TEST PROCEDURE FOR FUEL CONSUMPTION RATE AND EXHAUST EMISSIONS OF HEAVY-DUTY HYBRID ELECTRIC VEHICLES USING HARDWARE-IN-THE-LOOP SIMULATOR SYSTEM

Kokujikan No. 281 of March 16, 2007

1. Scope

This test procedure shall apply to ordinary-sized motor vehicles and small-sized motor vehicles (except motor cycles (including motor cycles with sidecar)) with a gross vehicle weight exceeding 3.5 tons (except motor vehicles used exclusively for carriage of passengers with a riding capacity of 10 persons or less), which are equipped as their power unit with an engine fuelled by diesel fuel and with an electric motor, and applies to measurements of fuel consumption rate when those motor vehicles are driven according to the city running mode method, intercity highway running mode method and urban running mode method, and to measurements of emission mass of carbon monoxide, total hydrocarbons, non-methane hydrocarbon, methane, nitrogen oxide, carbon dioxide, and particulate matters that are contained in the exhaust emissions generated and emitted from their exhaust pipes when they are driven according to the JE05-mode method, as well as to measurements of the work done generated when they are driven according to the JE05-mode method, in cases where those measurements are conducted using a Hardware-in-the-Loop Simulator system for heavy-duty hybrid electric vehicles (hereinafter referred to as the “HILS system”).

2. Test Procedure

Construct the HILS system. Control the HEV model for approval (referring to one of the components constituting the HILS system, which is a software model simulating the functions, mechanism, and other systems of the hybrid electric vehicle. Hereinafter the same.) by inputting parameters obtained by component tests of engine torque characteristics, etc. of electric hybrid heavy-duty vehicles. Calculate the engine operating conditions by performing a simulated running (referring to the running with the HEV model for approval, etc. actuated on the HILS system according to the reference vehicle speed pattern. Hereinafter the same.) thus measuring the fuel consumption rate and the exhaust emissions. An HILS system whose HEV model for approval has been verified shall be used.

(1) HILS system

The HILS system to be used for this test procedure shall be in

accordance with “Chapter 1 HILS System for Heavy-Duty Hybrid Electric Vehicles.”

(2) Test procedure for components such as engine torque characteristics

The test procedure for components such as engine torque characteristics to be inputted in the HILS system shall be in accordance with “Chapter 2 Test Procedure for Engine, Electric Motor and Electric Storage Device of Heavy-Duty Hybrid Electric Vehicles.”

(3) Test Procedure for fuel consumption rate

The test procedure for fuel consumption rate of heavy-duty hybrid electric vehicles using the HILS system shall be in accordance with “Chapter 3 Test Procedure for Fuel Consumption Rate of Heavy-Duty Hybrid Electric Vehicles.”

(4) Test Procedure for exhaust emissions

The test procedure for exhaust emissions from heavy-duty hybrid electric vehicles using the HILS system shall be in accordance with “Chapter 4 Test Procedure for Exhaust Emissions from Heavy-Duty Hybrid Electric Vehicles.”

(5) Verification test procedure for HILS system

The verification test procedure for checking accuracy of the operation, etc. of the HEV model for approval shall be in accordance with “Chapter 5 Verification Test Procedure for HILS System for Heavy-Duty Hybrid Electric Vehicles.”

3. Others

As the test procedures for fuel consumption rate and exhaust emissions of heavy-duty hybrid electric vehicles, the “Test Procedure for Fuel Consumption Rate of Heavy-Duty Hybrid Electric Vehicles” (Kokujikan No. 278 of March 31, 2006) and “Measurement Procedure for Exhaust Emissions from Heavy-Duty Hybrid Electric Vehicles” (Kokujikan No. 60 of June 30, 2004) may continue to be used as before.

CHAPTER 1 HILS SYSTEM FOR HEAVY-DUTY HYBRID ELECTRIC VEHICLES

1. Outline of HILS System for Heavy-Duty Hybrid-Electric Vehicles

The HILS system consist of, as shown in Figure 1, the HILS hardware, the HEV model for approval and its input parameters, the driver model and the reference vehicle speed pattern, and the hybrid ECU of the test motor vehicle (hereinafter refereed to as the “actual ECU”) and its power supply.

Fig. 1 Outline of HILS System for Heavy-Duty Hybrid Electric Vehicle
(See next page)

2. Softwares to be Used

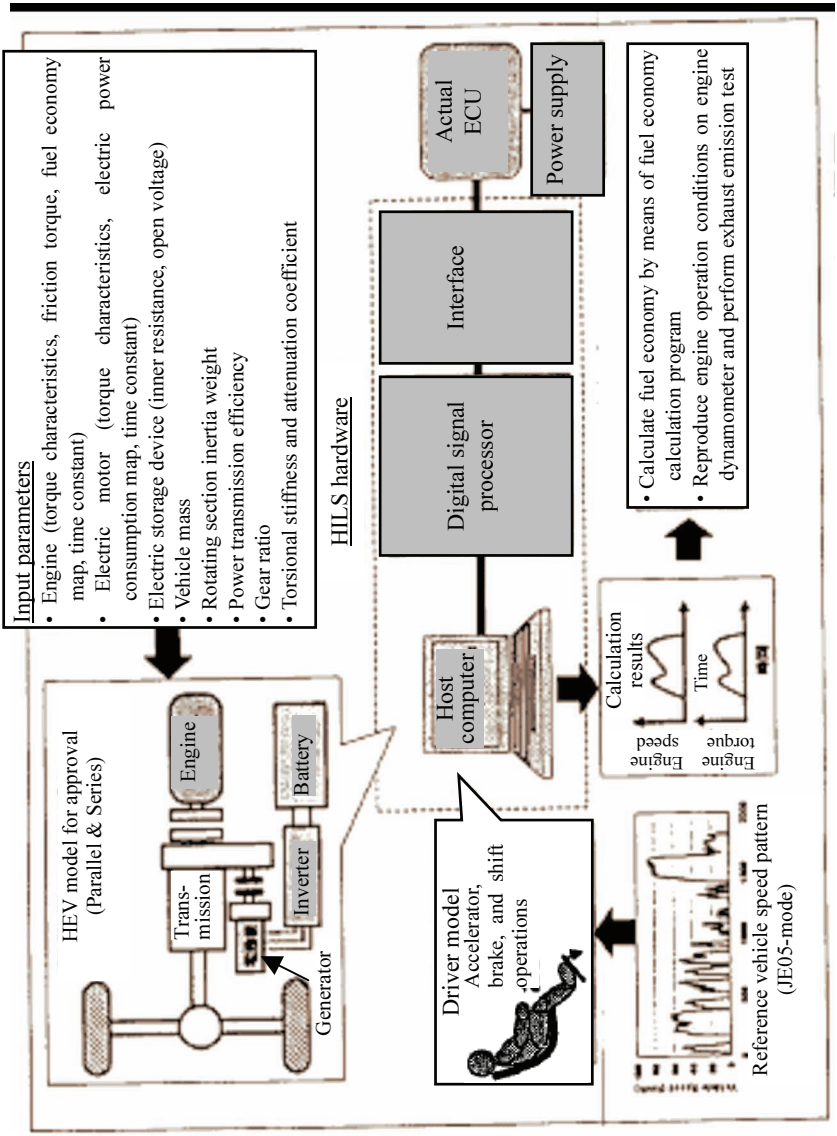
The softwares necessary for this test method are, in addition to an HEV models for approval (including the reference ECU model for the Software-in-the-Loop Simulator (hereinafter referred to as the “SILS”)) corresponding to parallel and series heavy-duty hybrid electric vehicles, a fuel economy calculation-assisting program capable of calculating fuel economy based on the engine revolution speed and torque that are obtained from the simulated running using the HILS system, as well as the Hermite interpolation program that can be used when creating table data of the input parameters, etc. The softwares to be used are enumerated below:

- Parallel HEV model for approval
- Series HEV model for approval
- Fuel efficiency calculation-assisting program
- Hermite interpolation program

3. HILS Hardware

The HILS hardware shall have the signal types (ADIO, PULSE, CAN) and number of channels that are sufficient for constructing the interface between the HILS hardware and the actual ECU, and shall be checked and calibrated.

Fig. 1


Input parameters
• Engine (torque characteristics, friction torque, fuel economy map, time constant)
• Electric motor (torque characteristics, electric power consumption map, time constant)
• Electric storage device (inner resistance, open voltage)
• Vehicle mass
• Rotating section inertia weight
• Power transmission efficiency
• Gear ratio
• Torsional stiffness and attenuation coefficient
HEV model for approval (Parallel & Series)
Engine
Trans-mission
Inverter
Battery
Generator
HILS hardware
Host computer
Digital signal processor
Interface
Actual ECU
Power supply
Driver model
Accelerator, brake, and shift operations
Calculation results
Engine torque
Engine speed
Time
• Calculate fuel economy by means of fuel economy calculation program
• Reproduce engine operation conditions on engine dynamometer and perform exhaust emission test
Reference vehicle speed pattern (JE05-mode)

4. Actual ECU

The hybrid ECU of the test motor vehicle shall be used as the actual ECU. Furthermore, in the case of a motor vehicle equipped with a transmission ECU, this may be used as the hybrid ECU at the same time.

5. Driver Model, etc.

The driver model makes the HEV model for approval to operate in such a way as to achieve the reference vehicle speed by generating accelerator, brake and shift signals, and is actuated by the PID control, etc. In addition, the driver model may be replaced by dot-sequential data of accelerator, brake and shift signals.

6. HEV Model for Approval

The HEV model for approval shall be created based on the specifications specified in Paragraphs 6–1 through 6–4 below. Thereafter, the input parameters pertaining to individual test motor vehicles shall be inputted and the parameter setting for the input / output shall be performed according to the system of heavy-duty hybrid electric vehicles.

6–1 Engine model

The engine model calculates the generated torque of the engine from the engine torque command value, throttle valve opening angle or injection amount command value and the torque map in relation to the revolution speed. The torque generated by the engine, the starter torque and the torque loaded on the engine from outside are combined. The revolution speed is determined from the combined torque and the inertia moment of the engine's rotating sections. If the actual ECU required revolution control or revolution limit, the PID control function inside the engine model controls the engine revolution speed. In addition, the idle revolution speed can be adjusted by the input for adjustment. It stops by the input of Ignition OFF or Fuel Cut ON signal (Fig. 2).

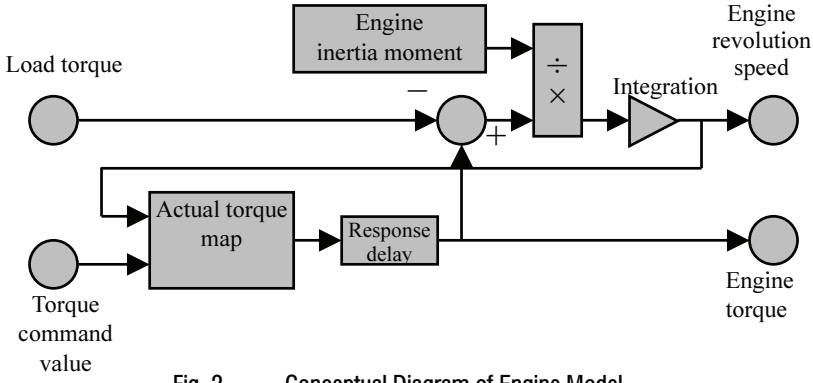


Fig. 2 Conceptual Diagram of Engine Model

6–2 Electric motor model

The electric motor model has the voltage as its parameter. It has the torque map and the electric power consumption map in relation to the electric motor torque command value and the revolution speed. While driving or controlling the vehicle based on the electric motor command value inputted from the actual ECU, it calculates electric power consumption. The electric motor torque command value corresponds to the switching of power running / regeneration (Fig. 3).

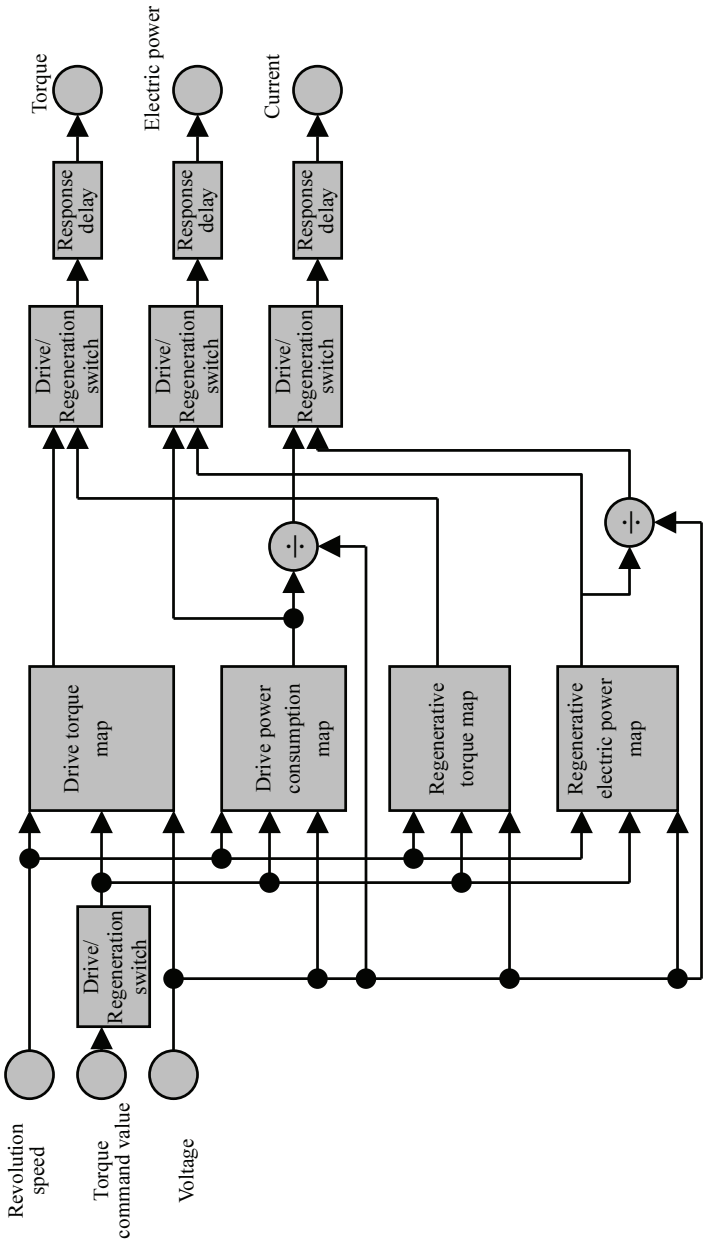


Fig. 3 Conceptual Diagram of Electric Motor Model

6–3 Electric storage device model

The charged / discharged power and the state of a charge of the nickel hydride battery or lithium-ion battery shall be calculated by using the following formulas: In this case, the state of charge shall be calculated by current integration assuming that the Coulomb efficiency is 100 %. Both the open voltage and internal resistance of the battery shall be calculated from the map in relation to the state of charge, since they change according to the state of charge (Fig. 4).

$$P = V_s I = (V_o - R_i I) I$$

$$SOC = SOC_{initial} - \int_0^t \frac{I}{C_{nominal} \times 3600} dt \times 100$$

where:

P	:	Charged / discharged power	(W)
Vs	:	Terminal voltage	(V)
I	:	Electric current	(A)
Vo	:	Open voltage	(V)
Ri	:	Internal resistance	(Ω)
SOC	:	State of charge	(%)
$SOC_{initial}$	:	Initial state of charge	(%)
$C_{nominal}$	:	Rated capacity	(Ah)
t	:	Elapsed time	(s)

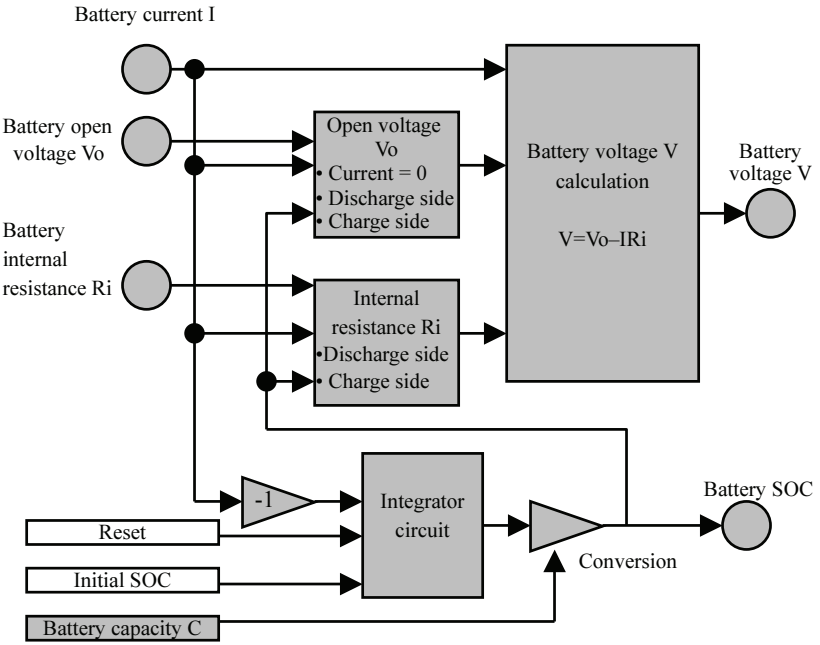


Fig. 4 Conceptual Diagram of Electric Storage Device Model

6–4 Vehicle • power train system model

The vehicle / power train system model consist of the running resistance model, the transmission • vehicle model and the clutch for electric motor model. This not only calculates the running resistance but also gives and receives the torque between the engine model and the electric motor model, generating the vehicle speed.

(1) Running resistance model

This model calculates the running resistance from the vehicles speed, using the following formula:

$$R = \mu_r mg + mg\sin\theta + \mu_a AV^2 g$$

where:

R	:	Running resistance	(N)
μ_r	:	Rolling resistance coefficient	(kg/kg)
m	:	Vehicle mass at time of test	(kg)
$\mu_a A$	:	Air resistance coefficient × frontal projected area	$(kg/(km/h)^2)$
V	:	Vehicle speed	(km/h)
g	:	Acceleration of gravity	(m/s^2)
θ	:	Longitudinal gradient	(rad)

Here, the acceleration of gravity is assumed to be 9.80665 (m/s^2).

(2) Transmission • vehicle model

This model calculates the torque transmitted to the vehicle from the engine torque, electric motor torque, reduction ratio at each speed, final reduction ratio, gear efficiency and inertia moment of each component. From this torque and the load torque consisting of the running resistance of the vehicle, vehicle mass, inertia moment of the tyres and axles, the acceleration of the vehicle shall be determined. The torque transmitted from the transmission input shaft to its output shaft is calculated from the clutch stroke and gear transmission efficiency, and inertia moment is set for each speed.

