UNECE EVE-IWG

In-Vehicle Battery Durability

OICA comments for
EVE-IWG #59
10.01.2023

GTR 22 _ MPR for Category 2 vehicles

Background:

- UNECE EVE-IWG agreed, that the MPR for Category 2 vehicles shall be for monitoring in phase 1
- During EVE-56 (June 2022), EU-Commission indicated: monitoring data from phase 1 take too long
- In EVE-57 in September 2022, JRC presented a first MPR proposal as discussion starter
- EU-COM Euro 7 proposal published in November 2022 with MPR for N1 vehicles (Category 2) with values as presented by JRC in September 2022

Status:

- OICA presented in EVE-58 (November 2022) energy throughput concept covering additional load
- Concept was rejected by EU-Commission due to following issues:
  1. Additional load is already reflected by V2X concept in GTR-22
  2. Verification of V2X counter would lead to additional loopholes

V2X definition in GTR 22

3.19. *"V2X"* means the use of the traction batteries to cover external power and energy demand, such as V2G (Vehicle-to-Grid) for **grid stabilization** by utilising traction batteries, V2H (Vehicle-to-Home) for utilizing traction batteries as residential storage for local optimisation or **emergency power sources in times of power failure**, and V2L (Vehicle-to-Load, only connected loads are supplied) for use **in times of power failure and/or outdoor activity in normal times.**

➔ **The definition does not cover extended Battey discharge during driving**

Load situation	Static / Dynamic	Covered by V2X Virtual Miles
Stationary V2G, V2H, V2L	Static	YES
Drive with max payload	Dynamic	NO
Cooling / refigeration demands	Dynamic	NO - Could be covered by modified V2X definition
Towing / Trailer	Dynamic	NO
Heating demands	Dynamic	NO
On-board power delivery (equipment)	Dynamic	NO - Could be covered by modified V2X definition

➔ **V2X is not sufficient to cover the additional degradation of a Category 2 vehicle**

V2X methodology is already part of GTR-22

- Wh-counter with sufficient accuracy needs to be integrated
- Wh-counter to cover all discharged energy (not only V2X)

Discharged energy Verification Methodology

- Discharged energy can be defined as sum of all energy provided from the battery
- During ISC-Part A, Verification is possible by TA test procedure
- Comparison of $\Delta E_{discharge}$ by external instrument, on-board $\Delta E_{discharge}$, and $\Delta E_{discharge}$ increase.

Values to be read from vehicles:

1. On board SOCE value
2. On board SOCR value
3. Odometer (in km)
4. Date of manufacture of the vehicle
5. Total distance (sum of the distance driven and the virtual distance) [km], if applicable
6. Percentage of virtual distance [in per cent], if applicable
7. Worst case certified energy consumption of PART B family [Wh/km], if applicable
8. Total discharge energy in V2X [Wh], if applicable
9. Elapsed time since last charged by more than 50 per cent SOC swing [Days]
10. Average battery temperature during charging, during propulsion system active and (if equipped) during non-usage of the vehicles (i.e. non-propulsion system active, non-charging)

Pass condition:

$\Delta E_{discharge}$ from external instrument x [1.05] $\geqq$ $\Delta E_{discharge}$ on-board,
$\Delta E_{discharge}$ increase (if a discrepancy of up to 5% is allowed)

The verification of the discharged energy measurement should be added to the GTR as well

Backup

GTR 22 _ MPR for Category 2 vehicles

Background:

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- During EVE-IWG 56 in June 2022 EU-Commission indicated, that it will take to long to wait for monitoring data froom phase 1
- In EVE-IWG 57 in September JRC presented a first proposal as discussion starter
- The Euro 7 draft was published recently with an MPR for N1 (Category 2) vehicles as presented by JRC

Table 2: Euro 7 Minimum performance requirements (MPR) for battery durability for N_1 vehicles

Battery energy based MPR	Start of life to 5 years or 100 000 km whichever comes first	Vehicles more than 5 years or 100 000 km, and up to whichever comes first of 8 years or 160 000 km	Vehicles up to additional lifetime*
OVC-HEV	75%	65%	
PEV	75%	65%	

- EVE-IWG agreed, that LCV have a different usage of the Battery than passenger cars that has to be reflected in the MPR
  - Wide variation of usecases
  - Continous use in a stationary state
  - Higher loads during operation that are different from WLTP
- OICA discussed internally the metric of Energy Throughput (Wh) as appropriate to assess the usage of the Battery

