

Comments to the Technical considerations (from EVE-25-07e)

Technical considerations

- Validation of TP1 and TP2 for HEV and PHEV configurations
 - Similarity of results
 - Avoid possibility of “cherry picking”
- Selection of CS or CD mode for PHEV configurations
 - Possibility of different power rating (V_{olt} greater in CS, i₃ greater in CD)
- Load collectives and maximum power
 - ISO provides a series of fixed vehicle speeds to identify max system power
 - However, detailed method for dividing and specifying speed intervals has not been described
 - Is manufacturer’s recommendation appropriate for a GTR?
- Reference and candidate methods
 - Reference method to be developed first
 - Candidate method should also be considered concurrently
 - ISO does not describe a candidate method
 - Once developed, it needs to be carefully validated against reference method
- Validation testing
 - See test site matrix
 - Need to identify and solidify test sites, vehicles to be tested
- Warm-up state for PHEVs
 - Maximum battery power is likely at maximum SOC, but achieving warm-up is likely to deplete battery to some degree
 - Artificial regeneration on dynamometer?

Comments to Technical considerations

Validation of TP1 and TP2 for HEV and PHEV configurations

- Similarity of results

⇒ Because of Difference in definition and Gearbox system efficiency or Conversion factors, Results may differ.

- Avoid possibility of “cherry picking”

⇒ if the definition of the output could be same, cherry picking will be avoidable.

<Definition> SEE appendix

TP1: Summation of the crank edge power of the ICE and the electric Motor power supplied from RESS output .

TP2: The input system edge power by the machine transmission to lead to an axle
< electrical power transmission after the ICE is not included >

Selection of CS or CD mode for PHEV configurations

- Possibility of different power rating (Volt greater in CS, i_3 greater in CD)

Pattern A;

Since the purpose of maximum hybrid system power is to utilize it for classification and/or down-scaling of the driving cycle, both CS and CD mode are needed to avoid cherry picking.

Pattern B;

Higher value of Either CS or CD is enough. Not necessary to conduct both mode.

- 1) If CD and CS mode tests will be conducted at different class, comparison of test results between CD and CS will be impossible.
- 2) When either CS or CD mode could not be followed ,
 - a) IF $CD\ power > CS\ power$, WOT must be operated and speed is not necessary within the cycle criteria during CS mode.
 - b) If $CS\ power > CD\ power$, Test should be ended when speed is lower than cycle criteria during CD mode. OR the combination of CS power component will be operated to follow cycle even at CS mode.

Load collectives and maximum power

- ISO provides a series of fixed vehicle speeds to identify max system power, However, detailed method for dividing and specifying speed intervals has not been described

=> It depends on a HEV system, but Japan considered that engine speed intervals are appropriate. Since the characteristic of the ENG power profile is thought to have a big influence for HEV system power .

- Is manufacturer's recommendation appropriate for a GTR?

=> It is appropriate. Since GTR will be utilized at the Homologation test , OEM will provide information and its background.

Reference and candidate methods

- Reference method to be developed first :

=> JASIC agreed and recommended TP1 first because of small fluctuation.

- Candidate method should also be considered concurrently

=> Not necessary to consider candidate method. OICA also agreed.

- ISO does not describe a candidate method

- Once developed, it needs to be carefully validated against reference method

=> JASIC(JAMA) don't want to extend the EVE activity to complete or validate a candidate method.

Validation testing

- See test site matrix
 - Need to identify and solidify test sites, vehicles to be tested
- => Discuss at the Tokyo meeting

Warm-up state for PHEVs

- Maximum battery power is likely at maximum SOC, but achieving warm-up is likely to deplete battery to some degree
 - Artificial regeneration on dynamometer?
- ⇒ EVE-24-04 presented by JASIC already described how to deal with.
Please confirm slide 15

APPENDIX

Difference in definition

Definition

TP1 6.9.2 Calculation for TP1(ISO Extracted)

a) ICE power (in kW): The test results of measurements according to ISO 1585 are necessary.

b) converted RESS power (in kW): Use the following formula:

$$(U_{RESS} \times I_{RESS} / 1\,000 - P_{DCDC} - P_{\text{auxiliaries}}) \times K$$

where (1)

U_{RESS} : measured RESS voltage (in V)

I_{RESS} : measured RESS current (in A)

P_{DCDC} : power to DC/DC converter for 12 V auxiliaries (1,0 kW or measured value) (in kW)

$P_{\text{auxiliaries}}$: power to auxiliaries except DC/DC converter for 12 V auxiliaries (measured value) (in kW)

K : conversion factor from electrical power to mechanical power (0,85 or measured value).

The HEV system power is calculated by adding the total of a) and b)

Definition

TP1 6.9.3 Calculation for TP2(ISO Extracted)

$$P_{HEV\ system} [kW] = \frac{P_{HEV\ system\ at\ wheels} [kW]}{\eta_{gearbox}} \quad (2)$$

Where

| | |
|-------------------------------|------------------------------------|
| $P_{HEV\ system}$ | HEV system power (in kW) |
| $P_{HEV\ system\ at\ wheels}$ | HEV system power at wheels (in kW) |
| $\eta_{gearbox}$ | gearbox system efficiency factor |

The gearbox system efficiency factor depends on individual gearbox system configurations. Therefore a value for this factor shall be used according to the vehicle manufacturer's recommendation or if not available, according to similar HEV examples and their gearbox system efficiency factors described in Annex A.

TP1:

The downstream loss after engine is not included as well as conventional ICE vehicles.

TP2:

The downstream loss after engine is included or reduced.

TP1 6.9.2 Calculation for TP1(ISO Extracted)

The HEV system power is calculated by adding the total of ICE power (in kW) and converted RESS power

TP2 6.9.3 Calculation for TP2(ISO Extracted)

Clause 6 describes TP 2, a measurement method to determine the maximum HEV system power via a torque and speed measurement at wheels of HEVs. In order to be able to compare HEV power values with those by ICE or motor-driven vehicles only, these HEVs measured power values at axle/wheel need to be transformed to a power level based on engine and/or motor shaft output level. In order to be able to perform this power transformation by calculation, it is necessary to take the gearbox system efficiency factor at maximum HEV system propulsion power into account. The gearbox system efficiency factor, η_{gearbox} , indicates the efficiency value for **the mechanical power** transfer for propulsion **from input, P_{in} , to output, P_{out} , of the gearbox system representing the following equation:**