(3) Clutch model

This model simulates the clutch operation between the engine and transmission, and calculates the transmission (including the electric motor) • input shaft revolution speed, and the load torque to the engine. It adds the torque inputted from the electric motor and calculates the input shaft revolution speed from the inertia of the clutch section including the electric motor.

7. Reference ECU Model for SILS

The reference ECU model for SILS is used for the purpose of operation check of the HEV model for approval. The signals given from the reference ECU model for SILS to the HEV model for approval are command values of

the torques of the engine and electric motor, of the gear change, clutch, lock up of hydraulic coupling, etc. Moreover, the reference ECU model for SILS shall be ancillary to the HEV model for approval, and shall be arranged in such away that it can be used by switching from the actual ECU with a selector switch.

8. Operation Check of HEV Model for Approval

The operation check of the HEV model for approval shall be performed by the following method:

Input the SILS reference parameters (Attached Sheet 1 in the case of the parallel type, and Attached Sheet 2 in the case of the series type) in the HEV model for approval, and control the HEV model for approval using the ancillary reference ECU model for SILS. Confirm that the calculation result of each parameter satisfies the criterion shown in Table 1 in relation to the SILS reference calculation result (Attached Sheet 3 in the case of the parallel type, and Attached Sheet 4 in the case of the series type). However, this provision shall not apply if changes have been made in the construction and constant of each component model of the HEV model for approval.

Table 1 Criterion for Operation Check of HEV Model for Approval by Means of Reference ECU Model for SILS

Verification items	Criterion		
	Slope	Intercept	Determination coefficient
Vehicle speed, electric motor revolution speed • torque, electric storage device voltage • current • state of charge, engine revolution speed • torque	0.9995 – 1.0005	±0.05 % or less of the maximum value	0.995 or more

9. Construction of Interface

In the HILS system, where the actual ECU, driver model and HEV model for approval are stored, connection is made by means of the interface shown in Table 2 and Table 3 for parallel and series heavy-duty hybrid electric vehicles, respectively. In addition, level tuning of the signal and the fail release correspondence, etc. can be handled by using a unique interface conversion model according to the system of the heavy-duty hybrid electric vehicle.

Table 2 Interface Specifications of Parallel HEV Model for Approval

Model	Input / output from model side		Designation	Unit	Remarks
Power train model	Input–1	BR_TQ_N	Mechanical brake force	N	Tyre contact area
	Input–2	CL_q_1	Clutch stroke	%	
	Input–3	shift_p	Gear position command	–	
	Input–4	Motor_CL	Motor clutch	–	ON/OFF
	Input–5	Clutch_position	Clutch (motor) position	–	
	Input–6	F_coup_on	Fluid coupling SW	–	ON/OFF
	Input–7	Lock_up	Lock up SW	–	ON/OFF
	Input–8	koubai	Transverse slope	%	
	Output–1	Speed_Out	Vehicle speed	km/h	
	Output–2	RL_N_Out	Running resistance	N	
	Output–3	Distance	Travel distance	km	
	Output–4	KASOKUDO	Acceleration	m/s^2	
	Output–5	Ni_rpm	Input shaft revolution speed	r/min	
	Output–6	Nc_rpm	Counter shaft revolution speed	r/min	
	Output–7	Eg_Fuka_Nm	Load torque	Nm	Motor control included
	Output–8	No_rpm	Output shaft revolution speed	r/min	
	Output–9	Nt_rpm	Turbine revolution speed	r/min	
	Output–10	shift_p	Shift position	–	
RESS model	Input–1	RESS_change	RESS selector switch	–	
	Input–2	Accessory1_ON	Accessory 1 SW	–	ON/OFF
	Input–3	Accessory2_ON	Accessory 2 SW	–	ON/OFF
	Output–1	RESS_SOC	State of charge (SOC)	%	

Model	Input / output from model side		Designation	Unit	Remarks
	Output–2	RESS_Voltage	RESS voltage	V	
	Output–3	RESS_Current	RESS current	A	
	Output–4	RESS_Power	RESS power	W	
Engine model	Input–1	Sireikaido	Torque command value	Nm	Also, %, mm^3/st, etc.
	Input–2	ACCkaido	Throttle valve opening angle	%	
	Input–3	ACC_switch	Torque command switching	–	0/1
	Input–4	IG_In	Ignition	–	ON/OFF
	Input–5	ST_In	Starter	–	ON/OFF
	Input–6	Fuel_cut	Fuel cut	–	ON/OFF
	Input–7	EXHB_In	Exhaust brake	–	ON/OFF
	Input–8	Rev_demand	Demanded revolution speed	rpm	
	Input–9	Rev_control_demand	Revolution control demand	–	ON/OFF
	Input–10	Rev_limit_demand	Revolution limit demand	–	ON/OFF
	Input–11	Tq_limit_demand	Torque limit demand	–	ON/OFF
	Input–12	Tq_limit_rate	Torque limit rate		
	Input–13	Tq_limit_switch	Torque limit SW	–	ON/OFF
	Input–14	Idl_rpm_adjust	Idle-speed adjustment input		
	Output–1	Ne_out	Engine revolution speed	r/min	
	Output–2	Fuel_Consumption	Fuel consumption rate	L	
	Output–3	EgDriveTq	Generated engine torque	Nm	
	Output–4	EgLossTq	Friction torque	Nm	
	Output–5	EgMaxTq	Engine maximum torque	Nm	
	Output–6	Eng_Tq	Engine torque	Nm	
	Output–7	Eng_Tq_rate	Engine torque rate		

Model	Input / output from model side		Designation	Unit	Remarks
	Output–8	Eng_Tq_rate2	Engine torque rate 2		
	Output–9	Loss_Tq_rate	Friction torque rate		
	Output–10	Loss_Tq_rate2	Friction torque rate 2		
	Output–11	Driver_demand_rate	Driver demand torque rate		
	Output–12	DRV_demand_Inj	Driver demand injection amount		
	Output–13	ISC	Fuel injection amount for idle-speed control		
	Output–14	EgDriveTq_woLoss	Engine torque except accessory loss	Nm	
	Output–15	Eg_Tq_map_sirei	Engine torque map command value		
Electric motor model	Input–1	Tq_Ref	Torque command value	Nm	Also, %, etc.
	Input–2	Ref_Rev	Commanded revolution speed	r/min	
	Input–3	Command_change	Torque command method change	–	0/1
	Input–4	Reduction_SW	Regeneration switch	–	0/1
	Input–5	Reduction_ON	Motor mode	–	0/1/2/3
	Output–1	Motor_Tq	Generated motor torque	Nm	Motor only
	Output–2	Motor_Tq_fb	Motor feedback torque	Nm	Motor only
	Output–3	Motor_Rev	Motor revolution speed	r/min	Motor only
	Output–4	Motor_Current	Motor consumption current	A	Discharge+/charge-
	Output–5	Motor_Power	Motor electric power consumption	W	Discharge+/charge-
	Output–6	MotorDriveTqMax	Motor maximum drive torque	Nm	
	Output–7	MotorRegenTqMax	Motor maximum regenerative torque	Nm	

66 points in total (30 points of input, 36 points of output)

Table 3 Interface Specifications of Series HEV Model for Approval

Model	Input / output from model side		Designation	Unit	Remarks
Power train model	Input–1	BR_TQ_In	Mechanical brake force	N	Tyre contact area
	Input–2	Command_change	Torque command method change	–	0/1
	Input–3	Reduction_SW	Regeneration switch		0/1
	Input–4	Reduction_ON	Motor mode	–	0/1/2/3
	Input–5	ECU_Tq_ref_In	ECU command torque	Nm	
	Input–6	koubai	Transverse slope	%	
	Output–1	Motor_Current	Electric current	A	Discharge+/charge
	Output–2	Vehicle_Speed	Vehicle speed	km/h	
	Output–3	Road_Load	Running resistance	N	
	Output–4	Distance	Travel distance	km	
	Output–5	Motor_Speed	Motor revolution speed	r/min	
	Output–6	Motor_Tq	Motor drive torque	Nm	
	Output–7	Motor_Power	Motor electric power consumption	W	-
	Output–8	Kasokudo	Acceleration	m/s^2	
	Output–9	MotorDriveTqMax	Motor maximum drive torque	Nm	
	Output–10	MotorRegenTqMax	Motor maximum regenerative torque	Nm	
	Output–11	Motor_Tq_ref	Motor torque command value	Nm	
RESS model	Input–1	RESS_change	RESS selector switch	–	
	Input–2	Accessory1_ON	Accessory 1 SW	–	ON/OFF
	Input–3	Accessory2_ON	Accessory 2 SW	–	ON/OFF
	Output–1	RESS_SOC	State of charge (SOC)	%	
	Output–2	RESS_Voltage	RESS voltage	V	

Model	Input / output from model side		Designation	Unit	Remarks
	Output–3	RESS_Power	RESS power	W	
	Output–4	RESS_Current	RESS current	A	
Engine generator model	Input–1	Sireikaido	Torque command value	Nm	Also, %, mm^3/st, etc.
	Input–2	ACCkaido	Throttle valve opening angle	%	
	Input–3	ACC_switch	Torque command switching	–	0/1
	Input–4	Keyon_In	Ignition	–	ON/OFF
	Input–5	ST_In	Starter	–	ON/OFF
	Input–6	Fuel_cut	Fuel cut	–	ON/OFF
	Input–7	EXHB_In	Exhaust brake	–	ON/OFF
	Input–8	Rev_demand	Demanded revolution speed	rpm	
	Input–9	Rev_control_demand	Revolution control demand	–	ON/OFF
	Input–10	Rev_limit_demand	Revolution limit demand	–	ON/OFF
	Input–11	Tq_limit_demand	Torque limit demand	–	ON/OFF
	Input–12	Tq_limit_rate	Torque limit rate		
	Input–13	Tq_limit_switch	Torque limit SW	–	ON/OFF
	Input–14	Idl_rpm_adjust	Idle-speed adjustment input		
	Input–15	ECU_ref_Power	Generator output command	kW	
	Input–16	ST_Tq	Starter torque	Nm	
	Input–17	Engine_Start_active	Engine start active switch		ON/OFF
	Input–18	Gen_ref_rev	Generator revolution speed command	rpm	
	Input–19	Eng_start_flag	Engine start flag	–	
	Input–20	Eng_stop_flag	Engine stop flag	–	
	Output–1	Eng_Ne	Engine revolution speed	r/min	
	Output–2	Fuel_Consumption	Fuel consumption rate	L	

Model	Input / output from model side		Designation	Unit	Remarks
	Output–3	EgDriveTq	Generated engine torque	Nm	
	Output–4	EgLossTq	Friction torque	Nm	
	Output–5	EgMaxTq	Engine maximum torque	Nm	
	Output–6	Eng_Tq_rate	Engine torque rate		
	Output–7	Eng_Tq_rate2	Engine torque rate 2		
	Output–8	Loss_Tq_rate	Friction torque rate		
	Output–9	Loss_Tq_rate2	Friction torque rate 2		
	Output–10	Driver_demand_rate	Driver demand torque rate		
	Output–11	DRV_demand_Inj	Driver demand injection amount		
	Output–12	ISC	Fuel injection amount for idle-speed control		
	Output–13	EgDriveTq_woLoss	Engine torque except accessory loss	Nm	
	Output–14	Eg_Tq_map_sirei	Engine torque map command value		
	Output–15	Gen_Power	Generator power	kW	
	Output–16	Gen_Tq	Generator torque	Nm	
	Output–17	Gen_Current	Generator current	A	
	Output–18	Gen_speed	Generator revolution speed	rpm	

62 points in total (29 points of input, 33 points of output)

Table 4 Example of Switch Setting and Output Items of Parallel HEV Model for Approval

Parallel HEV model input

Model	Symbol name	Designation	Unit	Application	Sample	
HEV model (Top)	RESS_change	Electric storage device selecting switch	–	0: Battery model 1: Capacitor model	Fixed value	0
HEV model (Top) Power train model	Cluch_position	Motor clutch	–	0: No 1: Yes	Fixed value	0
Power train model	F_coup_ON	Fluid coupling	–	0: No 1: Yes	Fixed value	0
Power train model	LockUp_in	Lock up	–	0: No 1: Yes	Fixed value	0
	koubai	Slope information	%	Inputting slope pattern	Pattern	–
	BR_N_in	Mechanical brake force	N	Mechanical brake	Control value	–
	CL_p_Percent	Clutch stroke	%	Disengagement/ engagement of clutch	Control value	–
	shift_p_in	Shift position	–	Inputting shift pattern	Pattern	–
Engine model	Eng_ST_in	Starter signal	–	Engine start	Control value	–
	EXHB_In	Exhaust brake	–	0: Inactive 1: Active	Fixed value	0
	EgASR_ON	Revolution speed control demand	–	0: Inactive 1: Active	Fixed value	0

Model	Symbol name	Designation	Unit	Application	Sample	
	Rev_limit_demand	Revolution speed limit demand	–	0: Inactive 1: Active	Fixed value	0
	Tq_limit_demand	Engine torque limit demand	–	0: Yes 1: No	Control value	–
	FC	Fuel cut	–	0: No demand to cut 1: Demanded to cut	Fixed value	0
	ACC_switch	Accelerator input selector switch	–	Accelerator command selection 0: % 1: mm^3/st	Fixed value	0
	Tq_limit_switch	Engine torque limit demand function selecting switch	–	Torque limit demand setting 0: Non-use 1: Use	Fixed value	1
	EgASR_Ref	Demanded revolution speed	rpm	Revolution command	Control value	Not set
	Acc_ref	Throttle valve opening angle command	%	Throttle valve opening angle	Control value	–
	Sireikaido	Fuel injection amount command	mm^3/st	Injection amount	Control value	Not set
	Tq_limit_rate	Engine torque command value	%	Engine torque limit demanded value	Control value	–
	Idle_rpm_adjust	Idle-speed adjustment input		Idle-speed adjustment		Not set
Electric motor model	Motort_CL_In	Motor clutch stroke	%	Disengagement/ engagement of motor	Fixed value	0

Model	Symbol name	Designation	Unit	Application	Sample	
				clutch		
	Motor_cont_mode	Motor mode	–	Motor mode setting 0: OFF 1: Power running 2: Regeneration 3: Revolution control	Fixed value	2
	Command_change	Motor torque command value code selecting switch	–	0: signed 1: unsigned	Fixed value	0
	Reduction_switch	Regeneration switch	–	O: Regeneration switch signal effective 1: Automatic switching to motor torque command value	Fixed value	1
	MotorRev_ref_rpm	Demanded motor revolution speed	rpm	Motor revolution command	Control value	Not set
	MotorTqRef_Nm	Motor torque demanded value	Nm	Motor torque commanded value	Control value	–

Parallel HEV model output

Model	Symbol name	Designation	Unit
Power train model	Speed_Out	Calculated vehicle speed	km/h
	Nc_rpm_Out	Counter shaft revolution speed	rpm
	No_rpm	Output shaft revolution speed	rpm

Model	Symbol name	Designation	Unit
	G_m_P_s2	Vehicle acceleration	m/s2
	Ni_rpm_Out	Input shaft revolution speed	rpm
	Ni_rpm	Turbine shaft revolution speed	rpm
Engine model	Ne_rpm_Out	Engine revolution speed	rpm
	Fuel	Fuel injection amount	L
	DemandTqDrive_1	Driver demand torque rate	0–1
	Q_DRV_DEM	Driver demand injection amount	L
	EgFrictionTq_1	Friction torque rate	
	Eng_Tqeff_1	Engine torque rate	
	ISC	Idle-speed control	
Electric motor model	Motor_tq_Out	Motor torque	Nm
	Motor_rev_Out	Motor revolution speed	rpm
	Current_Out	Current value	A
	Motor_tq_Nm	Motor torque	Nm
	MotorDriveTqMax	Motor maximum drive torque	Nm
	MotorRegenTqMax	Motor maximum regenerative torque	Nm
Battery model	Voltage_Out	Voltage value	V
	BATT_SOC_Percent	SOC	%
	BATT_POWER_W	Electric power consumption value	W

10. Input Parameters

Input parameters for engine torque characteristics, electric motor torque • electric power consumption characteristics and electric storage device internal resistance • open voltage shall be subjected to Paragraphs 10–1 through 10–3 below. Input parameters for those other than these shall be subjected to Paragraphs 10–4 through 10–10.

10–1 Engine torque characteristics

The parameter for the engine torque characteristics shall be the table data obtained in Paragraph 3 “Test Procedure for Engine” of Chapter 2. However, values equivalent to or lower than the minimum engine revolution speed may be added. In addition, the engine model accessory torque map shall not be used at the time of the approval test.

10–2 Electric motor torque • electric power consumption characteristics

The parameter for the electric motor torque • electric power consumption characteristics shall be the table data obtained in Paragraph 4 “Test Procedure for Electric Motor” of Chapter 2. However, characteristics value at a revolution speed of 0 min^{-1} may be added.

10–3 Internal resistance • open voltage of electric storage device

The parameter for the internal resistance • open voltage of the electric storage device shall be the table data obtained in Paragraph 5 “Test Procedure for Electric Storage Device” of Chapter 2.

10–4 Transmission efficiency

(1) The transmission efficiency of the transmission shall be 0.98 for a direct transmission, and 0.95 for others.

(2) The transmission efficiency of the final reduction gear shall be 0.95.

10–5 Rolling resistance coefficient and air resistance coefficient

The rolling resistance coefficient and air resistance coefficient shall be calculated by the following formulas: Here, the rolling resistance coefficient and air resistance coefficient of route buses or general buses shall be the value obtained by multiplying by 0.680 the value calculated using the following formulas:

$$\mu_r = 0.00513 + \frac{17.6}{W}$$

$$\mu_a A = 0.00299 B \cdot H - 0.000832$$

where:

μ_r	:	Rolling resistance coefficient	(kg/kg)
$\mu_a A$	:	Air resistance coefficient × frontal projected area	(kg/(km/h)^2)
W	:	Vehicle mass at time of test	(kg)
		In the case of a truck, etc.: {Vehicle kerb mass + maximum loading capacity / 2 + 55}	(kg)
		In the case of a route bus or general bus: {Vehicle kerb mass + riding capacity × 55 / 2}	(kg)
		In the case of a tractor: {Vehicle kerb mass (tractor + trailer) + maximum loading capacity / 2 + 55}	(kg)
B	:	Overall width	(m)
H	:	Overall height	(m)

10–6 Inertia moment of rotating sections

Different inertia moment of the rotating sections shall be used for respective conditions for the HILS verification test pursuant to Chapter 5 and for the approval test, as specified below:

(1) At the time of the HILS verification test: The inertia moment of each rotating section shall be in accordance with the provisions of the test procedures provided for in Paragraph 4–1 “Test procedure” of Chapter 5.

(2) At the time of the approval test: The inertia moment of the section from the gear on the driven side of the transmission to the tyres shall be set in such a way that the mass equivalent to this rotating section may become 7 % of the vehicle kerb mass. The inertia moment of the

section from the engine to the gear on the driving side of the transmission shall be the design value.

