

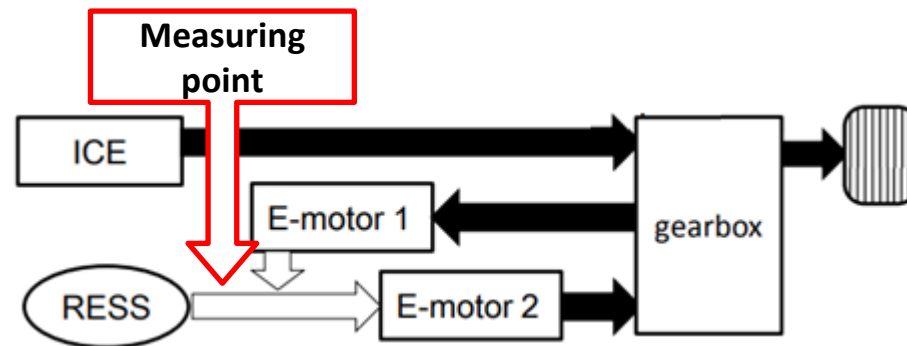
Proposal for system power determination for
HEVs
Japan
(24th EVE Meeting – 24-25th Oct. , 2017)

Background (Summary of the last session)

- In current situation, two candidate test procedures are there. The reflection of these procedures depends on actual test results which may be delivered during the validation program.

- TP1: REESS power based

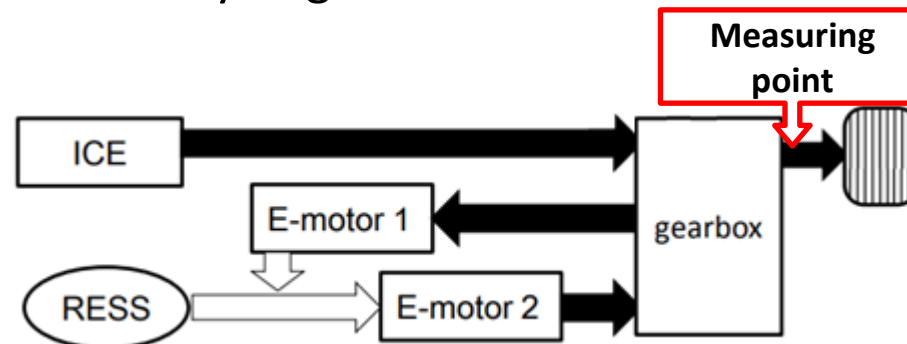
Transform efficiency of converter is considered.



Japan originally proposed TP1 for ISO.

- TP2: Gear box output axis power based

Transform efficiency of gear box is considered.

