Determination of Powertrain Performance of Hybrid Electric Vehicles

Presented by: Germany, Korea
EVE-16 meeting
October 19./20., 2015
Outline

1. Status Report
   Activities and current state-of-play since EVE-15

2. Presentation of the Discussion Paper
   Project Proposal

3. Open Questions, Discussion and Decision Making

4. Next steps and Planned Activities
   until EVE-17, Geneva, January XX/YY, 2016
Status Report

✓ Evaluation of Survey
   “Questionnaire to support the development of electrified vehicle’s system power determination” (EVE-14-07-Ref1e)

✓ Preparation of a discussion paper / project proposal
   “Determination of Powertrain Performance of Hybrid Electric Vehicles”
Discussion Paper

1. Project Charter
   - BACKGROUND
   - PROBLEM
   - MOTIVATION
   - GOAL

2. Scope of Work
   - APPRAISAL OF STAKEHOLDER INTERESTS
   - PROJECT FRAME
   - MULTI GENERATION PLAN
   - PROJECTS WITH SIMILAR FOCUS - DEPENDENCY ASSESSMENT AND SYNERGIES

3. Project Structure
   - REFERENCE METHOD
   - CANDIDATE METHOD
Background
UNECE R-85 provides currently a regulation under the 58’ Agreement that can be used for approval of internal combustion engines (ICE) and electric drive trains in M and N category vehicles. It focusses on the determination of engine power values, however, the technical description part of the regulation merely provides for the individual determination of the power of either an ICE or an electric motor.

Problem
The role of the propulsion battery is not considered by the regulation. A determination or recommendation for a calculation of the ‘motive power’ of the vehicle expressed as combined power or system power is missing.

Motivation & Goal
Clarify, how an improved technical prescription for the determination of the system power of such sophisticated powertrains like with pure and hybrid electric vehicles, could be realized in an efficient and easy way.

Project Focus & Scope
- HEV (light duty: M, N-category vehicles)
- Rated System Power (according “WLTP-demands”)
- Component testing, chassis dyno testing
- Integration into GTR15

Multi Generation Plan
- Phase I Rated System Power for GTR 15 (WLTP ) purposes
- Phase II extension to BEV vehicle types and system peak power as well as other relevant system power ratings like system torque
- Phase III harmonized regulation for NRMM and L-cat. vehicles.
1. Scope of work

Appraisal of Stakeholder Interests

EU

• The subject is important and relevant for many other Regulations
• Forms the basis for proper vehicle classification
• Consider expanding the scope beyond PC and LDCV: harmonized procedure for L-Category vehicle and NRMM
• For all engines, motors and combinations of propulsion units up to a tbd. limit there should be a single harmonized way to determine it’s continuous max. rated net and peak propulsion unit performance

Purpose:  • WLTP and others

Way forward:  • Upgrade of UN R85 and development of GTR in parallel
JP understands that the demand in WLTP is limited to the determination of the system power of HEV.

There is only need to define the combined power of hybrid electric vehicles.

No need to re-define the power of Battery EVs and Fuel Cell Vehicles, since the electric drive train has already been defined in UN-R85.

Purpose:
- WLTP, for P-t-M classification of HEV

Way forward:
- Target should be achieved by a world-wide agreed (ISO) Standard rather than a GTR, UN-R or Recommendation / Mutual Resolution
KOR

- Net power ratings from current UN-R85 are sufficient but the power limit ascribed to the traction battery should be properly considered and determined.
- Determination of power and torque should be done with a completed vehicle applying a kind of chassis dyno or power train dyno measurement

Purpose:

- WLTP

Way forward:

- UN-R85 should be adapted by an amendment / additional module and GTR-development in parallel
2. Scope of work

Appraisal of Stakeholder Interests

CAN

• As CAN is being party of the ‘98-Agreement, the UN-R85 has not been adopted or applied.

• CAN abstained from voting on phase 1 of WLTP since analysis of the GTR 15 (WLTP) is still ongoing and because stringent light duty vehicle reg. are already in place domestically.