10–7 Maximum transmitted torque

For the maximum transmitted torque of the clutch and the synchronizer, the design value shall be used.

10–8 Torsional stiffness and attenuation coefficient

The torsional stiffness and attenuation coefficient shall be 5000 Nm/rad and 300 Nms/rad for the drive shaft, 60000 Nm/rad and 40 Nms/rad for the propeller shaft, and 2000 Nm/rad and 20 Nms/rad for the clutch torsion spring section of the transmission. However, they may be changed if vibrations take place.

10–9 Engine model response delay block

The delay time in the engine model response delay block shall be 0.01 second, and its time constant shall be 0.01 second.

10–10 Gear-change period

The gear-change period for a manual transmission shall be one second.

11. Gear Change Method

Gear positions at the start, acceleration and deceleration during the approval test shall be the respective gear positions specified below according to the types of heavy-duty hybrid electric vehicles enumerated below: Furthermore, since heavy-duty series hybrid electric vehicles have no transmission, no gear positions are specified for them.

(1) Heavy-duty parallel hybrid electric vehicles fitted with a manual transmission and an automatic transmission with torque converter (AT): Gear positions pursuant to the provisions of the calculation program for the fuel consumption rate of heavy-duty motor vehicles provided for in Attached Table 6 (8), Test Procedure for Fuel Consumption Rate of Heavy-Duty Motor Vehicles (TRIAS 5–8–2006) of the “Type Approval Test Procedures” (Jisha No. 669 of October 20, 1971), or to the provisions of the “Measurement Procedure for Exhaust Emissions from Heavy-Duty Hybrid Electric Vehicles” (Kokujikan No. 60 of June 30, 2004).

(2) Heavy-duty parallel hybrid electric vehicles fitted with an automated manual transmission (AMT): Gear positions of the automatic gear shifting by means of the actual transmission ECU control. However, the gear positions specified in Item (1) may be used.

CHAPTER 2 TEST PROCEDURE FOR ENGINE, ELECTRIC MOTOR AND ELECTRIC STORAGE DEVICE OF HEAVY-DUTY HYBRID ELECTRIC VEHICLES

1. Scope

This test procedure applies to the test procedure for the HILS system components for obtaining parameters of the engine, electric motor and electric storage device, which are to be inputted in the HILS system and used to calculate the engine operating conditions in Chapters 3 and 4.

Moreover, with respect to engines, electric motors and storage batteries of heavy-duty hybrid electric vehicles which cannot be tested according to this provision, provisions shall be laid down separately, as required, at the stage when motor vehicles equipped with the said devices are available for use.

2. Definitions

Definitions and abbreviations of terms used in this test procedure shall be subjected to the provisions of Attachment 41 “Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles” (hereinafter referred to as the “Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles”) to the “Announcement That Prescribes Details of Safety Regulations for Road Vehicles” (Ministry of Land, Infrastructure and Transport Announcement No. 619 of 2002), as well as of Attached Table 6 (8), Test Procedure for Fuel Consumption Rate of Heavy-Duty Motor Vehicles (TRIAS 5–8–2006. Hereinafter referred to as “Measurement Procedure for Heavy-Duty Motor Vehicles Fuel Economy”) of the “Type Approval Test Procedures” (Jisha No. 669 of October 20, 1971).

3. Test Procedure for Engine

As the input parameters for the HILS system the engine torque characteristics, the engine friction loss, auxiliary brake, and engine fuel economy map shall be determined. The test method shall be as prescribed below:

3–1 Test engine

The test engine shall be in accordance with the provision of Paragraph 4 “Test Engine” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

3–2 Test fuel

The test fuel shall be in accordance with the provision of Paragraph 5 “Test Fuel” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

3–3 Accuracy, calibration, etc. of measuring devices

The engine dynamometer, etc. shall be in accordance with the provision of Paragraph 6–2 “Accuracy, calibration, etc. of measuring devices” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

3–4 Test room and atmospheric conditions related to test

The test room and atmospheric conditions related to the test during the measurements of the engine torque characteristics provided for in Paragraph 3–5 and of the engine fuel economy map provide for in Paragraph 3–7 shall be in accordance with the provision of Paragraph 7 “Test Room and Atmospheric Conditions Related to Test” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

3–5 Measurement of engine torque characteristics

The engine torque characteristics of the test engine shall be obtained by the method provided for in Paragraphs 3–5–1 and 3–5–2 below:

3–5–1 Range of engine revolution speed for measurement

The range of engine revolution speed for measuring the engine torque characteristics shall be from the minimum engine revolution speed to the maximum engine revolution speed given below:

(1) The minimum engine revolution speed shall be the idling revolution speed of the engine in a warmed-up state.

(2) The maximum revolution speed shall be as follows:

① In the case of engines without a governor, the maximum engine revolution speed shall be equal to or more than either 105 % of the revolution speed at which the maximum output was measured or the engine revolution speed exceeding the engine revolution speed at which the maximum output was measured and at which a drop of 3 % in relation to the said output took

place, whichever is smaller.

② In the case of engines with a governor, the maximum revolution speed shall be equal to or more than either the unloaded maximum revolution speed that was measured or the engine revolution speed at which the engine torque drops to zero in the condition where the engine torque command value and other command values related to the engine torque (hereinafter referred to as the "engine command values") such as the throttle valve opening angle and fuel injection amount are full-open, whichever is smaller.

3–5–2 Measurement of engine torque characteristics

The engine torque characteristics in relation to the engine command values shall be measured after the test engine has been thoroughly warmed up until the coolant temperature, lubricant temperature and lubricant pressure stabilize. The measurement shall be carried out according to the following method:

(1) The engine torque shall be measured, after confirming that the shaft torque and revolution speed of the test engine have stayed around a constant value for one minute, by reading out the braking load or shaft torque of the engine dynamometer. If the test engine and the engine dynamometer are connected via a transmission, the read-out-value shall be divided by the transmission efficiency and gear ratio of the transmission.

(2) The engine revolution speed shall be measured by reading out the revolution speed of the crank shaft or the revolution speed of the engine dynamometer. If the test engine and the engine dynamometer are connected via a transmission, the read-out-value shall be multiplied by the gear ratio.

(3) The engine torque shall be measured under at least 80 conditions in total, for the engine revolution speed under 10 conditions within a range from the minimum engine revolution speed to the maximum engine revolution speed, and for the engine command values under 8 conditions within a range from the full-open to the full-close.

(4) In order to obtain the data of revolution speed at the same command values, all recorded data shall undergo the piecewise cubic Hermite interpolation, and 100 or more table data shall be prepared in total, with 10 or more of the engine revolution speed and 10 or more of the

engine command values. However, this provision shall not apply if Item (3) meets the condition of the said table data.

3–6 Measurement of engine friction torque

The friction torque of the test engine shall be measured by the method provided for in Paragraphs 3–6–1 and 3–6–2 below: Furthermore, this may be omitted if the measurement of the engine torque characteristics can simultaneously measure the engine friction torque.

3–6–1 Range of engine revolution speed for measurement

The range of engine revolution speed for measuring the friction torque of the engine shall be from the minimum engine revolution speed to the maximum engine revolution speed given below:

(1) The minimum engine revolution speed shall be the idling revolution speed of the engine in a warmed-up state.

(2) The maximum revolution speed shall be as follows:

① In the case of engines without a governor, the maximum engine revolution speed shall be equal to or more than either 105 % of the revolution speed at which the maximum output was measured or the engine revolution speed exceeding the engine revolution speed at which the maximum output was measured and at which a drop of 3 % in relation to the said output took place, whichever is smaller.

② In the case of engines with a governor, the maximum revolution speed shall be equal to or more than either the unloaded maximum revolution speed that was measured or the engine revolution speed at which the engine torque drops to zero in the condition where the engine command values are full-open, whichever is smaller.

3–6–2 Measurement of friction torque of engine

The measurement of the friction torque of the engine shall be performed, after the test engine has been thoroughly warmed up until the coolant temperature, lubricant temperature and lubricant pressure stabilize. The measurement shall be carried out by driving the test engine from the engine dynamometer and performing the measurement under at least 6 conditions within a range from the minimum engine revolution speed to the maximum

engine revolution speed. Moreover, the friction torque when the auxiliary brake system such as an exhaust brake is operative shall be measured if that brake is needed in the HILS system in addition to the engine brake.

3–7 Measurement of engine fuel economy map

The fuel economy map of the test engine shall be measured by the method provided for in Paragraphs 3–7–1 and 3–7–2:

3–7–1 Range of engine revolution speed for measurement

The range of engine revolution speed for measuring the engine fuel economy map shall be from the minimum engine revolution speed to the maximum engine revolution speed given below:

(1) The minimum engine revolution speed shall be the idling revolution speed of the engine in a warmed-up state.

(2) The maximum revolution speed shall be as follows:

① In the case of engines without a governor, the maximum engine revolution speed shall be equal to or more than either 105 % of the revolution speed at which the maximum output was measured or the engine revolution speed exceeding the engine revolution speed at which the maximum output was measured and at which a drop of 3 % in relation to the said output took place, whichever is smaller.

② In the case of engines with a governor, the maximum revolution speed shall be the loaded maximum revolution speed.

3–7–2 Measurement of engine fuel economy map

The engine fuel economy map shall be measured, after the test engine has been thoroughly warmed up until the coolant temperature, lubricant temperature and lubricant pressure stabilize. The measurement shall be carried out according to the following method:

(1) After confirming that the shaft torque and revolution speed of the test engine have stayed around a constant value for one minute, read out the braking load or shaft torque of the engine dynamometer. If the test engine and engine dynamometer are connected via a transmission, divide the read-out-value by the transmission efficiency and the gear ratio of the transmission. In addition, the transitional period between

the measurement points shall be approximately one minute.

(2) The engine revolution speed shall be measured by reading out the revolution speed of the crank shaft or the revolution speed of the engine dynamometer. Read out the indicated value if the measured value is within ±10 min^{-1} in relation to the indicated value. In addition, when the measured value exceeds ±10 min^{-1}, perform a resetting. If the test engine and engine dynamometer are connected via a transmission, the read-out-value shall be multiplied by the gear ratio.

(3) The measurement of the amount of fuel consumption shall be carried out by measuring the flow rate of the fuel in term of volume or mass, which shall be, in principle, accumulated for at least 40 seconds. The measurement shall be conducted down to a unit of 0.0001 L or lower. The engine revolution speed shall be measured under at least 6 conditions including the maximum shaft torque engine revolution speed and maximum output engine revolution speed, within a range from 5 % normalizing engine revolution speed to the maximum engine revolution speed, and the shaft torque shall be measured under at least 5 conditions within a range from the torque equivalent to approximately 5 % load to the torque in the full-load operating condition. Therefore, the fuel flow rate shall be measured under a total of at least 30 conditions and at the minimum engine revolution speed. Moreover, the fuel flow rate shall be converted to the volume at the fuel temperature of 288 K (15 °C), using the Table 2B “Table Showing Coefficients for Volume Conversion in Relation to Temperature of Fuel and Oil” of Annexed Table II of JIS K 2249-1987. In addition, if any difficulty is encountered in controlling the engine revolution speed and torque due to the capabilities, etc. of the test facilities, the engine revolution speed and torque shall be set within a controllable range.

4. Test Procedure for Electric Motor

As the input parameters for the HILS system, the torque map and electric power consumption map of the electric storage device (including those with a generator function. The same applies hereinbelow.) shall be determined. The test method shall be as prescribed below:

4–1 Test electric motor and controller

The test motor and controller shall be in the condition described below:

(1) The test motor and controller shall be serviced in accordance with the inspection and maintenance procedure, and thoroughly driven with the

power absorber connected thereto.

(2) The power supply shall be a direct-current constant-voltage power supply or battery, which is capable of supplying sufficient electric power for the necessary input power to the controller at the maximum output of the electric motor.

(3) The voltage applied to the controller shall be ± 5 % of the nominal voltage of the electric storage device in a vehicle.

(4) If characteristics of the electric storage device change due to a large voltage variation in the voltage applied to the controller, the test shall be conducted by setting 3 conditions for the applied voltage: the maximum, minimum and medium in its control.

(5) The wiring between the electric motor and the controller shall be subjected to their in-vehicle specifications. However, if its in-vehicle layout is difficult, the wiring may be altered within a range not improving the electric motor performance. In addition, the wiring between the controller and the power supply need not be subjected to their in-vehicle specifications.

(6) The cooling system shall be subjected to its in-vehicle specifications. However, if its in-vehicle layout is difficult, the piping may be altered, or a cooling system exclusively used on a bench may be used, within a range not improving its cooling performance.

(7) No transmission shall be installed. However, in the case of an electric motor that cannot be driven if it is separated from the transmission due to the vehicle configuration, or an electric motor that has difficulty in being directly connected to the power absorber, a transmission may be installed. In such a case, a transmission whose gear ratio and transmission efficiency are clear shall be used.

4–2 Accuracy, calibration, etc. of measuring devices

Measuring devices that have the following accuracies and have been checked, serviced and calibrated according to the predetermined handling procedures shall be used:

(1) The accuracy of the measuring device for the drive torque shall be ± 1 % or less of the maximum torque of the test motor. The accuracy of the measuring device for the revolution speed shall be ± 0.5 % or less of the maximum revolution speed of the test motor.

(2) The measurement accuracy of the input power of the controller shall be ± 2 % or less of the maximum value of measured power.

(3) The accuracy of the voltmeter shall be ± 1 % or less of the maximum value of measured voltage, and the accuracy of the ammeter shall be ± 1 m/s or less of the maximum value of measured current.

(4) The accuracy of the thermometer shall be ± 1 K (1 ºC) for indoor types, and ± 2 K (2 ºC) for those other than indoor types.

4–3 Test room

The test shall be conducted at an appropriate place in the test room, taking into account the influence of direct sunlight, and of the radiant heat and exhaust heat from the electric motor and the controller.

4–4 Measurement of electric motor torque map

The test motor shall be driven according to the method in Paragraph 4–4–1, and the measurement shall be carried out in connection with the measurement items in Paragraph 4–4–2.

4–4–1 Driving method

The test motor shall be driven after the power absorber has been thoroughly warmed up under the warm-up operation conditions specified by the manufacturer.

(1) The output of the test motor shall be set under at least 6 conditions for the positive side and the negative side, respectively, within a range of the electric motor torque command values from the full-close (0 %) to the full-open (100 %).

(2) The test revolution speed shall be set within a range of ± 1 % or ± 10 min^{-1}, whichever is larger, of the target revolution speeds that have been set under at least 6 conditions from the stopped state (0 min^{-1}) to the maximum design revolution speed. Moreover, the torque may be measured at the minimum revolution speed for a stable operation of the power absorber if its measurement in the stopped state (0 min^{-1}) is difficult.

(3) The driving shall be performed with the winding temperature and controller temperature during the test kept to the allowable values or

lower. Furthermore, the motor may be driven with low-power or stopped for the purpose of cooling, as required

(4) The cooling system may be operated with its maximum cooling capacity.

4–4–2 Measurement items

(1) The shaft torque shall be measured, after confirming that the shaft torque and revolution speed of the test motor have been stabilized, by reading out the braking load or shaft torque of the power absorber. If the test motor and the power absorber are connected via a transmission, the read-out-value shall be divided by the transmission efficiency and the gear ratio of the transmission.

(2) The test revolution speed shall be measured by reading out the revolution speed of the test motor output shaft or the revolution speed of the dynamometer. However, if the test motor and the power absorber are connected via a transmission, it may be measured by reading out the revolution speed of the power absorber and multiplying the read-out-value by the gear ratio.

(3) The input power of the controller shall be measured with a wattmeter measuring the electric power as a multiplication of the voltage and current. However, it may be measured by multiplying the input voltage by the input current that are measured with a direct-current voltmeter and direct-current ammeter, respectively.

(4) In the operating condition prescribed in Paragraph 4–4–1, the winding temperature and temperature of each section of the controller shall be measured as reference values, simultaneously with the measurement of the shaft torque at each test revolution speed.

(5) The measurement method for the temperature at each section of the electric motor shall be the implanted thermometer method. The number of elements in the implanted thermometer shall be 3 to 6, which shall be appropriately distributed in circumferential direction, and implanted in axial direction at the sites where the temperature is expected to be the highest. However, if this method is difficult in terms of measurement, the thermometer method may be used.

(6) The ambient temperature shall be measured at the start and end of the test. The coolant temperature (in the case of liquid-cooling) shall be measured only at the start of the test.

4–4–3 Calculation formulas

The shaft output of the electric motor shall be calculated by means of the following formula:

$$P = \frac{2\pi \cdot T \cdot N}{60 \times 1000}$$

where:

P : Electric motor shaft output (kW)

T : Electric motor shaft torque (N•m)

N : Electric motor revolution speed (min^{-1})

5. Test Procedure for Electric storage device

As the input parameters for the HILS system, the direct-current internal resistance • open voltage of the battery shall be obtained. The test method shall be as prescribed below:

5–1 Test procedure for internal resistance • open voltage of nickel hydride battery and lithium-ion battery

5–1–1 Test battery

The test battery shall be in the condition described below:

(1) The test battery shall be in in-vehicle condition, including unit batteries (module) or balancer, etc. If unit batteries are used for the test, the internal resistance • open voltage shall be calculated as follows:

- Inter-terminal internal resistance in in-vehicle condition = Inter-terminal internal resistance of a unit battery × number of unit batteries + connection resistance

- Inter-terminal voltage in in-vehicle condition = Inter-terminal voltage of a unit battery × number of unit batteries

Connection resistance: This refers to the resistance value to be added in in-vehicle condition, and the application value shall be used.

(2) As the test battery, one that has reached its rated capacity after repeating charging / discharging 5 times or less shall be used.

Rated capacity: The electric charge expressed in Cn (Ah) by the manufacturer. This is the electric quantity which can be released by the battery after fully charging it at an ambient temperature of 298 ± 2 K (25 ºC ± 2 ºC) according to the charging method specified by the manufacturer, then soaking it for 1 hour or more but not more than 4 hours under the said condition, and letting it discharge until it reaches the discharge termination condition which is, at 298 K (25 ºC) and with a constant current of In (A), 1.0 (V) per unit cell in the case of a nickel hydride battery, and a value specified by the manufacturer in the case of a lithium-ion battery.

$$I_n = \frac{C_n}{n}$$

where

I_n : Standard charging • discharging current (A)

C_n : n-hour rate of rated capacity published by manufacturer of battery (Ah)

n : n=3 (h) in case of nickel hydride battery, and n=1 (h) or n=3 (h) in case of lithium-ion battery

5–1–2 Accuracy, calibration, etc. of measuring devices

Measuring devices that have the following accuracies and have been checked, serviced and calibrated according to the predetermined handling procedures shall be used:

(1) The accuracy of the thermometer shall be ± 1 K (1 ºC) or less.

(2) The accuracy of the voltmeter shall be ± 1 % of the maximum value of measured voltage, and the accuracy of the ammeter shall be ± 1 % of the maximum value of measured current.