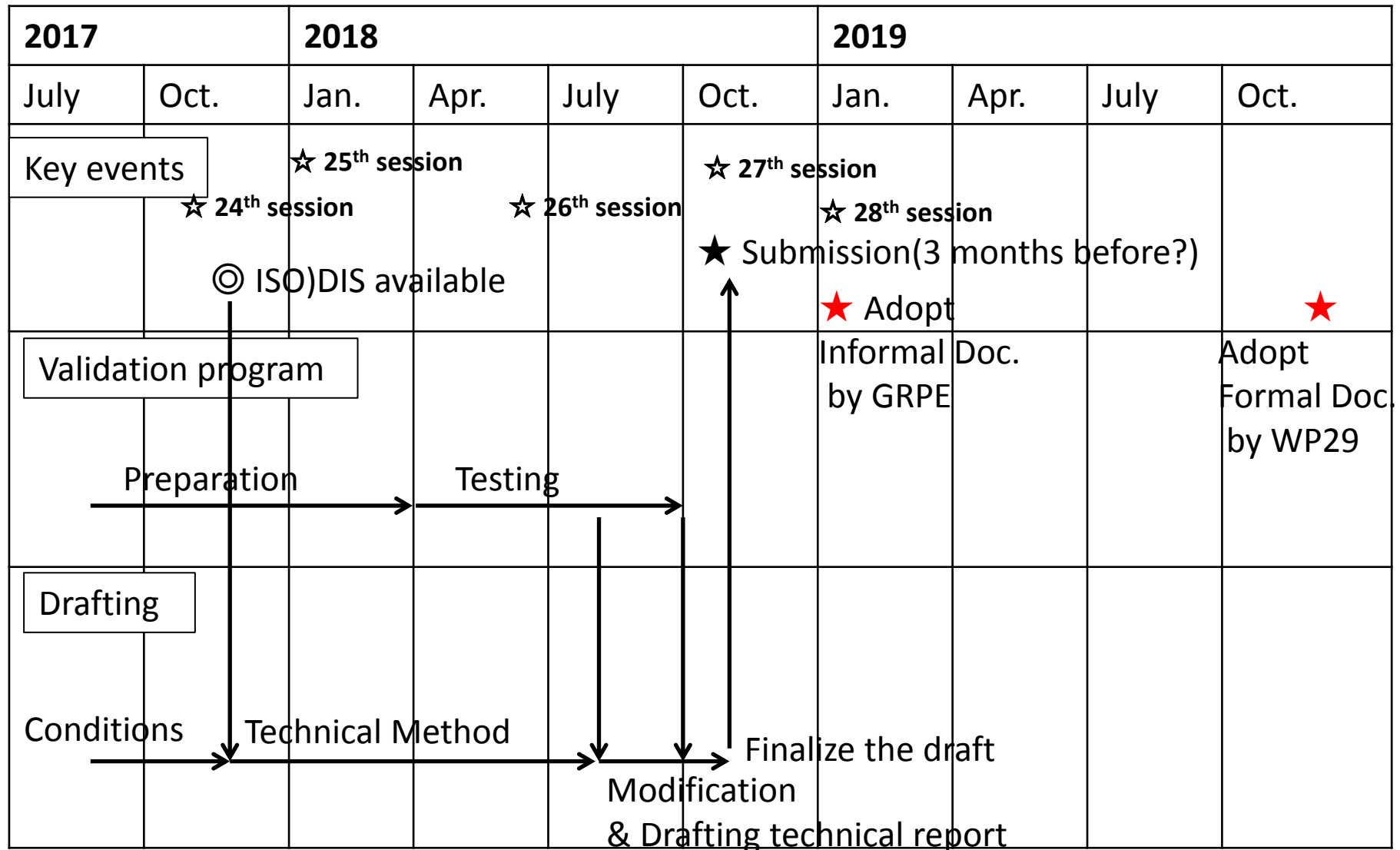


Background (Summary of the last session)

- Agreement with WLTP group
 - ISO test procedure can deliver the system power for 2s operation in 10s measurement.
 - >WLTP confirmed.

 - Adoption by WP29 in Nov. 2019 is EVE's target.
Adoption of informal document by GRPE in Jan. 2019 is required.
 - >WLTP confirmed

Schedule for EVE



Introduction of Japan's activity on system power determination

Outline 1

- DIS of ISO test procedure is already available. In current situation, TP1 and TP2 are represented.
- JARI(Japan) conducted tests for three hybrid vehicles with TP1 in order to validate its repeatability.

Outline 2

Test Sequence for the test program by JARI

1. Warm-up of the test vehicle (Driving the test vehicle on CDY for 20minutes at 60km/h) =>**6.8.2 in 20762**
2. Setting the level of SOC (Increase of SOC : Regenerating through the driving on CDY , Decrease of SOC : Motoring through the driving on CDY at 60km/h) =>**6.8.3&6.5. in 20762**
3. Accelerating the test vehicle until the system emits the highest power on CDY (CDY is controlled in fixed speed mode)
=>**6.8.5 in 20762**
4. Commanding maximum accelerator pedal for 10 seconds
=>**6.8.5 in 20762**
5. Decelerating the test vehicle toward 0km/h =>**6.8.6 in 20762**
6. Repeating the step from 1. to 5. in this sequence to obtain the maximum power