⇨ Seperate presentation prepared by ACEA

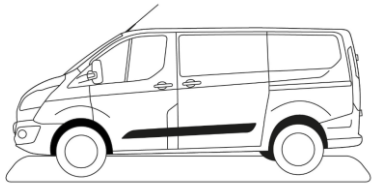
COMMERCIAL VEHICLE PROPOSAL

- Light commercial vehicles are **work tools** chosen to meet specific operational needs addressing a **broad range of use cases**
- No / limited data available for commercial vehicles - preliminary simulations show up to **5-10% additional degradation** over 8 years compared to passenger cars
- Battery ageing significantly influenced by **battery cycling** (mileage, high payload, & external loads – worst case external load whilst driving) and fast charging
- **Energy Throughput (Wh) concept** developed to define performance targets against mileage, age and battery throughput (Wh)
- Throughput accounts for heavy loads, external loads, V2X and driving combined

Sample Customer	Profile Examples
Ambulance	High up-time with long daily shifts Low mileage High aux load Multiple daily DCFC
Rural delivery	Medium up time - high mileage/av. speed Daily AC charge with multiple daily DC top-ups Food delivery including refrigeration – high V2L
City delivery	Medium-high up time - med mileage, lower av. speed than non-city Daily AC charging, with DCFC top-ups when required Food delivery including refrigeration – high V2L
Local trades	Low driving time - commuting mileage High aux load V2L Daily AC charge at home - No DCFC
Park-at-home utility operator (no home charger access)	Medium up time DC only charging Low-med aux load for tablet/power tool chargers.

Many more use cases / scenarios possible

Proposal



SOCE (%)

Wh_{actual}

$5\ year\ maximum\ discharge\ energy\ (Wh) = X\ Wh$

$8\ year\ maximum\ discharge\ energy\ (Wh) = Y\ Wh$

Max based on WLTP energy consumption (Wh/km) + %
Vehicles exceeding maximum discharge energy excluded from MPR assessment

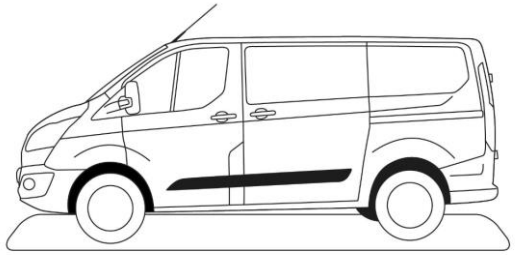
THROUGHPUT PROPOSAL

Capacity Retention	PV PHEV / BEV Minimum Performance (EU7)
Up to 5 years or 100,000 km	80%
Up to 8 years or 160,000 km	70%

Capacity Retention	CV PHEV / BEV Minimum Performance (EU7)
Up to 5 years or 100,000 km or x Wh	~~Monitoring~~ TBD %
Up to 8 years or 160,000 km or x Wh	~~Monitoring~~ TBD %

Link to GTR-22 HDV Proposal: OICA Proposal MPR Threshold based on total cycle energy

$$Number\ of\ full\ cycles = \frac{Total\ Cycled\ Energy}{Total\ Energy\ in\ Battery\ System\ at\ start}$$



Net Discharge energy (Wh)

SOCE (%)

Wh_{actual}

$$5\ year\ maximum\ discharge\ energy\ (Wh) = X\ Wh$$

$$8\ year\ maximum\ discharge\ energy\ (Wh) = Y\ Wh$$

Vehicles exceeding maximum discharge energy excluded from MPR assessment

$$Wh_{5\ year\ nominal\ WLTP} = TMH\ Energy\ consumption_{WLTP}\left(\frac{Wh}{km}\right) x\ 100\ 000\ km$$

$$Wh_{8\ year\ nominal\ WLTP} = TMH\ Energy\ consumption_{WLTP}\left(\frac{Wh}{km}\right) x\ 160\ 000\ km$$

Possible Solution:
Worst Case WLTP (TMH Energy Consumption Wh/km)

Manufacturers have two key objectives: Meeting Customer Performance & Limiting Degradation

Commercial Vehicle Degradation Challenges:

(1) Protecting Battery from Extreme Exportable Power

- Virtual miles could cover this use case: suggestion to amend V2X definition to cover all exportable power scenario's (stationary + driving)

(2) Protecting the battery from other factors impacting SOH excessively

- High Wh/mile via high electrical, cooling & heating, payloads, towing, grades etc.
- Other factors influence SOH but acknowledged complexity to regulate (e.g. cell temp, cell voltage, DCFC, DOD) - handled in design through attribute trade-offs

Using a Throughput (Wh) Counter: Limits exposure to some of (1) and (2) in an uncomplicated way

(1) Potential to be easily understood by customers - allows a natural flex in how customers decide to use their vehicle

(2) The throughput concept shouldn't limit vast majority of customers - only those with very high throughput or exportable power. Challenge: defining throughput boundary

(3) Battery chemistry, weight, size and cost holding back ability to meet all customer energy needs – manufacturers pushing the limits of battery technology to avoid extreme degradation

(4) Without accounting for all energy use, trade-offs may be required - possible limitations on features leading to excessive degradation (e.g., limiting DCFC or exportable power / throughput, limiting BOL performance e.g. increased battery reserves weight / cost trade-off on range).