5–1–3 Test conditions

(1) The battery test environment shall be a place that is not influenced by direct sunlight from outside and by the radiant heat from other devices.

(2) The voltage shall be measured between the terminals of the unit battery or the terminals in the in-vehicle condition.

(3) The temperature measurement shall follow the method specified by the manufacturer. Or it shall be performed, as shown in Figures 1 and 2 below, in the condition not affected by the outside temperature, with the thermometer attached to the central part of the battery and covered with insulation.

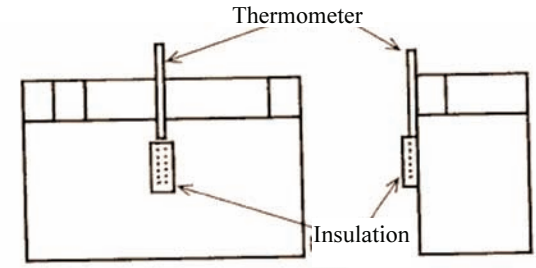


Fig. 1 Temperature Measurement Method for Rectangular Battery

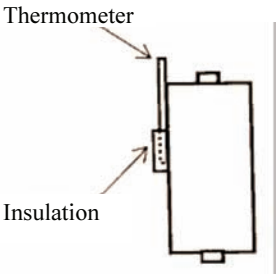


Fig. 2 Temperature Measurement Method for Cylindrical Battery

5–1–4 Current–voltage characteristic test

In this test, the voltage at the 10th second of discharging and charging with a constant current shall be measured by procedure given below:

(1) The test shall be conducted by changing the depth of discharge (100 % – state of charge %) within the range used for the JE05-mode. The depth of discharge shall be level 3 or more, and shall be set in such a way as to allow for interpolation.

(2) As for the depth of discharge, after fully charging the battery at an ambient temperature of 298 ± 2 K (25 ºC ± 2 ºC) according to the charging method specified by the manufacturer, it shall be soaked under the same condition. The adjustment shall be started 1 hour or more but not more than 4 hours thereafter. The adjustment shall be performed by changing the discharge time with a constant current In

(A). The depth of discharge (a %) is the state after discharging the battery at In (A) for (0.01 × a × n) hours. However, adjustment may be made by using the immediately preceding actually-measured battery capacity to calculate the discharge time for obtaining the targeted depth of discharge. Furthermore, if, after the completion of the current–voltage characteristic test at the first depth of discharge, an adjustment to the next depth of discharge is continuously performed, the adjustment may be made by calculating the discharge time from the present depth of discharge and the next depth of discharge.

(3) The battery temperature at the start of the test shall be 298 ± 2 K (25 ºC ± 2 ºC). However, 318 ± 2 K (45 ºC ± 2 ºC) may be selected by reporting in the application the actually-measured battery temperature at the time of the JE-05-mode (city running mode) driving equivalent to the in-vehicle condition.

(4) After adjusting the depth of discharge, soak the battery at the prescribed battery temperature at the star of the test. The test shall be started 1 hour or more but not more than 4 hours thereafter, and 16 hours or more but not more than 24 hours thereafter in the case of 45 ºC.

(5) The test shall be conducted according to the sequence shown in Fig.3:

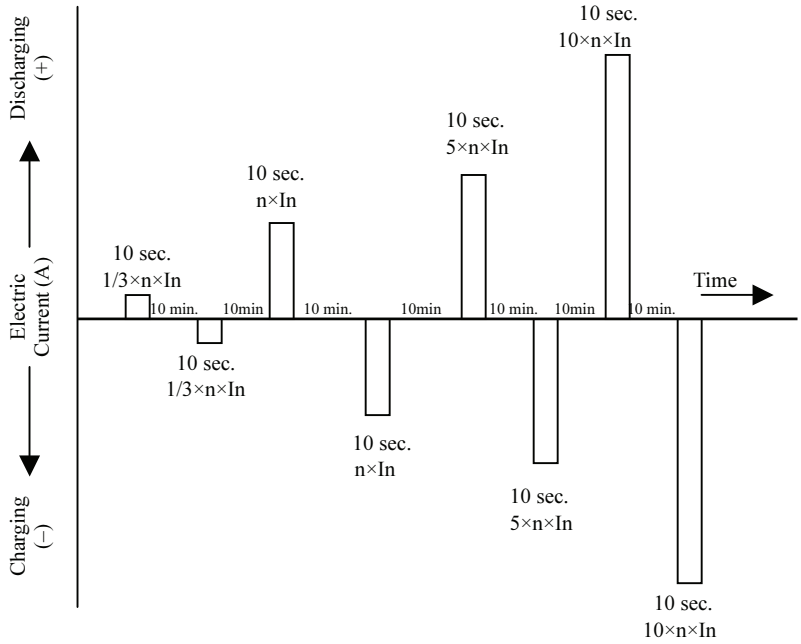


Fig. 3 Test Sequence of Current–Voltage Characteristic Test (Example: When rated capacity is less than 20 Ah)

(6) The battery voltage at the 10th second shall be measured by discharging and charging at each current specified for each category of the rated capacity posted in Table 1 below. The upper limit of the charging • discharging current shall be 200 (A). However, if the battery voltage at the 10th second exceeds the lower limit of discharging voltage or the upper limit of charging voltage, that measurement data shall be discarded.

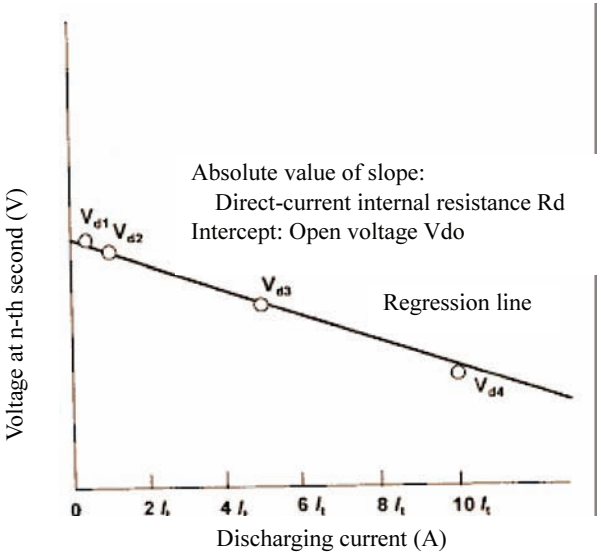
Table 1 Charging • Discharging Current for Each Category of Rated Capacity

Category of rated capacity	Charging • discharging current (A)			
Less than 20 Ah	1/3 × n × In	n × In	5 × n × In	10 × n × In
20 Ah or more	1/3 × n × In	n × In	2 × n × In	5 × n × In

(7) During the rest period, the battery shall be cooled off for at least 10 minutes. It shall be confirmed that the change of temperature is kept within + 2 ºC before moving onto the next discharging or charging.

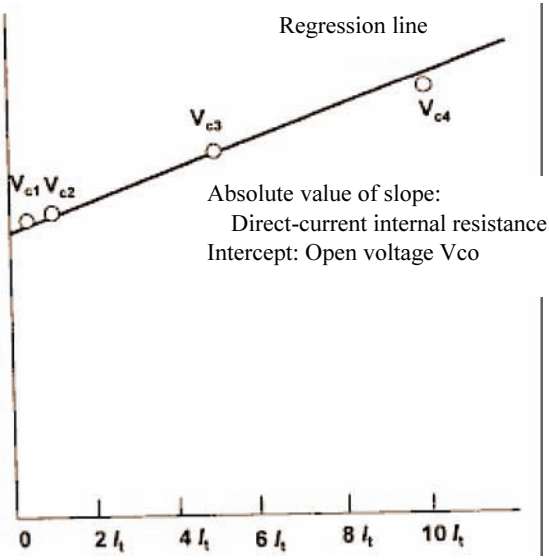
5–1–5 Calculation of direct-current internal resistance and open voltage

Use the measurement data to calculate the current–voltage characteristics that can be determined from each charging • discharging current (A) and their corresponding voltages Vd1 – Vd4, Vc1 – Vc4 (V) by means of the least-square method. From Figure 4, calculate the absolute value of the slope (direct-current inner pressure on the output side Rd) and the intercept (open voltage on the output side Vdo) of the regression line determined by means of the least-square method, and from Figure 5, determine the absolute value of the slope (direct-current inner pressure on the input side Rc) and the intercept (open voltage on the input side Vco) of the regression line determined by means of the least-square method.



Note: N=10

Fig. 4 How to Determine Internal Resistance and Open Voltage on Output Side

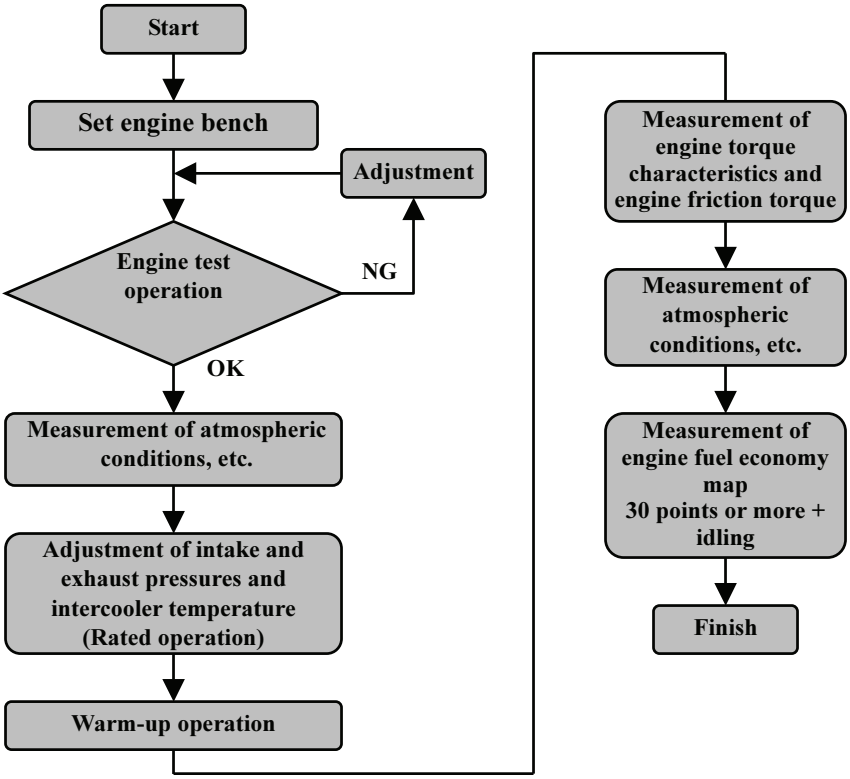


Note: N=10

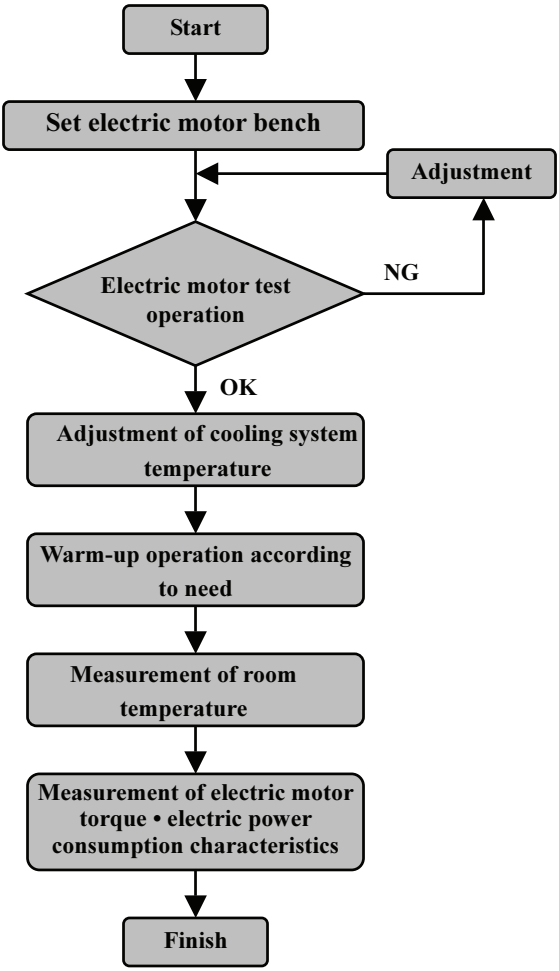
Fig. 5 How to Determine Internal Resistance and Open Voltage on Input Side

Appendix Test Procedures for Engine, Electric Motor and Electric Storage Device of Heavy-Duty Hybrid Electric Vehicles

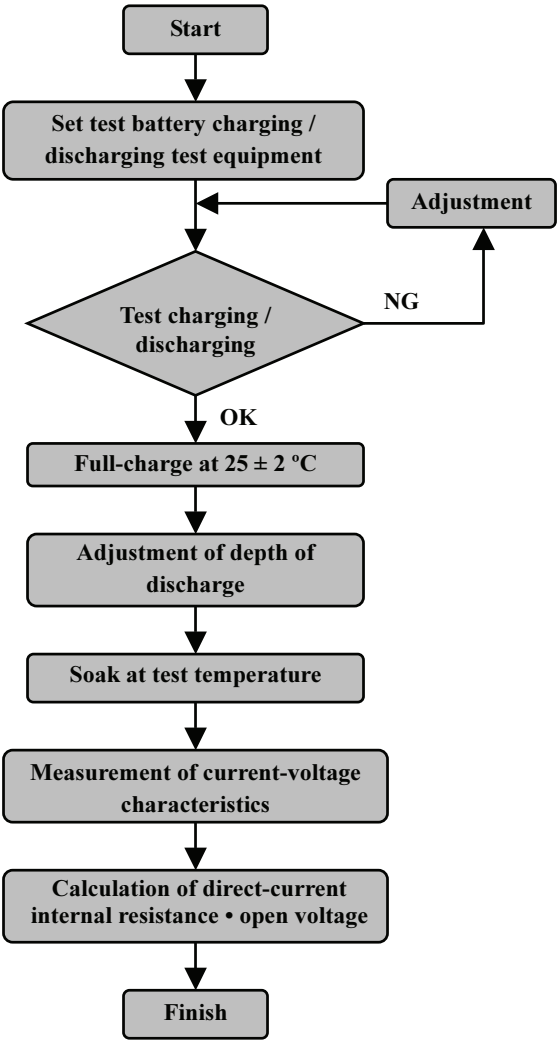
1. Test Procedure for Engine Torque Characteristics • Fuel Economy Map for HILS System



2. Test Procedure for Electric Motor Torque • Electric Power Consumption Characteristics for HILS System



3. Test Procedure for Internal resistance • Open Voltage of Ni–MH / Li–ion Battery for HILS System



CHAPTER 3 TEST PROCEDURE FOR FUEL CONSUMPTION RATE OF HEAVY-DUTY HYBRID ELECTRIC VEHICLES

1. Scope

This test procedure applies to the test procedure using the HILS system for fuel consumption rate of ordinary-sized motor vehicles and small-sized motor vehicles (except motor cycles (including motor cycles with sidecar)) with a gross vehicle weight exceeding 3.5 tons (except motor vehicles used exclusively for carriage of passengers with a riding capacity of 10 persons or less), which are equipped as their power unit with an engine fuelled by diesel fuel and with an electric motor, when they are operated according to the city running mode method, intercity highway running mode method and urban running mode method.

Moreover, with respect to motor vehicles equipped with a hybrid electric system that cannot be tested according to this provision, regulations shall be laid down, as required, at the stage when the motor vehicles concerned are available for use.

2. Definitions

Definitions of terms and abbreviations used in this test procedure shall be subjected to the provisions of the Measurement Procedure for Heavy-Duty Motor Vehicles Fuel Economy.

3. Calculation of Average Fuel Consumption Rate

3–1 Operation check of HILS system

Before calculating the fuel consumption rate, actuate the HEV model for approval by using the SILS reference ECU model and the SILS reference parameter, and make sure that the calculated values of the HILS system are within the tolerance. (See Chapter 1)

3–2 Construction of HILS system and verification of compatibility

Pursuant to the provisions of Chapter 1, construct the HILS system by using the actual ECU, driver model, unique interface conversion model according to the system of the heavy-duty hybrid electric vehicle, HEV model for approval, etc, which are the objects of examination. In the HEV model for approval, input the engine torque characteristics and engine friction torque, the electric motor electric power consumption • torque map, the

battery internal resistance • open voltage map that are measured pursuant to the provisions of Chapter 2, as well as the standard vehicle specifications (Attached Sheet 1), transmission, final reduction gear and tyre specifications according to the category of the gross vehicle weight of the heavy-duty hybrid electric vehicle concerned.

In accordance with Chapter 5, confirm the operation of the HEV model for approval and the accuracy of the simulated running.

3–3 Calculation of engine operating conditions by means of HILS system simulation running

Using the HILS system, perform simulated running in connection with the city running mode provided for in “Attached Sheet 2” to the Measurement Procedure for Heavy-Duty Motor Vehicles Fuel Economy, the intercity highway running mode provided for in “Attached Sheet 3” to the Measurement Procedure for Heavy-Duty Motor Vehicles Fuel Economy and urban running mode which corresponds to the period between the 644th second and 1410th second of the city running mode (hereinafter referred to as "each running mode"), thus calculating the engine operating conditions (revolution speed, torque) per 0.2 seconds or less.

Allowable errors in speed and time during the simulated running shall be, at any point during each running mode, within ± 2.0 km/h in speed and within ± 1.0 second in time, and shall be within the range of the coloured section in Figure 1. Moreover, if deviations are within the tolerance corresponding to the setting items posted in the left column of Table 1, they shall be deemed to be within the allowable errors. Time deviations at the times of start and gear change operations, however, shall not be included in the total cumulative time. In addition, this provision shall not apply to motor vehicles incapable of attaining the speeds of each running mode during the accelerations with their accelerator pedals fully depressed.