Calculation of System Power

Terms	Explanations	Discussion points
HEV system power	= ICE power [kW] + Converted RESS power [kW]	
ICE power [kW]	<p>The test results of measurements according to ISO1585 are necessary.</p> <p>ICE power is based on the measured engine speed and intake manifold pressure in inlet system or fuel flow rate, it shall be determined by the engine dynamometer test specified in international standards and/or legal requirements.</p> <p>The engine dynamometer test fuel shall be the same as in 6.3(= vehicle test).</p>	How EVE treat the reference of R85?
Converted RESS power [kW]	<p>= $(U_{\text{RESS}} [\text{V}] \times I_{\text{RESS}} [\text{A}] / 1000 - P_{\text{DCDC}}) \times K$</p> <p>$P_{\text{DCDC}}$ = Power to DC/DC converter for 12V auxiliaries (1,0kW or measured value) [kW]</p> <p>K=Conversion factor from electrical power to mechanical power (0,85 or measured value).</p>	

For JARI test, sampling frequency was 10Hz (reference:5.2.2 in 20762). Measured values were smoothed by the moving average for 2s.

Test Vehicles

Specification of test vehicles		2015		2016
		Vehicle A	Vehicle B	Vehicle C
Vehicle	Length × width × height m	3.99×1.69×1.44	3.95×1.69×1.52	4.69×1.80×1.71
	Vehicle Weight kg	1080	1160	1820
	Gross vehicle weight kg	1355	1435	2095
	Test vehicle kg	1340	1360	1933
Engine	displacement L	1.496	1.496	1.998
	Maximum power kW	54	81	87
Motor	Maximum power kW	45	22	60/60
*HEV system	Maximum HEV system power kW	73	101	-

