# Input for HEV power determination From Japan

# analysis of revisited JARI test results with K factors (Revised)

## **Reviewed Validation Results by JARI**

Yaris HEV

	アクア				
	TP1(MAX)	TP1(SUS)	TP2(MAX)	TP2(SUS)	6.10
battety power	16.6	14.2	16.6	14.2	Bat
engine power	54.9	55.2			TV
Vehicle power			63.2	62.9	By H
0.8	68.2	66.6	78.9	78.6	-
0.82	68.5	66.8	77.0	76.7	
0.84	68.9	67.1	75.2	74.9	
0.86	69.2	67.4	73.4	73.1	
0.88	69.5	67.7	71.8	71.5	
0.9	69.8	68.0	70.2	69.9	
0.92	70.2	68.3	00.0	68.4	
0.94	70.5	68.6	67.2	66.9	
0.96	70.8	68.8	65.8	65.5	
0.98	71.2	69.1	64.4	64.2	
1	71.5	69.4	63.2	62.9	

2 Battery power-1kW コエンバンハーカ 9 By Hub dynamo.

#### OEM provided K1: 0.86

TP1(max)=54.9(ICE)+16.6(REESS)x**0.86**=69.2(kW) If TP1=TP2 then **K2= 0.91** (default value: 0.93)



#### procedure

- 1. Calculate TP1 with K1 provided by OEM
- 2. Calculate K2 , Premise: TP1 = TP2

## **Reviewed Validation Results by JARI**

Fit HEV

	フィット   TP1(MAX) TP1(SUS) TP2(MAX) TP2(SUS)   14.1 14.1 14.1 14.1   79.1 79.1 87.2 87.2   90.3 90.3 109.0 109.0   90.6 90.6 106.4 106.4   91.2 91.2 91.2 101.4   91.5 91.5 99.1 99.1   91.8 91.8 96.9 96.9   92.0 92.0 94.8 94.8   92.3 92.3 92.8 92.8				
	TP1(MAX)	TP1(SUS)	TP2(MAX)	TP2(SUS)	_
battety power	14.1	14.1	14.1	14.1	В
engine power	79.1	79.1			
Vehicle power			87.2	87.2	В
0.8	90.3	90.3	109.0	109.0	
0.82	90.6	90.6	106.4	106.4	
0.84	90.9	90.9	103.8	103.8	
0.86	91.2	91.2	101.4	101.4	
0.88	91.5	91.5	99.1	99.1	
0.9	91.8	91.8	96.9	96.9	
0.92	92.0	92.0	94.8	94.8	
0.94	92.3	92.3	02.0	92.8	
0.96	92.6	92.6	90.9	90.9	
0.98	02 9	92.9	89.0	89.0	
1	<u> </u>	93.2	87.2	87.2	

Battery power-1kW

By Hub dynamo.

#### OEM provided K1: 0.86

TP1(max)=79.1(ICE)+14.1(REESS)x**0.86**=91.2(kW) If TP1=TP2 then **K2= 0.96** (default value: 0.97)



## **Reviewed Validation Results by JARI**



# Summary

	K1(OEM)	K2( If TP1=TP2)	Default K2
Yaris	0.86	0.91	0.93
Fit	0.86	0.96	0.97
Outlander	0.89	0.98	0.96

 The motor operating point of Yaris HEV and Fit HEV are near the maximum output point of the motor and its efficiency is relatively lower than the best efficient point. The motor efficiency of Outlander is slightly better than Yaris and Fit HEV because it is not operating near the maximum output due to the sharing power of the front and rear motors.

2.Assuming that TP1 = TP2, the value of K2 is different from the default value by 2 points from -2 points.

## Power determination

Discussion of TP1 and TP2 and various hybrid configurations

May 10, 2019

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EVE Power [	Determination Validation	Program - Matrix of	Hybrid Types			
NOVC-HEV	(a) Architecture	(b) Propulsion sources at	Examples exist?	Candidates	Models tested	Tested by
	Mild 48-Volt HEV	ICE only	Uncertain	?		
		ICE + Electric	Probably yes	?		
		Electric only	No	N/A	N/A	N/A
	BAS, CISG HEV (P0, P1) <sup>2</sup>	ICE only	Uncertain	?		
		ICE + Electric	Yes	various GM	2013 Malibu Eco	US EPA
		Electric only	No	N/A	N/A	N/A
		ICE only	Uncertain	?		
			Yes	various	1. Honda Fit HEV	Japan (2016)
Parallel pre-gearbox HEV (P2) <sup>3</sup>		ICE + Electric			2. Hyundai Ioniq	KATRI
					3. undisclosed Hyundai	JRC

# Suggestion

- Modify TP1:
  - Instead of "REESS voltage and current", specify "voltage and current at input to each inverter"
  - If only one inverter, it is the same as measuring at the battery
  - If two or more inverters, more instrumentation is necessary

#### Japan support but Propose to change the order.

Modify TP1:

If only one inverter, it is the same as measuring at the battery If two or more inverters, more instrumentation is necessary Instead of "REESS voltage and current", specify "voltage and current at input to each inverter"

It is anticipated that there is difficulty to attach the voltage and current sensors at input to each inverter, As an alternative to the external measurement, the manufacturer may use the onboard data if its accuracy is demonstrated to the responsible authority Example text:

- "The maximum system power may be determined by performing TP1 or TP2, subject to the following requirements:"
- "For each powered axle:
  - If the torque to the axle is provided by a single power-producing component, then the power to the axle may be determined by either TP1 or TP2.
  - Otherwise [this means that the torque to the axle is a combined torque, provided by more than one power-producing component]:
    - If the respective torque contributions of each power-producing component are transmitted to the axle via the same mechanical path, the power to the axle may be determined by either TP1 or TP2.
    - Otherwise [this means that one or more of the individual torque contributions are transmitted to the axle via different mechanical paths], the power to the axle shall be determined by either:
      - TP1, or
      - TP2, with the additional requirements:
        - (a) an average K2 representing the net efficiency of the combined mechanical path, and documentation to support; or
        - (b):
          - additional instrumentation by which the proportional torque provided by each powerproducing component may be determined, and
          - K2 factors representing the efficiency of the mechanical path followed by the torque from each power-producing component."

Comment to Matrix of hybrid types

- 1. Hybrid vehicle with "e-power" is only available to purchase in japan, but Japan(JARI) has no plan to conduct any other validation test .
- 2.Japan provided the limited information about e-power test result. Is it possible with this data to fill in the blank of Series hybrid architecture ?

3.I think the Parallel post-gear-box HEV can be covered by the Parallel post-gear-box PHEV result.