Table 1

Setting item	Tolerance
1. Tolerable time range for one deviation	1.0 second
2. Tolerable time range for the total cumulative value of time deviations	2.0 seconds

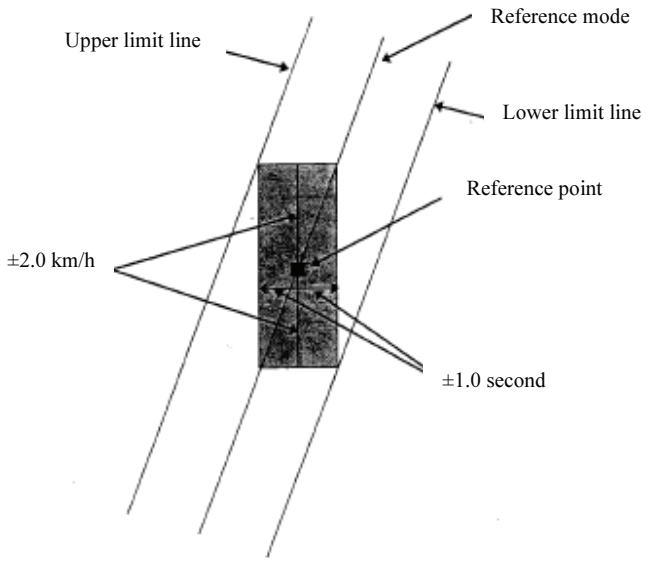


Fig. 1 Allowable Errors in Speed and Time during Simulated Running

3–4 Range of electricity balance for HILS system simulated running

The initial state of charge shall be adjusted so that the ratio of the energy conversion value of the electricity balance to the energy of the consumed fuel, which is calculated pursuant to Paragraph 3–5, may satisfy the following formulas:

$$\left|\Delta E / C\right| < 0.003$$

$$\Delta E = \Delta Ah \times V_{nominal} \times 3600$$

$$C = Q \times \rho \times Hu$$

where:

ΔE : Energy conversion value of electricity balance (J)

C : Energy conversion value of cumulative amount of fuel consumption (J)

ΔAh	:	Electricity balance	(Ah)
Vnominal	:	Rated voltage	(V)
Q	:	Cumulative amount of fuel consumption	(L)
ρ	:	Specific gravity	(kg/L)
Hu	:	Lower calorific value	(J/kg)

3–5 Calculation of fuel consumption rate of heavy-duty motor vehicles

Fuel consumption rate (km/L) of each running mode shall be calculated from the engine operating conditions, vehicle speed and shit positions calculated in Paragraphs 3–3, and the engine fuel economy map measured pursuant to the provision in Chapter 2, by means of the fuel economy calculation assistance program provided for in Chapter 1.

Furthermore, in the case of a motor vehicle equipped with an automatic transmission with torque converter (AT), the fuel consumption rates of the said motor vehicle shall be determined by multiplying the calculated fuel consumption rate by 0.91 in the case of the city running mode, by 0.96 in the case of the intercity highway running mode, and by 0.91 in the case of the urban running mode.

From the thus-obtained fuel consumption rates in the city running mode and intercity highway running mode, the heavy-duty motor vehicle fuel consumption rate shall be calculated based on the intercity running ratio shown in Table 4, using the following formula:

$$E = \frac{1}{\frac{1-a/100}{E_u} + \frac{a/100}{E_h}}$$

where:

E	:	Fuel consumption rate heavy-duty motor vehicle	(km/L)
E_u	:	City running fuel consumption rate	(km/L)
E_h	:	Intercity running fuel consumption rate	(km/L)
α	:	Intercity running ratio	(%)

Attached Sheet 1 **Standard Vehicle Specifications and Intercity Running Ratio at Time of Fuel Economy Measurement of Motor Vehicles with Gross Vehicle Weight Exceeding 3.5 tons**

Table 1 Standard Specifications and Intercity Running Ratio of Trucks, etc.

Fuel economy category No.	Category		Standard vehicle specifications					Intercity running ratio (%)
	Range of gross vehicle weight (ton)	Range of maximum loading capacity (ton)	Vehicle weight (kg)	Maximum loading capacity (kg)	Riding capacity (persons)	Overall height (m)	Overall width (m)	
T1	3.5 < & ≤ 7.5	≤ 1.5	1,957	1,490	3	1.982	1.695	10
T2		1.5 < & ≤ 2	2,356	2,000	3	2.099	1.751	
T3		2 < & ≤ 3	2,652	2,995	3	2.041	1.729	
T4		3 <	2,979	3,749	3	2.363	2.161	
T5	7.5 < & ≤ 8	–	3,543	4,275	2	2.454	2.235	
T6	8 < & ≤ 10	–	3,659	5,789	2	2.625	2.239	
T7	10 < & ≤ 12	–	4,048	7,483	2	2.541	2.350	
T8	12 < & ≤ 14	–	4,516	7,992	2	2.572	2.379	
T9	14 < & ≤ 16	–	5,533	8,900	2	2.745	2.480	
T10	16 < & ≤ 20	–	8,688	11,089	2	3.049	2.490	
T11	20 <	–	8,765	15,530	2	2.934	2.490	30

Table 2 Standard Specifications and Intercity Running Ratio of Trucks (tractors)

Fuel economy category No.	Category	Standard vehicle specifications					Intercity running ratio (%)
	(Tractor head) Range of gross vehicle weight (ton)	Vehicle weight (kg)	Maximum loading capacity (kg)	Riding capacity (persons)	Overall height (m)	Overall width (m)	
TT1	≤ 20	10,525	24,000	2	2,927	2.490	20
TT2	20 <	19,028	40,000	2	2.890	2.490	10

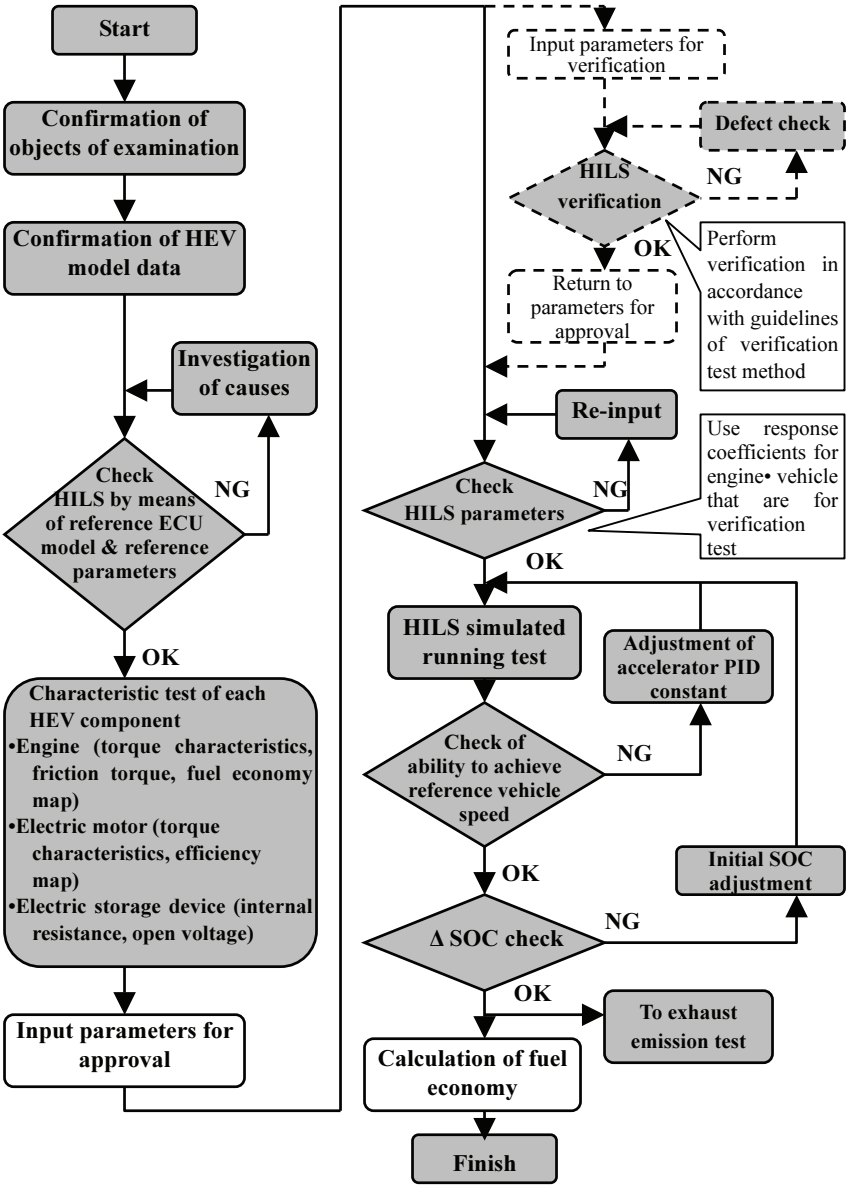
Table 3 Standard Specifications and Intercity Running Ratio of Passenger Vehicles (Route Buses)

Fuel economy category No.	Category	Standard vehicle specifications				Intercity running ratio (%)
	Range of gross vehicle weight (ton)	Vehicle weight (kg)	Riding capacity (persons)	Overall height (m)	Overall width (m)	
BR1	6 < & ≤ 8	5,186	39	2.880	2.072	0
BR2	8 < & ≤ 10	6,672	46	2.947	2.301	
BR3	10 < & ≤ 12	7,324	62	2.949	2.304	
BR4	12 < & ≤ 14	8,654	77	2.969	2.385	
BR5	14 <	9,790	79	2.962	2.490	

Table 4 Standard Specifications and Intercity Running Ratio of Passenger Vehicles (General Buses)

Fuel economy category No.	Category	Standard vehicle specifications				Intercity running ratio (%)
	Range of gross vehicle weight (ton)	Vehicle weight (kg)	Riding capacity (persons)	Overall height (m)	Overall width (m)	
B1	3.5 < & ≤ 6	3,543	29	2.593	2.027	10
B2	6 < & ≤ 8	5,622	29	3.019	2.197	
B3	8 < & ≤ 10	6,608	49	3.105	2.314	
B4	10 < & ≤ 12	8,022	58	3.160	2.399	
B5	12 < & ≤ 14	9,774	60	3.168	2.490	
B6	14 < & ≤ 16	12,110	62	3.320	2.490	35
B7	16 <	14,583	51	3.668	2.490	

Appendix **Test Procedure for Fuel Consumption Rate of Heavy-Duty Hybrid Electric Vehicles**



CHAPTER 4 TEST PROCEDURE FOR EXHAUST EMISSIONS FROM HEAVY-DUTY HYBRID ELECTRIC VEHICLES

1. Scope

This test procedure applies to the test procedures with the use of the HILS system for emission mass of carbon monoxide (hereinafter referred to as "CO"), total hydrocarbons (hereinafter referred to as "THC"), non-methane hydrocarbon (hereinafter referred to as "NMHC"), methane (hereinafter referred to as "CH_4"), nitrogen oxide (hereinafter referred to as "NOx"), carbon dioxide (hereinafter referred to as "CO_2"), and particulate matters (hereinafter referred to as "PM") that are contained in the exhaust emissions (hereinafter referred to as "exhaust gas") that is generated and emitted from the exhaust pipes of ordinary-sized motor vehicles and small-sized motor vehicles (except motor cycles (including motor cycles with sidecar)) with a gross vehicle weight exceeding 3.5 tons (except motor vehicles used exclusively for carriage of passengers with a riding capacity of 10 persons or less) which are equipped as their power unit with an engine fuelled by diesel fuel and with an electric motor when those motor vehicles are driven according to the JE05-mode, as well as for the work done generated when those motor vehicles are driven according to the JE05-mode.

In addition, with respect to motor vehicles equipped with a hybrid electric system that cannot be tested according to this provision, regulations shall be laid down, as required, at the stage when the motor vehicles concerned are available for use.

2. Definitions

Definitions of terms and abbreviations used in this test procedure shall be in accordance with the provisions of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

3. Test Method for Exhaust Emissions from Heavy-Duty Hybrid Electric Motor Vehicles

3–1 Test procedure for JE05-mode exhaust emission

The test procedure for the JE05-mode exhaust emission shall be conducted as follows:

(1) By the method in Paragraph 8, convert the JE05-mode provided for in "Attached Sheet 2" of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles to the exhaust gas measurement cycle.

(2) Connect the test engine to the engine dynamometer. Conduct the test according to the exhaust gas measurement cycle obtained in Item (1), and measure the mass of the exhaust gas and the work done.

4. Test Engine

The test engine shall be in accordance with the provision of Paragraph 4 "Test Engine" of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

5. Test fuel

The test fuel to be used for the test engine shall be in accordance with the provision of Paragraph 5 "Test Fuel" of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

6. Measuring Devices

The measuring devices and the accuracy, calibration, etc. of the measuring devices shall be in accordance with the provisions of Paragraph 6–1 "Measuring devices" and Paragraph 6–2 "Accuracy, calibration, etc. of measuring devices" of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

7. Test Room and Atmospheric Conditions Related to Test

The test room and atmospheric conditions shall be in accordance with the provision of Paragraph 7 "Test Room and Atmospheric Conditions Related to Test" of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

8. Creation of Exhaust Gas Measurement Cycle

8–1 Conversion method to exhaust gas measurement cycle

8–1–1 Operation check of HILS system

Before calculating the exhaust gas measurement cycle, activate the HEV model for approval by using the SILS reference ECU model and the SILS

reference parameter, and make sure that the calculated values of the HILS system are within the tolerance. (See Chapter 1)

8–1–2 Construction of HILS system and verification of compatibility

Pursuant to the provisions of Chapter 1, construct the HILS system by using the actual ECU, driver model, unique interface conversion model according to the system of the heavy-duty hybrid electric vehicle, HEV model for approval, etc, which are the objects of examination. In the HEV model for approval, input the engine torque characteristics and engine friction torque, the electric motor, electric power consumption • torque map, the battery internal resistance • open voltage map that are measured pursuant to the provisions of Chapter 2, as well as the vehicle specifications, rolling resistance coefficient and air resistance coefficient pursuant to the provision of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

In accordance with Chapter 5, confirm the operation of the HEV model for approval and the accuracy of the simulated running.

8–1–3 Calculation of exhaust gas measurement cycle by means of HILS system simulated running

Using the HILS system, perform the simulated running according to the JE05-mode provided for in “Attached Sheet 2” to the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles. Record its results at a measuring frequency of 1 Hz, and convert them to the exhaust gas measurement cycle that consists of values of the test engine revolution speed and test engine torque. Here, the data during the gear change period (from clutch disengagement to clutch engagement) may be replaced by the data immediately before the gear change.

Allowable errors in speed and time during the simulated running shall be, at any point during each running mode, within ± 2.0 km/h in speed and within ± 1.0 second in time, and shall be within the range of the coloured section in Figure 1. Moreover, if deviations are within the tolerance corresponding to the setting items posted in the left column of Table 1, they shall be deemed to be within the allowable errors. Time deviations at the times of start and gear change operation, however, shall not be included in the total cumulative time. In addition, this provision shall not apply to motor vehicles incapable of attaining the speeds of each running mode during the accelerations with their accelerator pedals fully depressed.

Table 1

Setting item	Tolerance
1. Tolerable time range for one deviation	1.0 second
2. Tolerable time range for the total cumulative value of time deviations	2.0 seconds

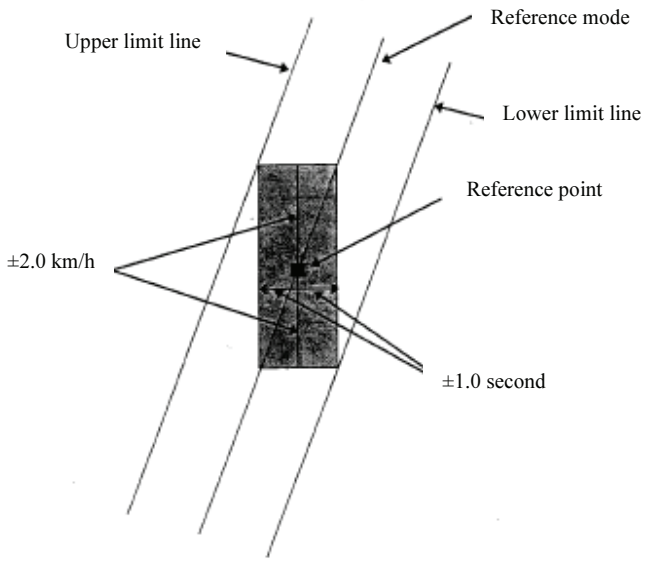


Fig. 1 Allowable Errors in Speed and Time during Simulated Running

8–1–4 Range of electricity balance for HILS system simulated running

The initial state of charge shall be adjusted so that the ratio of the energy conversion value of the electricity balance to the integrated shaft output of the engine by the simulated running of the HILS system may satisfy the following formulas:

$$\left|\Delta E / W_{eng\_ref}\right| < 0.03$$

$$\Delta E = \Delta Ah \times V_{no\,\min al}$$

where:

ΔE	:	Energy conversion value of electricity balance	(kWh)
ΔAh	:	Electricity balance	(Ah)
Vnominal	:	Rated voltage	(V)
Weng_ref	:	Integrated positive engine shaft torque	(kWh)

8–2 Replacement of test torque value at time of motoring

If the test torque becomes negative when the JE05-mode is converted to the exhaust gas measurement cycle by means of the HILS system, values obtained from the engine friction torque curve necessary for driving the engine from the minimum engine revolution speed to the maximum engine revolution speed shall be used as the test torque concerned.

9. Test Procedure for Exhaust Emissions from Heavy-Duty Hybrid Electric Vehicles

9–1 Preparation prior to test

The preparation prior to the test shall be in accordance with the provision of Paragraph 10–1 “Preparation prior to test” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

9–2 Running procedure for test engine

The running procedure for the test engine shall be in accordance with the provision of Paragraph 10–2 “Running procedure for test engine” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

9–3 Verification of driving accuracy, etc.

The verification of the integrated shaft output and the driving accuracy during the measurement driving shall be performed by the following method:

9–3–1 Time correction of engine revolution speed and shaft torque

In order to reduce the time lag between the engine revolution speed (hereinafter referred to as the “measured engine revolution speed”) and the

engine shaft torque (hereinafter referred to as the "measured engine shaft torque") that have been measured by means of the measurement driving, and the engine revolution speed (hereinafter referred to as the "test engine revolution speed") and the engine torque (hereinafter referred to as the "test engine torque") that have been obtained from the simulated running of the HILS system, a time correction may be performed for both the measured engine revolution speed and the measured engine shaft torque by the same level and in the same direction.

9–3–2 Calculation of integrated engine shaft output, etc.

(1) The integrated engine shaft output during the measurement driving (hereinafter referred to as "Weng_act") shall be obtained by integrating the engine shaft output (hereinafter referred to as the "measured engine shaft output") which is calculated using the measured engine revolution speed and the measured engine shaft torque, throughout the whole period of the measurement driving.

$$W_{eng\_act} = \left(\sum_{i=1}^{n} \frac{2\times\pi\times T_{q,i}\times N_{e,i}}{60\times 1000}\times\frac{1}{f}\right)\times\frac{1}{3600}$$

where:

Weng_act:		Integrated engine shaft output during measurement driving	(kWh)
Tq	:	Measured engine shaft torque	(Nm)
Ne	:	Measured engine revolution speed	(min^{-1})
f	:	Measuring frequency	(Hz)
π	:	Circle ratio	
n	:	Number of data during test cycle	
i	:	Subscript representing individual values of Tq and Ne	

(2) The integrated test engine output during the exhaust gas measurement cycle (hereinafter referred to as "Weng_ref") shall be obtained by integrating the engine shaft output (hereinafter referred to as the "test engine output") that is calculated from the test engine revolution speed and the test engine torque, throughout the whole period of the exhaust

gas measurement cycle.

$$W_{eng\_ref} = (\sum_{i=1}^{n} \frac{2 \times \pi \times T_{qref,i} \times N_{eref,i}}{60 \times 1000}) \times \frac{1}{3600}$$

where:

Weng_ref: Integrated test engine output during exhaust gas measurement cycle (kWh)

Tqref : Test engine torque (Nm)

Neref : Test engine revolution speed (min^{-1})

π : Circle ratio

n : Number of data during test cycle

i : Subscript representing individual values of Tqref and Neref

9–3–2–1 Negative engine shaft torque

All measured engine shaft torques that are negative shall be handled as zero in calculating the measured engine shaft output. However, in cases where the measuring frequency of the engine shaft torque is less than 5 Hz and adjacent measured values of the engine shaft torque change from positive to negative or from negative to positive, the negative part shall be handled as zero and the positive part shall be included in Weng_act by calculating its measured engine shaft output.