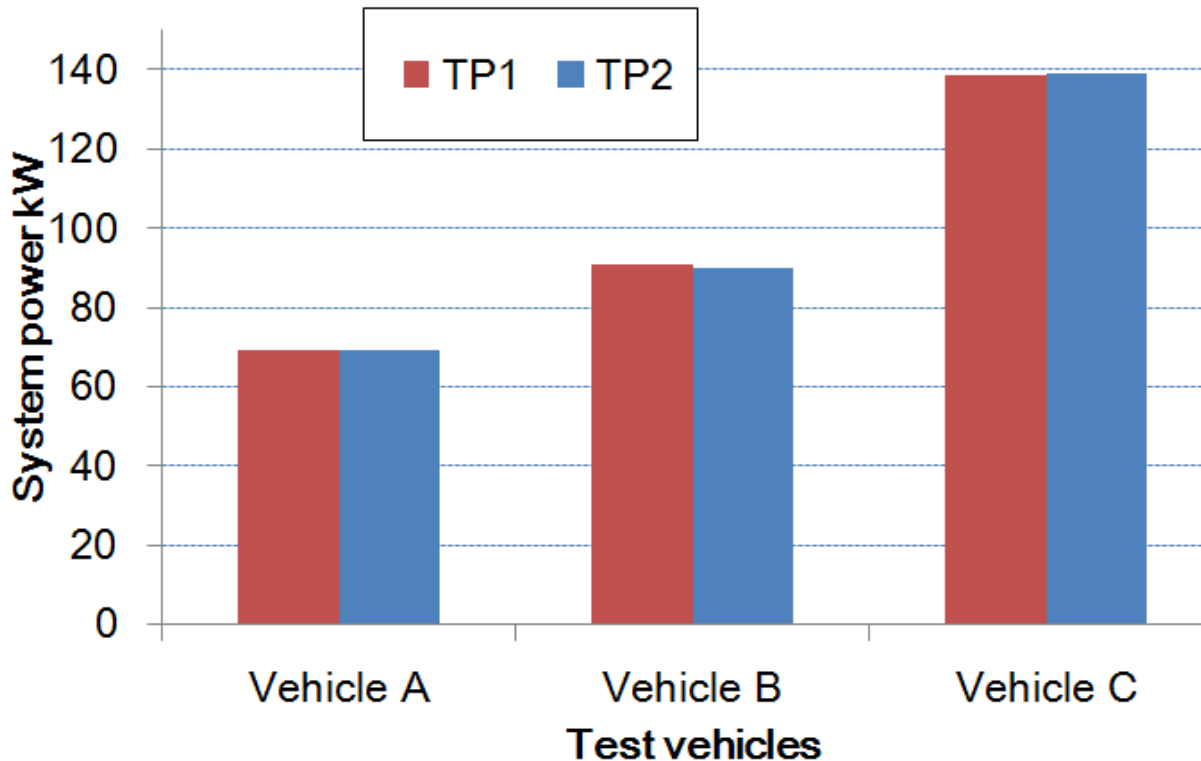
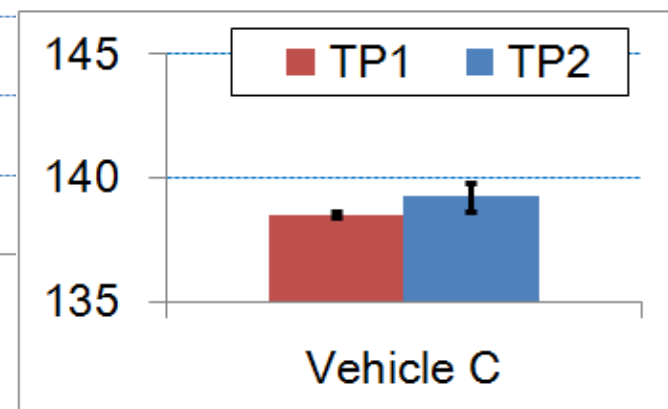
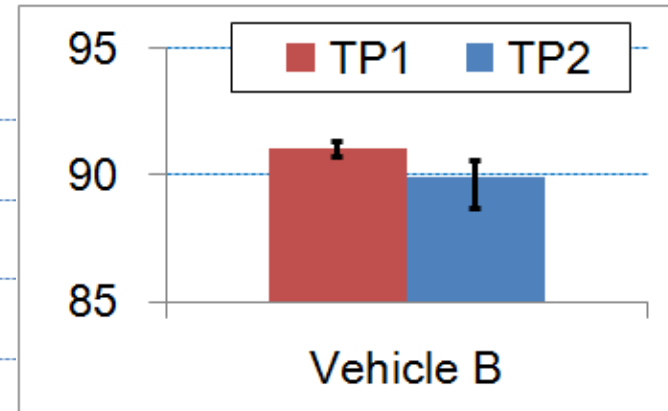
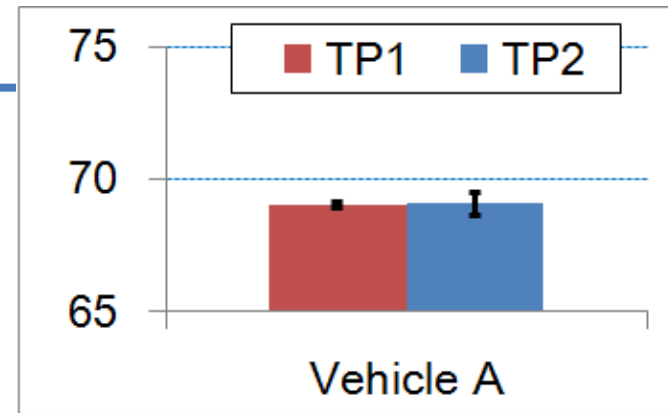
*HEV system : OEM's catalog information