Purpose:

Way forward:
2. Scope of work

Appraisal of Stakeholder Interests

OICA

- OICA supports the development of a harmonized procedure for every category of electric vehicles to determine comparable system power/system torque (if required) based on needs, priorities and requests from relevant groups (e.g. WLTP-IWG).
- Measurement of individual components followed by a calculation method.
- To be derived from a standard procedure.

Purpose:
- WLTP, since the only current regulation where SP, ST is needed.
- SP for cycle classification and downscaling.
- ST for gear shift calculation in case of a manual transmission.

Way forward:
- Integration either into GTR 15 or as another GTR.
2. Scope of work

Project Frame

- HEV (light duty: M, N-category vehicles)
- Rated System Power (according “WLTP-demands”)
- Component testing
- Chassis dyno testing
- Integration into GTR15

Out of frame:
- NRMM,
- L-category
- All engines, motors and combinations of propulsion units

BEV
- Torque (according “WLTP-demands”)
- System Peak Power and other sy.pow. ratings

Amendment of UN-R85 (provision for traction battery)

Separate GTR
2. Scope of work

Multi Generation Plan

• Generation I
  – For immediate action
  – In the frame topics

• Generation II
  – Extension of results from Gen. I
  – On the frame topics

• Generation III
  – Harmonized regulation for NRRM and L-cat. vehicles
## 2. Scope of work

### Projects with similar focus

<table>
<thead>
<tr>
<th>Principle (Hybrid system power)</th>
<th>Nominal rating + System power test</th>
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<th>Nominal rating + System power test</th>
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<tbody>
<tr>
<td>SAE J2908 TF (Argonne, U.S.)</td>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
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<tr>
<td>ISO tc/22/SC37/WG2 (JARI, Japan)</td>
<td><img src="image4.png" alt="Graph" /></td>
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<td>KATRI updated (KATRI, Korea)</td>
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<td><img src="image8.png" alt="Graph" /></td>
<td><img src="image9.png" alt="Graph" /></td>
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- **Nominal Rating (ICE)**
  - SAE J1349

- **System Power Test (Electric source)**
  - To be discussed

- **Test Equipment (Dynamometer)**
  - Hub dyno or Chassis dyno
  - Chassis dyno
  - Power train dyno or Chassis dyno
3. Project Structure

**Suppliers:**
- OICA
- KATRI
- ISO/JARI
- SAE/ANL

**Input:**
- Expertise
- Data
- Lab capacity
- Software code
- Programming

**Process:**
- WLTP calculations (gearshift, downscaling, ...)
- Evaluation
- Improvements
- Normalization/Correlation
- Drafting

**Output:**
- New Regulation

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### Determination of Test burden collectives

### Determination of System Power (and torque) according SAE, ISO and calc. of
- P-t-M
- Gear shift
- According WLTP

### Improved Normalization/Correlation towards testbed values

### Evaluation and Analyze

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### Component Measurement R85

### Battery performance

### Calculation Tool

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### Candidate Method

### Determination of
- P-t-M
- Gear shift
- According WLTP

### Improved Normalization/Correlation towards testbed values

### Evaluation and Analyze

### Validation with Reference

### Drafting
Discussion

• **Project Frame:**
  – BEV
  – Torque
  – System PP
  – Separate GTR
  – Amendment UN-R85
• **MGP:**
• **Project Structure:**
• **Project Team:**
  – Chair
  – Co-Chair
  – Secretary
  – Members of Experts
Planned activities until EVE-17

- Determination of the formal framework: Chair, Co-Chair, Secretary
- Notification for 167 WP.29 Nov 2015
- Work Brake-down Structure
- Drafting of a mandate document to be endorsed by GRPE during 72. meeting, Jan 2016
- Formal Adoption of Mandate during 168 WP.29 / A.C.3 in March 2016
Timeline
updated version 06/2015

WP.29

2015
1  2  3  4  5  6  7  8  9  10  11  12

GRPE

2016
1  2  3  4  5  6  7  8  9  10  11  12

EVE

2017
1  2

14/9/2015

Document EVE-16-XXe

17
Backup