9–3–2–2 Range of integrated shaft output

The difference of Weng_act to Weng_ref shall be not less than –15 % but not more than +5 %.

9–3–3 Calculation of driving accuracy

(1) Liner regression

For the measured engine revolution speed, measured engine shaft torque and measured engine shaft output, the liner regression of the

values measured every one second to their respective reference values shall be performed using the least-square method, thus obtaining values of a and b in the following formulas:

$$y = a \times x + b$$

$$a = \frac{n \times \sum x_i y_i - \sum x_i \times \sum y_i}{n \times \sum x_i^{\,2} - (\sum x_i)^2}$$

$$b = \frac{\sum x_i^{\,2} \times \sum y_i - \sum x_i \times \sum x_i y_i}{n \times \sum x_i^{\,2} - (\sum x_i)^2}$$

where:

a : Slope of regression line

a : y intercept of regression line

n : Number of data

x : Test engine revolution speed (min^{-1}), test engine shaft torque (Nm), test engine shaft output (kW)

y : Measured engine revolution speed (min^{-1}), measured engine shaft torque (Nm), measured engine shaft output (kW)

i : Subscript representing individual values of x and y

(2) Standard error and determination coefficient

The standard error and determination coefficient of the estimated value of y to x shall be calculated for respective regression lines by the following methods.

$$SE = \sqrt{\left\{\frac{1}{n \times (n-2)}\right\} \times \left\{n \times \sum y_i^{\,2} - (\sum y_i)^2 - \frac{(n \times \sum x_i y_i - \sum x_i \times \sum y_i)^2}{n \times \sum x_i^{\,2} - (\sum x_i)^2}\right\}}$$

$$r^2 = \left(\frac{n \times \sum x_i y_i - \sum x_i \times \sum y_i}{\sqrt{\left[n \times \sum x_i^{\,2} - (\sum x_i)^2 \right] \times \left[n \times \sum y_i^{\,2} - (\sum y_i)^2 \right]}} \right)^2$$

where:

SE : Standard error of estimated value of y to x

r^2 : Determination coefficient of estimated value of y to x

n : Number of data

x : Test engine revolution speed (min^{-1}), test engine shaft torque (Nm), test engine shaft output (kW)

y : Measured engine revolution speed (min^{-1}), measured engine shaft torque (Nm), measured engine shaft output (kW)

i : Subscript representing individual values of x and y

(3) Provisions for exclusion from calculation of driving accuracy

Measured engine shaft torques and measured engine shaft outputs during the period when the test engine torque becomes negative torque shall be excluded from the calculation of the driving accuracy.

Furthermore, when the conditions provided for in Table 2 are satisfied, the respective items may be excluded from the validation calculation of the driving accuracy.

Table 2 Conditions for Exclusion from Calculation of Driving Accuracy

Conditions	Items excluded
Cases where the measured engine shaft torque is not equal to the test engine shaft torque when the maximum engine torque is equal to the test engine shaft torque, or cases where the measured engine shaft torque is not equal to the test engine shaft torque when the accelerator is in a fully open state	Engine shaft torque and shaft output
Cases where the measured engine shaft torque exceeds the test engine shaft torque in an unloaded state except at idling operation, or cases where the measured engine shaft torque exceeds the test engine shaft torque when the accelerator is in a fully closed state except idling operation	Engine shaft torque and shaft output
Cases where the measured engine revolution speed during the idling operation exceeds the test engine revolution speed in an unloaded state or when the accelerator is in a fully closed state	Engine revolution speed and shaft output
Of series hybrid vehicles, cases where the engine revolution speed and the shaft torque during generation of electricity are fixed-point operation	Engine revolution speed and shaft torque

9–3–4 Range of driving accuracy

The results of driving accuracy pursuant to the preceding paragraph shall satisfy the standards in Table 3.

Table 3 Range of Driving Accuracy of Engine

	Engine revolution speed	Shaft torque	Shaft output
Standard error of estimated value of y to x (SE)	100 min^{-1} or less	13 % or less of the maximum shaft torque	8 % or less of the maximum shaft output
Slope of regression line (a)	0.95 – 1.03	0.83 – 1.03	0.89 – 1.03
Determination coefficient (r^2)	0.9700 or more	0.8800 or more	0.9100 or more
y intercept of regression line (b)	within ± 50 min^{-1}	± 20 Nm or ± 2 % of the maximum shaft torque – whichever is larger – or less	± 4 kW or ± 2 % of the maximum shaft output – whichever is larger – or less

10. Measurement of Emission Mass of CO, etc. and PM

Measurements of emission mass of CO, etc. and PM at the measurement driving shall be in accordance with Paragraph 11 “Measurement of Mean Emission Mass of CO, etc. and PM” of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles.

11. Calculation of Integrated System Shaft Output

The integrated shaft output (hereinafter referred to as “Wsys”) that is used to calculate the emission mass of the exhaust gas per unit work done shall be calculated using the integrated shaft output of the hybrid system obtained by means of the HILS system, as shown below:

(1) Cases where Weng_act < Weng_ref:

$$W_{sys} = W_{sys\_ref} \times W_{eng\_act} / W_{eng\_ref}$$

(2) Cases where Weng_act ≥ Weng_ref:

$$W_{sys} = W_{sys\_ref}$$

where:

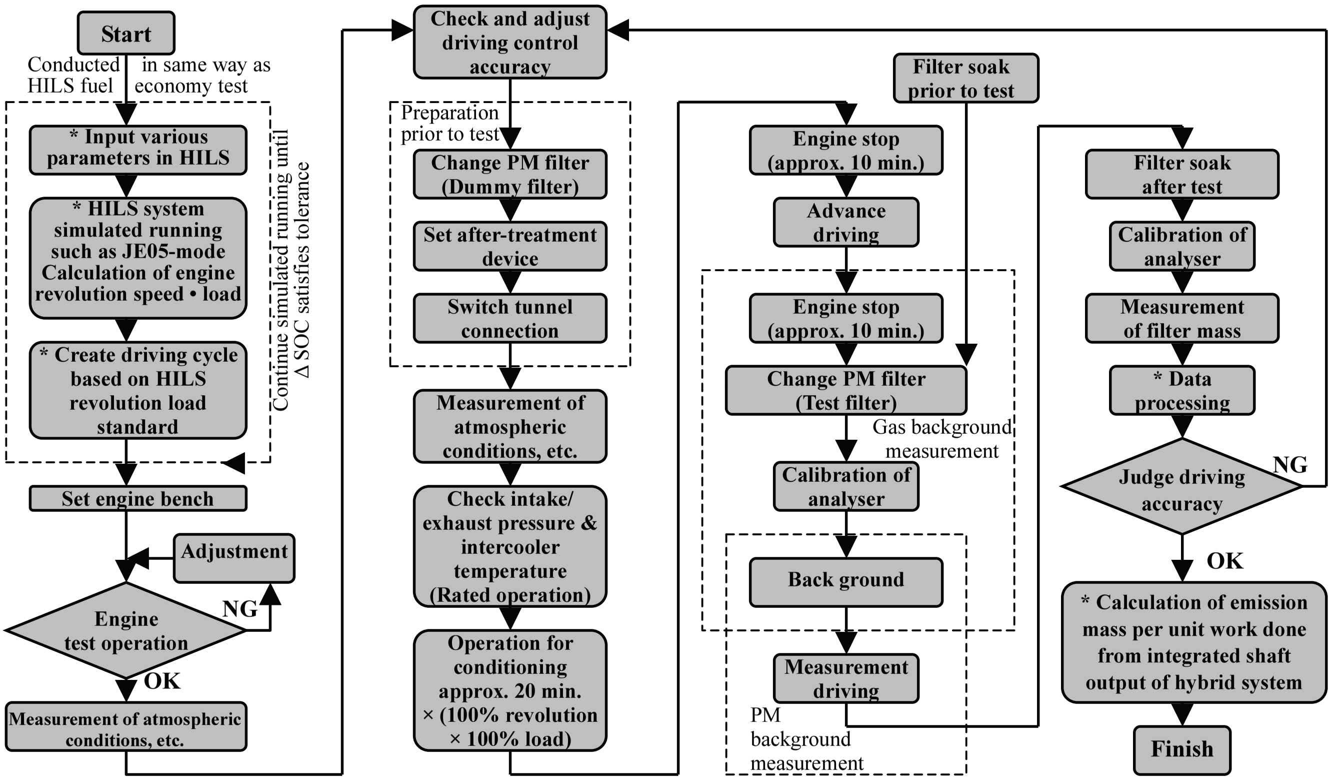
Wsys : Integrated positive shaft output of hybrid system (kWh)

Wsys_ref : Integrated positive shaft output of hybrid system by means of HILS system (kWh)

Weng_ac t: Integrated measured positive engine shaft output (kWh)

Weng_ref : Integrated measured positive test engine shaft output (kWh)

Appendix Test Procedure for Exhaust Emissions from Heavy-Duty Hybrid Electric Vehicles



* Sections that differ from conventional vehicle test methods

CHAPTER 5 VERIFICATION TEST PROCEDURE FOR HILS SYSTEM FOR HEAVY-DUTY HYBRID ELECTRIC VEHICLES

1. Scope

This test procedure applies to the verification procedure for the HILS system to be used in Chapters 3 and 4.

2. Definitions

Definitions of terms and abbreviations used in this test procedure shall be in accordance with the provisions of the Measurement Procedure for Exhaust Emissions from Heavy-Duty Motor Vehicles and the Measurement Procedure for Heavy-Duty Vehicles Fuel Economy.

3. Cases Requiring Verification of HILS System

The verification aims at checking the operation and the accuracy of the simulated running of the HEV model for approval. The verification shall be conducted when the equivalence of the HILS system to the test motor vehicle needs to be confirmed.

4. Actual vehicle test

4–1 Test procedure

The test using the actual vehicle (hereinafter referred to as the “actual vehicle test”) which serves as the standard for the HILS system verification shall be conducted by either of the following test methods: However, if the operation of the hybrid system cannot be reproduced with these test methods, other test method that is deemed to be equivalent to these test methods may be used. Furthermore, provisions concerning measurement of exhaust emissions may be omitted according to need.

(1) System bench test: This test shall be conducted according to the provisions of the “Test Procedure for Fuel Consumption Rate of Heavy-Duty Hybrid Electric Vehicles” (Kokujikan No. 278 of March 31, 2006) and the “Measurement Procedure for Exhaust Emissions from Heavy-Duty Hybrid Electric Vehicles” (Kokujikan No. 60 of June 30, 2004).

(2) Chassis dynamometer test: This test shall be conducted in accordance with the provisions of the “Measurement Procedure for JE05-Mode

Exhaust Emissions by Means of Chassis Dynamometer" (Kokujikan No. 280 of March 16, 2007) shall be applied.

4–2 Test conditions

The test shall be conducted for the following two kinds of conditions:

(1) One heap in the JE05-mode (period from the 1st second to the 121st second)

(2) Entire JE05-mode.

4–3 Measurement items

The following items, etc. shall be measured by actual measurement or with the use of CAN signals, etc. at a sampling period of 0.2 seconds or less, which shall become the actually-measured data for the HILS system verification (hereinafter referred to as the "actually-measured verification values").

- System shaft revolution speed, system shaft torque, system shaft output
- Vehicle speed
- Quantity of manipulation of the actual vehicle (accelerator, brake, clutch and shift operation signal, etc.) or quantity of manipulation on the engine dynamometer (throttle valve opening angle)
- Engine revolution speed, engine command values
- Electric motor revolution speed, torque command value
- Electric storage device output, voltage, current

5. HILS Simulated Running

5–1 Method for HILS simulated running

Use the HILS system constructed pursuant to the provisions of Chapter 1 to perform a simulated running pursuant to Paragraph 4–2 "Test conditions" and acquire the calculation data related to Paragraph 4–3 "Setting items" and HILS simulated running data for HILS system verification (hereinafter referred to as the "HILS simulated running values"). In this case, the same

parameters as those for the actual vehicle test shall be inputted in the HILS system, and the same gear positions (except the difference in gear positions involved in gear change operations) as those in the actual vehicle test shall be used for the simulated running. In addition, in cases where the load condition of the actual vehicle test is different from the bench engine characteristic test due to use of a cooling fan, power steering, etc., the engine model accessory torque map in the HEV model for approval may be used.

5–2 Test conditions

The driving shall be performed for the following two kinds of test conditions by the respective methods specified below:

(1) One heap in the JE05-mode (period from the 1st second to the 121st second): Driving by inputting quantity of manipulation of the actual vehicle or on the engine dynamometer

(2) Entire JE05-mode: Driving by means of a driver model similar to the HEV for approval, using the actual vehicle speed or reference vehicle speed.

6. Comparison of Actually-Measured Values with HILS Simulated Running Values

6–1 Confirmation of correlation

Correlation between the actually-measured verification values and the HILS simulated running values shall be verified in connection with the “One heap in the JE05-mode” mentioned in Item (1) of Paragraph 4–2 “Test conditions.” Table 1 shows tolerances of the determination coefficient between those values.

Here, data during gear changes (from clutch disengagement to clutch engagement) and for one second before and after gear changes may be omitted.

Table 1 Tolerance in Correlation (Determination Coefficient) of Actually-Measured Verification Values and HILS Simulated Running Values

Test condition	Vehicle speed or engine revolution speed	Electric motor		Engine		Electric storage device output
		Torque	Output	Torque	Output	
One heap in JE05-mode	0.97 or more	0.88 or more	0.88 or more	0.88 or more	0.88 or more	0.88 or more

6–2 Overall verification

6–2–1 Verification items and tolerances

In connection with the “Entire JE05-mode” mentioned in Item (2) of Paragraph 4–2 “Test conditions”, compare the actually-measured verification values and the HILS simulated running values and verify the calculation accuracy. Table 2 shows tolerances in the determination coefficient of the vehicle speed or engine revolution speed and of the engine torque, and in the positive engine work and fuel economy value.

In addition, in calculating the determination coefficient, data during gear change (from clutch disengagement to clutch engagement) and one second before and after gear change may be omitted.

Table 2 Tolerances in Overall Verification

Test condition	Vehicle speed or engine revolution speed	Engine torque	Positive engine work	Fuel economy value
	Determination coefficient	Determination coefficient	W_{eng_HILS} / $W_{eng\_vehicle}$	FE_{HILS} / $FE_{vehicle}$
Entire JE05-mode	0.97 or more	0.88 or more	0.97 or more	1.03 or less

where:

W_{eng_HILS}: Integrated positive engine shaft output in HILS simulated running (kWh)

$W_{eng\_vehicle}$: Integrated positive engine shaft output in actual vehicle test

(kWh)

FE_{HILS} : Fuel economy value in HILS simulated running

(km/L)

$FE_{vehicle}$: Fuel economy value in actual vehicle test (km/L)

6–2–2 Calculation method for verification items

(1) The engine torque and the positive engine work shall be acquired by the following methods, respectively, according to the test data enumerated below:

① Actually-measured verification value: Methods that are technically valid, such as a method where the value is calculated from the operating conditions of the hybrid system (system shaft revolution speed, system shaft torque) obtained by the actual vehicle test, using the input/output voltage and current to/from the electric motor controller, or a method where the value is calculated by using the data such as the engine torque characteristics acquired pursuant to Chapter 2.

② HILS simulated running value: A method where the value is calculated from the engine operating conditions (revolution speed, torque) obtained by the HILS simulated running.

(2) The fuel economy value shall be acquired according to the test data enumerated below by the following method, respectively:

① Actually-measured verification value: A method where the value is calculated from the engine operating conditions (revolution speed, torque) obtained by the actual vehicle test, using the fuel economy calculation-assisting program provided for in Chapter 1.

② HILS simulated running value: A method where the value is calculated from the engine operating conditions (revolution speed, torque) obtained by the HILS simulated running, using the fuel economy calculation-assisting program provided for in Chapter 1.

6–2–3 Range of electricity balance

The electricity balance during the actual vehicle running in the actual vehicle test and during the HILS simulated running shall satisfy the following formula:

$$\left|\Delta E_{HILS} - \Delta E_{vehicle}\right| / C < 0.003$$

where:

ΔE_{HILS} : Energy conversion value of electricity balance during HILS simulated running (J)

$\Delta E_{vehicle}$: Energy conversion value of electricity balance during actual vehicle running in actual vehicle test (J)

C : Energy conversion value of cumulative amount of fuel consumption during HILS simulated running (J)

6–2–4 Conditions for verification by means of determination coefficient of engine torque

The determination coefficient of the engine torque shall be a target of verification when the exhaust emission test pursuant to the provision of Chapter 4 is used, but needs not be verified when the fuel economy test pursuant to Chapter 3 is used. Moreover, even if the said determination coefficient of the engine torque is less than 0.88, when the tolerances in the determination coefficient of the vehicle speed or engine revolution speed, and in the positive engine work and fuel economy value are satisfied, and either of the following items applies, the verification shall be deemed to have been done.

(1) Cases where the emission mass of the exhaust gas that has been measured by means of the exhaust emission test pursuant to the provision of Chapter 4 meets either of the following conditions:

① When the said emission mass is deemed to be equivalent to the emission mass of the exhaust gas measured by the actual vehicle test.

