Open Questions

- The prediction for the fleet may not be accurate due to limited vehicle models used in this analysis (probably the data from less than 1/3 vehicle models around the world have been available in Geotab database).

- More data points to use for the regression will improve the estimations. There are only 3 data points used for the regression for each vehicle in this study.

Open Questions:
- How does Geotab access vehicle data? Is it through an aftermarket OBDII port device?
- How is the data accessed being interpreted to provide SOH?
- Is Geotab attempting to calculate their own SOH using data on remaining capacity and state of charge?
  - There may be problems with how those values are developed and used within the vehicle CAN system
  - Geotab data likely doesn’t account for the SOH accuracy issues that automakers are struggling with as they compare SOH calculation results with actual battery capacity values
- It is unlikely that Geotab has any actual measured data on battery capacity to go with the data they took from the OBDII CAN bus
  - CAN bus numbers can look really clean, with no indication of just how much of an approximation they are.

Data Specific Questions:
- Vehicle SOH vs Time
- Vehicle location
- Mileage per year
- Charge data
- Ambient temperature data – average, max/min
Data Conclusions and Recommendations

Open questions on available datasets need to be addressed
- JRC response to TEMA questions from industry to be reviewed
- Deep dive analysis with Geotab – in process

Current data analysis
- TEMA model without battery reserve indicates a MPR level of 70% at 5 years / 100,000 km
- The Geotab linear regression analysis for 5 years indicates that 70% SOH is attainable, and that a higher SOH value cannot currently be supported by the data.
  ▲ No significant difference in total degradation between BEV and PHEV.
  ▲ Moving to a MPR higher than 70% will begin to filter out a large number of vehicles – at 80% MPR closer to 15% of all vehicles will fail the target.

Potential impact of basing MPR on current datasets
- Vehicles become less affordable
- Increased battery size/weight
- Innovations, such as V2G/V2B, could be hindered
- Customer dissatisfied by the requirement to replace battery that is meeting customer needs

Recommended next steps:
- Use phase 1 to collect data and establish an MPR representative of a large dataset on the most up-to-date vehicles. EVE IWG should identify exactly what data should be collected in phase 1.
- If phase 1 data collection is not agreeable, establish a Phase 1 MPR based on fleet average and introduce a backstop concept in Phase 2