Fluctuation of Measured System Power between TP1 and TP2

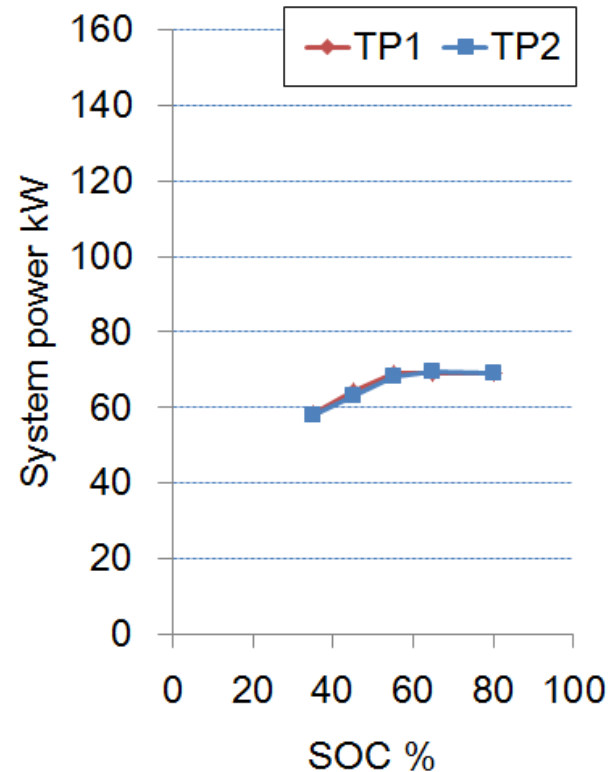
The error bar was delivered through 4 times repetition of the same test condition for each vehicle. **The fluctuation of measured power with TP1 was smaller than that of TP2 non-dependending on the type of vehicles.**

NOTICE: TP1 with Chassis Dynamo/TP2 with Hub Dynamo

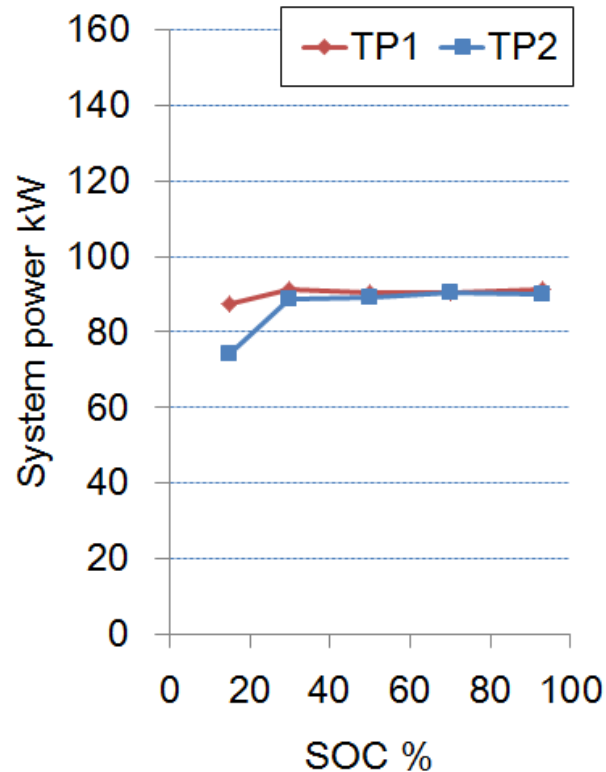


System Power Dependency on Initial SOC

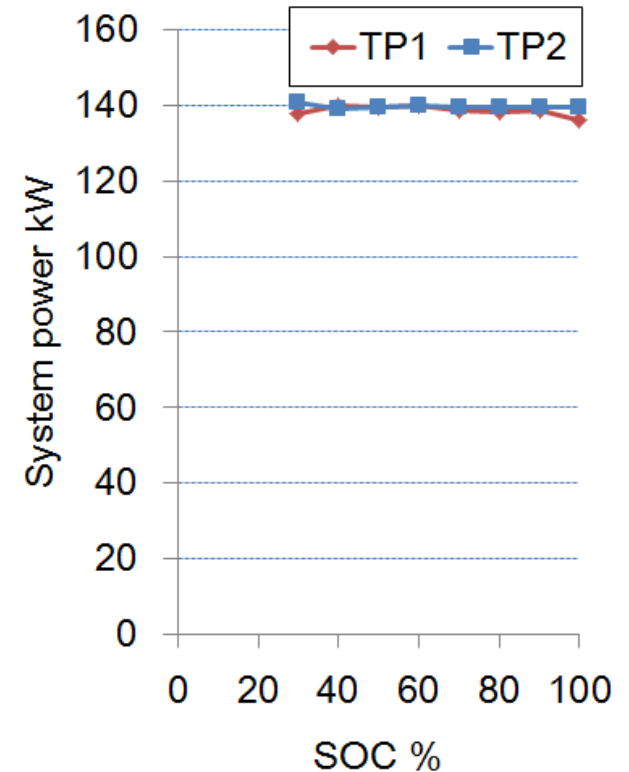
The system power's dependency on the initial setting of SOC was investigated.