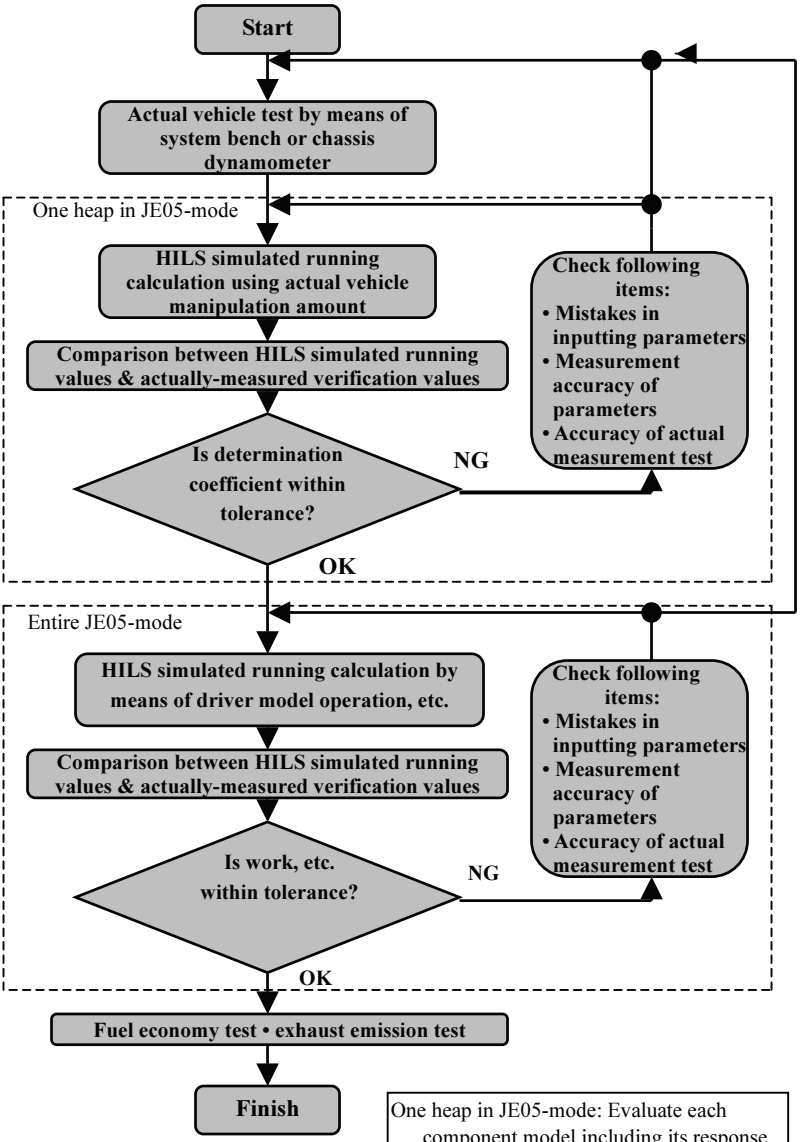
② When the said emission mass is deemed to be equivalent to the emission mass of the exhaust gas actually measured by means of an engine bench reproducing the operating conditions of the engine alone that are obtained by the actual vehicle test.

(2) Of series hybrid electric vehicles, cases where the engine revolution speed and shaft torque during generation of electricity are fixed-point operation.

7. Others

For the time being, when the fuel economy test pursuant to Chapter 3 is used, in addition to the verification pursuant to Chapter 6 “Comparison between Actually-Measured Values and HILS Simulated Running Values,” further verification shall be performed according to a method specified separately.

Appendix **Verification Test Procedure for HILS System for Heavy-Duty Hybrid Electric Vehicles**



One heap in JE05-mode: Evaluate each component model including its response
Entire JE05-mode: Evaluate equivalence of fuel economy value, work, torque, etc.

Attached Sheet 1

SILS REFERENCE PARAMETERS FOR PARALLEL HEV MODEL

```
<set_parame_p>
% HILS parameters for parallel HEV when reference ECU model is used
%
% Setting and load of vehicle parameter, controlling constant, various characteristics
clear;

% Setting of ECU switch
ECU = 0; % 1: Actual ECU, 0: ECU model

%  Since calculation of denormal numbers may become slow, their threshold shall be provided.  20060413
denormalNumber=10^(-15);

% Engine model set value  2006.07.18
eng_const1 = 1;
eng_const2 = 1;

% Load of characteristic map
map_para_p;

% Sampling [s]
stepsize = 0.0005;
%  Acceleration of gravity [m/s2]
g = 9.80665;

% Vehicle mass [kg]
ms = 6000;
%  Tyre radius [m]
rd = 0.4;

% Load formula [kgf]  Fr = la + lb*V[km/h] + Ic*[km/h]*V[km/h]l
mu = 0.006; % Actual inertia  Rolling resistance coefficient
W = ms*g; % Gross vehicle weight [N]
A = 4.0; % Frontal projected area [m2]
Cd = 0.004*g; % Actual inertia  Air resistance coefficient
la = (mu*W)/g;
lb = 0;
lc = Cd*A/g; %cd=kN*h2/(m2*km2)
```

```
% Speed-up gear    % 2006.07.18 Designation change
% Electric motor internal gear ratio
tm_gear_ratio = 1.6; % Transmission side
mo_gear_ratio = 1.8; % Electric motor side
mo_gear_ratio_in = 1.0; %internal Electric motor internal gear ratio
% Gear ratio
nc = 40/22; % Counter gear
nf = 4.9; % Differential gear
nl = 6.7; %1st
n2 = 4.0; %2nd
n3 = 2.3; %3rd
n4 = 1.4; %4th
n5 = 1.0; %5th
n6 = 0.75; %6th
gear_rate = [0 0 1/n1 1/n2 1/n3 1/n4 1/n5 1/n6 1/n6];
shift_p = [-1 0 1 2 3 4 5 6 10];

% Rotary inertia moment of each section [kgm2]
jl = (ms+150)*rd*rd; % Vehicle body and tyre
j2 = 0.4; %0.1414; % j2: Differential gear
j3_1 = 0.3+0.07; %1st: Transmission output side
j3_2 = 0.2+0.07; %2nd
j3_3 = 0.1+0.07; %3rd
j3_4 = 0.06+0.07; %4th
j3_5 = 0.04+0.07; %5th
j3_6 = 0.03+0.07; %6th
gear_j = [0 0 j3_1 j3_2 j3_3 j3_4 j3_5 j3_6 j3_6];
j4 = 0.15; % Transmission input side:
j5 = 1.1; % Engine:ENG+F/W
jt = 0.02; % Turbine inertia (between fluid coupling and transmission clutch)
Dummy
motor_j =0.00007; % Electric motor
reduce_j =0.04; % Speed-up gear

% Transmission efficiency
diff_efficiency =0.95; % Differential gear
tm_efficiency =[0.95 0.95 0.95 0.95 0.95 0.95 0.98 0.95 0.95]; %
Transmission
2006.08.22 Dummy
reduce_efficiency =0.9; % Speed-up gear

% Drag resistance [Nms/rad]
cf1 = 0.0; % Vehicle body
```

```
cf2 = 0.0; % Differential gear
cf4 = 0.0; % Transmission
cf5 = 0.0; % Engine

% Number of cylinders    For conversion of fuel flow rate
cylinder = 4;
% Engine limit revolution speed [r/min]
Rev_limit = 4000.0;
% Generator torque generated at start of engine [Nm]
ST_TQ = 200;

% Setting of static friction when vehicle is stopped [Nm]
SEISHI_masatu_tq = 1a * g * rd * 1.1;

% Initial state of charge [%]
initial_capa_capacity = 93.0;
% Capacitor capacity [F]
capacity = 35.0;
% Capacitor MAX voltage in regular use [V]
cap_maX_vol = 330.0;
% Capacitor MAX voltage while charging [V]
cap_max_vol_ch = 350.0;
% Capacitor internal resistance [Ω]
capa_r = 0.095;

% Initial state of charge [%]
initial_batt_capacity = 60.0;
% Battery capacity [Ah]
batt_capacity = 6;

% Torsional stiffness k [Nm/rad], Attenuation coefficient c[Nms/rad]
% k1/c1: Drive shaft, ks/c2: Propeller shaft, k4/c4 Clutch torsion spring (lock
up clutch)
k1 = 5000;
k2 = 60000;
k4 = 2000;
k_Lc = 2000;
c1 = 300;
c2 = 40;
c4 = 20;
c_Lc = 20;

% Clutch characteristics [Nm]
cl_TQ_MAX = 1000;
```

```
Lock_Up_TQ_MAX = 1000;
% Synchronizer characteristics [Nm]
Sync_yoryo = 2000;

% Shift change operating time
ch_time_tm_MT=0.05;

% Time constant
tcm1 = 0.01; % Electric motor 1
tcm2 = 0.01; % Electric motor 2
tcm3 = 0.01; % Electric motor 3
tcm4 = 0.01; % Electric motor 4
tcm5 = 0.01; % Electric motor 5
tcel = 0.005; % Engine 1

% Engine revolution speed controlling constant
adj_EngASR_PID_P = 0.45;
adj_EngASR_PID_I = 0.4;
adj_EngASR_PID_D = 0;
cons_0 = 0; % 2006.12.28 added

% Electric motor revolution speed controlling constant
adj_MotorASR_PID_P = 0.06;
adj_MotorASR_PID_I = 0;
Motor_Tq_Max = 100; % Maximum torque when revolution speed is
controlled [Nm]


<map_para_p>
% Map file for automatic operation of electric motor and engine

% Battery ------------------------------------------------------------
% Battery remaining capacity [%]
SOC = [0 20 40 60 80 100];
% Open voltage [V]
open_voltage = [100 250 280 285 290 300];
% Open voltage (discharging) [V]
disch_open_voltage = [100 250 280 285 290 300];
% Open voltage (charging) [V]
ch_open_voltage = [100 250 280 285 290 300];
% Internal resistance (discharging) [Ω]
disch_inside_resi = [1 1 1 1 1 1]*0.001;
% Internal resistance(charging) [Ω]
ch_inside_resi = [1 1 1 1 1 1]*0.001;
```

```
% ----------------------------------------------------------------

% Electric motor
% Electric motor revolution speed [r/min]
motor_speed = [0.0 1000.0 2000.0 3000.0 4000.0 5000.0 6000.0 7000.0
8000.0 9000.0];
% Electric motor revolution speed [r/min] Maximum power running  For
regenerative torque  2006.07.18 Dummy
motor_speed_max(1,1:10) = [0.0 1000.0 2000.0 3000.0 4000.0 5000.0
6000.0 7000.0 8000.0 9000.0];
% Electric motor command [%]
motor_ref = [0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0];
% Electric motor voltage [V]
motor_vol = [210.0 290.0 350.0];
% Electric motor maximum voltage [V]
map_max = 350.0;
% Electric motor minimum voltage [V]
map_min = 210.0;

% Excitation loss [A]
% Described by one-dimensional map of motor_speed (revolution speed).
reiji(1,1:10) = [0 0 0 1.5 3.0 4.5 6.0 7.5 7.5 7.5];

% Electric motor drive torque [Nm]
% Described by three-dimensional map of motor_speed (revolution speed),
motor_ref (command) and motor_vol (voltage).
motor_tq_drive(1:10,1:11,1) = [
0 14 27 39 52 63 77 90 104 118 118,
1 14 27 39 52 63 77 90 104 118 118,
1 14 26 39 52 64 79 91 105 120 120,
1 14 26 39 52 64 79 91 105 120 120,
1 14 26 40 52 66 79 91 105 113 113,
1 13 27 41 53 66 78 91 97 97 97,
1 13 27 40 51 64 76 83 83 83 83,
1 13 27 38 50 61 69 69 69 69 69,
1 12 25 37 49 58 58 58 58 58 58,
1 13 25 35 47 47 47 47 47 47 47];
motor_tq_drive(1:10,1:11,2) = [
0 14 27 39 52 63 77 90 104 118 118,
1 14 27 39 52 63 77 90 104 118 118,
1 14 26 39 52 64 79 91 105 120 120,
1 14 26 39 52 64 79 91 105 120 120,
1 14 26 40 52 66 79 91 105 113 113,
1 13 27 41 53 66 78 91 97 97 97,
```

```
1 13 27 40 51 64 76 83 83 83 83,
1 13 27 38 50 61 69 69 69 69 69,
1 12 25 37 49 58 58 58 58 58 58,
1 13 25 35 47 47 47 47 47 47 47];
motor_tq_drive(1:10,1:11,3) = [
0 14 27 39 52 63 77 90 104 118 118,
1 14 27 39 52 63 77 90 104 118 118,
1 14 26 39 52 64 79 91 105 120 120,
1 14 26 39 52 64 79 91 105 120 120,
1 14 26 40 52 66 79 91 105 113 113,
1 13 27 41 53 66 78 91 97 97 97,
1 13 27 40 51 64 76 83 83 83 83,
1 13 27 38 50 61 69 69 69 69 69,
1 12 25 37 49 58 58 58 58 58 58,
1 13 25 35 47 47 47 47 47 47 47];

% Electric motor regenerative torque [Nm]
% Described by three-dimensional map of motor_speed (revolution speed), motor_ref (command) and motor_vol (voltage).
motor_tq_reduction (1:10,1:11,1) = [
0   0   0   0   0   0   0   0   0   0   0,
0 -14 -27 -39 -52 -63 -77 -90 -104 -118 -118,
0 -14 -26 -39 -52 -64 -79 -91 -105 -120 -120,
0 -14 -26 -39 -52 -64 -79 -91 -105 -120 -120,
0 -14 -26 -40 -52 -66 -79 -91 -105 -113 -113,
0 -13 -27 -41 -53 -66 -78 -91 -97 -97 -97,
0 -13 -27 -40 -51 -64 -76 -83 -83 -83 -83,
0 -13 -27 -38 -50 -61 -69 -69 -69 -69 -69,
0 -12 -25 -37 -49 -58 -58 -58 -58 -58 -58,
0 -13 -25 -35 -47 -47 -47 -47 -47 -47 -47];
motor_tq_reduction(1:10,1:11,2) = [
0   0   0   0   0   0   0   0   0   0   0,
0 -14 -27 -39 -52 -63 -77 -90 -104 -118 -118,
0 -14 -26 -39 -52 -64 -79 -91 -105 -120 -120,
0 -14 -26 -39 -52 -64 -79 -91 -105 -120 -120,
0 -14 -26 -40 -52 -66 -79 -91 -105 -113 -113,
0 -13 -27 -41 -53 -66 -78 -91 -97 -97 -97,
0 -13 -27 -40 -51 -64 = -76 -83 -83 -83 -83,
0 -13 -27 -38 -50 -61 -69 -69 -69 -69 -69,
0 -12 -25 -37 -49 -58 -58 -58 -58 -58 -58,
0 -13 -25 -35 -47 -47 -47 -47 -47 -47 -47];
motor-tq_reduction(1:10,1:11,3) = [
0   0   0   0   0   0   0   0   0   0   0,
0 -14 -27 -39 -52 -63 -77 -90 -104 -118 -118,
```

```
0 -14 -26 -39 -52 -64 -79 -91 -105 -120 -120,
0 -14 -26 -39 -52 -64 -79 -91 -105 -120 -120,
0 -14 -26 -40 -52 -66 -79 -91 -105 -113 -113,
0 -13 -27 -41 -53 -66 -78 -91 -97 -97 -97,
0 -13 -27 -40 -51 -64 -76 -83 -83 -83 -83,
0 -13 -27 -38 -50 -61 -69 -69 -69 -69 -69,
0 -12 -25 -37 -49 -58 -58 -58 -58 -58 -58,
0 -13 -25 -35 -47 -47 -47 -47 -47 -47 -47];

% Electric motor electric power    motor_elepower_drive [W]
% Described by three-dimensional map of motor_speed (revolution speed),
motor_ref (command %) and motor_vol (voltage).
motor_elepower_drive(1:10,1:11,1) = [
 0   1   1   1   1   1   1   1   1   1   1,
 1   2   4   5   7   9 11 13 15 18 18,
 1   3   6   9 13 16 19 23 27 32 37,
 2   5   9 14 19 23 28 33 39 44 45,
 3   7 12 18 24 31 37 43 50 55 95,
 4   8 16 24 31 39 46 54 59 85 86,
 5   9 19 28 36 45 54 60 88 88 88,
 6 11 22 31 41 51 58 85 85 85 85,
 6 12 24 35 46 56 82 82 82 82 82,
 7 14 26 38 51 75 75 75 75 75 75]*10^3;
motor_elepower_drive(1:10,1:11,2) = [
 0   1   1   1   1   1   1   1   1   1   1,
 1   2   4   5   7   9 11 13 15 18 18,
 1   3   6   9 13 16 19 23 27 32 37,
 2   5   9 14 19 23 28 33 39 44 45,
 3   7 12 18 24 31 37 43 50 55 95,
 4   8 16 24 31 39 46 54 59 85 86,
 5   9 19 28 36 45 54 60 88 88 88,
 6 11 22 31 41 51 58 85 85 85 85,
 6 12 24 35 46 56 82 82 82 82 82,
 7 14 26 38 51 75 75 75 75 75 75]*10^3;
motor_elepower_drive(1:10,1:11,3) = [
 0   1   1   1   1   1   1   1   1   1   1,
 1   2   4   5   7   9 11 13 15 18 18,
 1   3   6   9 13 16 19 23 27 32 37,
 2   5   9 14 19 23 28 33 39 44 45,
 3   7 12 18 24 31 37 43 50 55 95,
 4   8 16 24 31 39 46 54 59 85 86,
 5   9 19 28 36 45 54 60 88 88 88,
 6 11 22 31 41 51 58 85 85 85 85,
 6 12 24 35 46 56 82 82 82 82 82,
```

```
 7 14 26 38 51 75 75 75 75 75 75]*10^3;

% Electric motor regenerative electric power  motor_elepower_reduction [W]
% Described by three-dimensional map of motor_speed (revolution speed), motor_ref (command) and motor_vol (voltage).
motor_elepower_reduction(1:10,1:11,1) = [
 0  1  1  1  1  1  1  1  1  1  1,
 1  2  4  5  7  9 11 13 15 18 18,
 1  3  6  9 13 16 19 23 27 32 37,
 2  5  9 14 19 23 28 33 39 44 45,
 3  7 12 18 24 31 37 43 50 55 95,
 4  8 16 24 31 39 46 54 59 85 86,
 5  9 19 28 36 45 54 60 88 88 88,
 6 11 22 31 41 51 58 85 85 85 85,
 6 12 24 35 46 56 82 82 82 82 82,
 7 14 26 38 51 75 75 75 75 75 75]*(-10^3);
motor_elepower_reduction(1:10,1:11,2) = [
 0  1  1  1  1  1  1  1  1  1  1,
 1  2  4  5  7  9 11 13 15 18 18,
 1  3  6  9 13 16 19 23 27 32 37,
 2  5  9 14 19 23 28 33 39 44 45,
 3  7 12 18 24 31 37 43 50 55 95,
 4  8 16 24 31 39 46 54 59 85 86,
 5  9 19 28 36 45 54 60 88 88 88,
 6 11 22 31 41 51 58 85 85 85 85,
 6 12 24 35 46 56 82 82 82 82 82,
 7 14 26 38 51 75 75 75 75 75 75]*(-10^3);
motor_elepower_reduction(1:10,1:11,3) = [
 0  1  1  1  1  1  1  1  1  1  1,
 1  2  4  5  7  9 11 13 15 18 18,
 1  3  6  9 13 16 19 23 27 32 37,
 2  5  9 14 19 23 28 33 39 44 45,
 3  7 12 18 24 31 37 43 50 55 95,
 4  8 16 24 31 39 46 54 59 85 86,
 5  9 19 28 36 45 54 60 88 88 88,
 6 11 22 31 41 51 58 85 85 85 85,
 6 12 24 35 46 56 82 82 82 82 82,
 7 14 26 38 51 75 75 75 75 75 75]*(-10^3);

% Electric motor maximum power running torque map [Nm] Drivable torque
% Described by two-dimensional map of motor_speed_max (revolution speed) and motor_vol (voltage).
motor_max_mtr_tq_lim(1:10,1:3) = [
```

```
200 200 200 200 200 200 200 200 200 200,
200 200 200 200 200 200 200 200 200 200,
200 200 200 200 200 200 200 200 200 200]';

% Electric motor maximum regenerative torque map [Nm] Regeneratable torque
% Described by two-dimensional map of motor_speed_max (revolution speed) and motor_vol (voltage).
motor_max_reg_tq(1:10,1:3) = [
200 200 200 200 200 200 200 200 200 200,
200 200 200 200 200 200 200 200 200 200,
200 200 200 200 200 200 200 200 200 200]';
% ------------------------------------------------------------------------

% Engine ----------------------------------------------------------------
% Engine characteristics
% ECU commanded throttle valve opening angle [%]
eg_tq(1:11) = [0 10 20 30 40 50 60 70 80 90 100];
% Engine revolution speed [r/min]
eg_rev(1:7) = [0.0 570.0 800.0 1400.0 3000.0 3200.0 3400.0];
% Engine revolution speed [r/min]
ilI_eg_rev_acc = 7;
eg_rev_acc(1:ilI_eg_rev_acc) = [0.0 570.0 800.0 1400.0 3000.0 3200.0 3400.0];
% Torque limit rate (0 – 1)
eg_tq_1im_rate=[0    1];
% Throttle valve opening angle [%]        % Fuel injection amount for idle-speed adjustment and for driver demand
isc(1,1:6) = [0    20    40    60    80    100];
% Idle-speed command [r/min]
eg_idle_ref(1,1:5) = [-100    0    600    1000    4000];
% Engine revolution speed for fuel economy map [r/min]
eg_fuel_rev(1:7) = [0    600    900    1400    2000    2600    3200];
% Engine torque for fuel economy map [Nm]
eg_fuel_tq(1:9) = [-160.0 0.0 50.0 100.0 200.0 300.0 400.0 450.0 500.0];

% Actual torque map (auxiliary brake ON) [Nm]
% Described by two-dimensional map of eg_tq (commanded opening angle) and eg_rev_acc (engine revolution speed).
eg_tq_exbr_map(1:ilI_eg_rev_acc, 1:11) = [
   0      0      0     0     0      0      0      0      0      0      0,
   0      0      3    40    78    116    153    191    228    266    304,
-131    -77    -24    29    83    136    190    243    297    351    404,
-227 -169 -111    -52     5    63    121    180    238    296    354,
```

```
-401 -339 -276 -213 -151  -88  -25  37  99  162  225,
-413 -359 -305 -251 -197 -143  -89  -34  19  73  127,
-413 -398 -382 -367 -352 -336 -321 -305 -290 -275 -259];

% Actual torque map (auxiliary brake OFF) [Nm] 2006.07.20 Dummy
% Described by two-dimensional map of eg_tq (commanded opening angle)
and eg_rev_acc (engine revolution speed).
eg_tq_map(1:ilI_eg_rev_acc, 1:11) = [
   0    0    0    0    0    0    0    0    0    0    0,
   0    0    3   40   78  116  153  191  228  266  304,
 -75  -21   31   85  138  192  246  299  353  406  460,
 -82  -24   34   92  150  208  266  325  383  441  499,
-145  -82  -19   43  105  168  231  293  356  419  482,
-154 -100  -46    7   61  115  169  223  278  332  386,
-154 -139 -124 -108  -93  -77  -62  -47  -31  -16  -1];

% Maximum torque map [Nm] 2006.07.20 Dummy
% Described by one-dimensional map of eg_rev (engine revolution speed).
eg_max_trq(1:7) = [0.1 380 540 580 630 540 155];

% Friction torque map [Nm]
% Described by one-dimensional map of eg_rev (engine revolution speed).
eg_loss(1:7) = [0   72   75   82 145 154 154] *(-1);

% Friction torque map of accessories [Nm]
% Described by one-dimensional map of eg_rev (engine revolution speed).
accessory_loss(1:7) = [0   1   1   1   1   1   1]*(-1);

% Torque limit map [Nm]
% Described by two-dimensional map of eg_rev (engine revolution speed)
and eg_tq_limit_rate (torque limit rate).
eg_tq_limit_map(1:7,1:2) = [
600 600,
600 600,
600 600,
600 600,
600 600,
600 600,
600 600];

% Driver demand combustion injection amount [mm3/st]
% Described by two-dimensional map of eg_idle_ref (idle-speed command)
and isc (throttle valve opening angle).
acc_rev_map(1:5,1:6) = [
```

```
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0];

% Injection amount for idle-speed control [mm3/st]
% Described by two-dimensional map of eg_idle_ref (idle-speed command) and isc (throttle valve opening angle).
idle_rev_map(1:5,1:6) = [
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0,
0   0   0.00    0.00   0   0];

% Fuel consumption rate map [L/h] -- > 10^6/360/(EgRev rpm/60*Number of cylinders/2) -- > [mm3/st]
% Described by two-dimensional map of eg_fuel_rev (engine revolution speed) and eg_fuel_tq (actual torque).
fuel_consumption(1:7,1:9) = [
0.0 0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0,
0.0 0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0,
0.0 2.0   2.5   3.0   5.0   7.0 10.0 11.0 13.0,
0.0 2.0   3.0   5.0   7.0 11.0 15.0 18.0 20.0,
0.0 4.0   6.0   8.0 12.0 17.0 23.0 26.0 29.0,
0.0 6.0   8.0 10.0 15.0 22.0 29.0 33.0 37.0,
0.0 9.0 12.0 15.0 22.0 30.0 40.0 45.0 50.0];

% Engine torque response delay
eg_time_SIM = [0 1000 9000 10000 20000];
eg_m_SIM = [0.0100 0.0100 0.0100 0.0100 0.0100];
eg_j_SIM = [0.0100 0.0100 0.0100 0.0100 0.0100];
% ------------------------------------------------------------------------

% Accessory loss current map [A]
% 2007.1.16 Added ------------------------------------------------------
% Accessory voltage [V]
vol_accessory(1:5) = [0   200   250   300   350];
% Described by one-dimensional map of vol_accessory (accessory voltage).
curr_accessory1(1:5) = [0   0   0   0   0];
curr_accessory2(1:5) = [0   0   0   0   0];
% ------------------------------------------------------------------------
```

```
% Fluid coupling ----------------------------------------------------------------
% Torqe-Converter Parameter TQ-bi TQ-youryo [Nm/(r/min)2]
% Torque converter setting    Be careful of the unit of torque volume.
tq_t_e = [0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0]; %
Revolution ratio = Low revolution/high revolution
tq_t_t = [1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0]; %
Torque ratio – 1
tq_y_e = tq_t_e;
tq_y_y = [0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0]; %
torque volume
% ------------------------------------------------------------------------
```