Vehicle A



Vehicle B



Vehicle C

These results suggest that requirements to reduce the flexibilities of system power for initial SOC conditions should be considered.

Japan's proposal

Summary(Proposal)

JARI conducted tests with TP1 and TP2. The results represented that TP1 delivered good repeatability with small deviation.

Proposal:

Japan proposes that EVE should start drafting with TP1 because the JARI's results are already available.

Suggestions for drafting

Test conditions in ISO DIS20762

Major terms	Requirements	Info
Preparation of vehicle(6.3)	The tire pressure shall be adjusted in accordance with the vehicle manufacturer's recommendation or the owner's manual. The vehicle lubricants and levels specified by the manufacturer shall be used.	Reference: R85
Initial charge of RESS(6.5)	The RESS of the vehicle shall be charged to the SOC specified by the vehicle manufacturer. After the SOC has been set, the current and voltage measurements shall be started. The SOC shall be adjusted by regenerative braking or by charging from the external electric power supply or by discharging via electric driving. Additional requirement will be necessary. >The initial SOC shall be set to obtain the maximum system power.	WLTP allows the use of external electric power supply??
Vehicle soak(6.6)	The vehicle shall be soaked in accordance with the vehicle manufacturer's recommendation, or regional standards or legal requirements. Unless otherwise specified, the temperature shall be $(25 \pm 5) ^\circ\text{C}$.	
Auxiliary systems(6.7)	During the test, auxiliary systems (for example: air-conditioning and heating etc.) which are not contributing to vehicle propulsion, may be turned off.	

Test conditions in ISO DIS20762

Major terms	Requirements	Info
Vehicle conditioning(6.8.2)	The vehicle shall run at the speed of 60km/h at the vehicle road load for at least 20 minutes or with the vehicle manufacturer's recommendation.	
Vehicle operation(6.8.4)	Run the vehicle at a fixed speed in accordance with the vehicle manufacturer's recommendation. Otherwise, to be able measuring the maximum power value, a sufficient number of tests shall be carried out at the appropriately varied speeds of chassis dynamometer (see 6.10).	
Maximum power test(6.8.5)	The maximum accelerator pedal command shall be given by either pedal position or by vehicle communication network for duration of at least 10 s.	
End of vehicle running(6.8.6)	After the measurement according to 6.8.5 the vehicle and measurement devices except those for the current and voltage shall be stopped.	

These test conditions and requirements should be defined in line with WLTP. The drafting team should keep it in mind.

Accuracy of measurement items in ISO DIS20762

Item	Units	Accuracy	Remark
Engine speed	min ⁻¹	± 0.5 %	
Intake manifold pressure	Pa	± 50 Pa	Intake manifold pressure means inlet depression in ISO1585.
Barometric pressure	Pa	± 100 Pa	
Fuel flow rate	g/s	± 3 %	Only used for compression-ignition engines
Voltage	V	± 0.5 %	
Current	A	± 0.5 %	The current transducer shall have a minimum accuracy of 0.5 % of the measured value or 0.1 % of the maximum value of the scale.
Room temperature	K	± 2 K	<div style="border: 1px solid black; padding: 10px; color: red; text-align: center;"> <p>Accuracy for equipment should be defined in line with WLTP. The drafting team should keep it in mind.</p> </div>
Chassis dynamometer roller speed	km/h	± 0.5 km/h or ± 1 %, whichever is greater	
Time	s	± 0.01 s	
Axle/wheel rotational speed	s ⁻¹	± 0.05 s ⁻¹ or ± 1 %, whichever is greater	
Axle/wheel torque	Nm	± 6 Nm or ± 0.5 %, whichever is greater	