Attached Sheet 2

SILS REFERENCE PARAMETER FOR SERIES HEV MODEL

```
<set_parame_s>
% SILS reference parameter for series HEV model
%
% Vehicle parameter, battery characteristics, brake characteristics and
% controlling constant, load of various characteristics

clear;

% Setting of ECU switch
ECU = 0;    % 1:Actula ECU, 0:ECU model
% Since calculation of denormal numbers may become slow, their threshold
shall be provided.    20060413
denormalNumber=10^(-15);

% Load of characteristic map
map_para_s;

% Sampling [s]
stepsize = 0.0005;
% Acceleration of gravity [m/s2]
g = 9.80665;

% Vehicle weight [kg]
ms = 12000; %<-?  Gross weight 15200; Vehicle weight 11200; loaded
weight 13110
% Tyre radius [m]
rd = 0.47;

% Load formula [kgf]    Fr = la + lb*V[km/h] +lc*V[km/h]*V[km/h]
mu = 0.008;    % Rolling resistance coefficient
W = ms*g;    % Gross vehicle weight [N]
A = 6.0;    % Frontal projected area [m2]
Cd = 0.005*g;    % Air resistance coefficient
la = 96;%(mu*W)/g;
lb = 0.0;
lc = 0.03;%Cd*A/g; %cd=kN*h2/(m2*km2);

% Reduction gear ratio
%reduction-gear_ration = 6.2;
```

```
%reducation_gear_ratio=reduction_gear_ration;
reduction_gear_ratio = 6▪2;

% Final gear ratio
nf = 6.1;

% Rotary inertia moment of each section [kgm2]
% jl: vehicle body and tyre, j2: differential gear, j3: transmission output side,
j4: transmission input side
jl = 800;
tire_j=0.001;
j2 = 0.6;
j3 = 0.4;
j4 = 0.0;
% Engine inertia [kg2]
engine_j = 0.13*g;
j5 = engine_j;

% Differential gear transmission efficiency [%]
%deff_efficiency = 0.95;
%diff_efficiency = deff_efficiency;
diff_efficiency = 0.95;

% Reduction gear transmission efficiency [%]
reduce_efficiency = 0.95;

gen_gear_eff=0.95;
gen_gear_efficiency = 0.95;
gen_gear-ratio=2.23;
Gen2Eg_ratio=gen_gear_ratio;

% Drag resistance [Nms/rad]
% cfl: Vehicle body, cf2: Differential gear, cf4: Transmission
cf1 = 0.0;
cf2 = 0.0;
cf4 = 0.0;
% Viscosity resistance of each section
cf5 = 0.005;

% Engine limit revolution speed [rpm]
Rev_1imit = 2500.0;
% Generator torque generated at engine start [Nm]
ST_TQ = 700;
% Idle-speed [r/min]
```

```
eng_const1=1;
eng_const2=2;

% Setting of static friction when vehicle is stopped [Nm]
SEISHI_masatu_tq = 1a * g * rd * 1.1;

% Initial state of charge [%]
initial_capa_capacity = 93▪0;
% Capacitor capacity [F]
capacity = 35.0;
% Capacitor MAX voltage in regular use [V]
cap_max_vol = 330.0;
% Capacitor MAX voltage while charging [V]
cap_max_vol = 350.0;
% Capacitor internal resistance [Ω]
capa_r = 0.095;

% Initial state of charge [%]
initial_batt_capacity = 60.0;
% Battery capacity [Ah]
batt_capacity = 6;
% Battery remaining capacity [%]
SOC = [0 20 40 60 80 100];
% Open voltage [V]
open_voltage = [100 290 300 310 320 330];
% Open voltage (discharging) [V]
disch_open_voltage = [100 290 300 310 320 330];
% Open voltage (charging) [V]
ch_open_voltage = [100 290 300 310 320 330];
% Internal resistance (discharging) [Ω]
disch_inside_resi = [1 1 1 1 1 1]*0.001;
% Internal resistance (charging) [Ω]
ch_inside_resi = [1 1 1 1 1 1]*0.001;

% Number of electric motor
motor_num = 1;
% Electric motor inertia [kgm2]
motor_j = (0.07) *motor_num; % For two motors
% Electric motor positive rotation limit [rpm]
upper_rev = 13000;
% Electric motor negative rotation limit [rpm]
lower_rev = 2000.0;

% Electric motor inertia [kgm2]
```

```
generator_j = 0.09;

% Torsional stiffness [Nm/rad], Attenuation coefficient c[Nms/rad]
% kl/cl: Drive shaft, k2/c2: Propeller shaft, k4/c4: Clutch torsion spring (lock up clutch)
% Since a provisional value with which the model can operate is set, it may be different from actual performance.
% In such a case, set the value of actual vehicle, or a value that causes no problem.
k1 = 20000;%10000;
k2 = 600000;%300000;
k4 = 2000;%1000;
c1 = 40;%200;%6000
c2 = 40;%250;%7500
c4 = 40;%10;%100

% Time constant
tcm1 = 0.01; % Motor 1
tcm2 = 0.01; % Motor 2
tcm3 = 0.01; % Motor 3
tcm4 = 0.01; % Motor 4
tce1 = 0.005; % Engine 1

% Engine revolution speed controlling constant
adj_EngASR_PID_P = 0.1;
adj_EngASR_PID_I = 0.1;
adj_EngASR_PID_D = 0;

% The following parameters are set for the sake of convenience of the model.
% They do not function in series HEV.
% They need not be changed. ----------------------------------------------

% Clutch characteristics [Nm]
cl_TQ_MAX = 2000;

% ---------------------- 070125A    Hereinbelow are added -----------------
% Time constant
tcg1 = 0.01;
tcg2 = 0.01;
tcg3 = 0.01;
tcg4 = 0.01;
tcg5 = 0.01;
tcg6 = 0.005; % Differential time constant
```

```
% Engine revolution speed controlling constant
cons_0 = -3000;

% Starter torque additional revolution
starter_rev_limit = 1500;

% Generator revolution speed controlling PID constant
adj_GenASR_PID_P = 1;
adj_GenASR_PID_I = 5;
adj_GenASR_PID_D = 0;

<map_para_s>
% SILS reference map parameters for series HEV model
%
% Map file for automatic operation of electric motor and engine.
% 070125A    Accessory consumption current map added

% Electric motor revolution speed [r/min]
motor_speed = [0 1300 2600 3900 5200 6500 7800 9100 10400 11700
13000];

% Electric motor revolution speed for maximum torque [r/min]
motor_speed_max = [0 1300 2600 3900 5200 6500 7800 9100 10400 11700
13000];

% Electric motor command [%]
motor_ref = [0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0];

% Electric motor voltage [V]
motor_vol = [300 310 320];

map_max = 350.0;
map_min=210.0;

% Electric motor maximum drive torque [Nm]
Motor_max_mtr_tq_lim = [
      430 430 430,
      430 430 430,
      430 430 430,
      400 400 400,
      300 300 300,
      240 240 240,
      200 200 200,
      180 180 180,
```

```
    150 150 150,
    130 130 130,
    120 120 120];

% Electric motor maximum, regenerative torque [Nm]
motor_max_reg_tq = [
    430 430 430,
    430 430 430,
    430 430 430,
    400 400 400,
    300 300 300,
    240 240 240,
    200 200 200,
    180 180 180,
    150 150 150,
    130 130 130,
    120 120 120];

% Electric motor drive torque [Nm]
motor_tq_drive(1:11,1:11,1) = [
     0 40 90 130 180 220 260 300 350 390 430,
    40 40 90 130 180 220 260 300 350 390 430,
    40 40 90 130 180 220 260 300 350 390 430,
    37 37 75 115 150 190 220 260 300 340 400,
    30 30 60 80 120 140 170 200 225 250 300,
    25 25 50 70 90 115 140 160 180 210 240,
    20 20 40 60 80 90 110 130 150 170 200,
    17 17 30 50 70 80 100 120 130 150 180,
    15 15 30 45 60 75 90 100 120 130 150,
    13 13 25 40 50 65 80 90 100 115 130,
    12 12 23 35 45 60 70 80 90 105 120];

motor_tq_drive(1:11,1:11,2) = [
     0 40 90 130 180 220 260 300 350 390 430,
    40 40 90 130 180 220 260 300 350 390 430,
    40 40 90 130 180 220 260 300 350 390 430,
    37 37 75 115 150 190 220 260 300 340 400,
    30 30 60 80 120 140 170 200 225 250 300,
    25 25 50 70 90 115 140 160 180 210 240,
    20 20 40 60 80 90 110 130 150 170 200,
    17 17 30 50 70 80 100 120 130 150 180,
    15 15 30 45 60 75 90 100 120 130 150,
    13 13 25 40 50 65 80 90 100 115 130,
    12 12 23 35 45 60 70 80 90 105 120];
```

```
motor_tq_drive(1:11,1:11,3) = [
       0 40 90 130 180 220 260 300 350 390 430,
      40 40 90 130 180 220 260 300 350 390 430,
      40 40 90 130 180 220 260 300 350 390 430,
      37 37 75 115 150 190 220 260 300 340 400,
      30 30 60 80 120 140 170 200 225 250 300,
      25 25 50 70 90 115 140 160 180 210 240,
      20 20 40 60 80 90 110 130 150 170 200,
      17 17 30 50 70 80 100 120 130 150 180,
      15 15 30 45 60 75 90 100 120 130 150,
      13 13 25 40 50 65 80 90 100 115 130,
      12 12 23 35 45 60 70 80 90 105 120];

% Electric motor regenerative torque [Nm]
motor_tq_reduction(1:11,1:11,1) = [
       0   0   0   0   0   0   0   0   0   0   0,
      40 40 90 130 180 220 260 300 350 390 430,
      40 40 90 130 180 220 260 300 350 390 430,
      37 37 75 115 150 190 220 260 300 340 400,
      30 30 60 80 120 140 170 200 225 250 300,
      25 25 50 70 90 115 140 160 180 210 240,
      20 20 40 60 80 90 110 130 150 170 200,
      17 17 30 50 70 80 100 120 130 150 180,
      15 15 30 45 60 75 90 100 120 130 150,
      13 13 25 40 50 65 80 90 100 115 130,
      12 12 23 35 45 60 70 80 90 105 120]*(-1);

motor_tq_reduction(1:11,1:11,2) = [
       0   0   0   0   0   0   0   0   0   0   0,
      40 40 90 130 180 220 260 300 350 390 430,
      40 40 90 130 180 220 260 300 350 390 430,
      37 37 75 115 150 190 220 260 300 340 400,
      30 30 60 80 120 140 170 200 225 250 300,
      25 25 50 70 90 115 140 160 180 210 240,
      20 20 40 60 80 90 110 130 150 170 200,
      17 17 30 50 70 80 100 120 130 150 180,
      15 15 30 45 60 75 90 100 120 130 150,
      13 13 25 40 50 65 80 90 100 115 130,
      12 12 23 35 45 60 70 80 90 105 120]*(-1);

motor_tq_reduction(1:11,1:11,3) = [
       0   0   0   0   0   0   0   0   0   0   0,
      40 40 90 130 180 220 260 300 350 390 430,
```

```
    40 40 90 130 180 220 260 300 350 390 430,
    37 37 75 115 150 190 220 260 300 340 400,
    30 30 60 80 120 140 170 200 225 250 300,
    25 25 50 70 90 115 140 160 180 210 240,
    20 20 40 60 80 90 110 130 150 170 200,
    17 17 30 50 70 80 100 120 130 150 180,
    15 15 30 45 60 75 90 100 120 130 150,
    13 13 25 40 50 65 80 90 100 115 130,
    12 12 23 35 45 60 70 80 90 105 120]*(1);

% Electric motor drive electric power [kW]
motor_elepower_drive(1:11,1:11,1) = [
1   1   1   1    1    1    1    1    1    1   1,
1   5 10   15   20   25   30   35   40   45 120,
2 10 20   30   40   50   60   70   80   90 150,
2 15 30   50   60   80 100 110 130 140 200,
2 17 35   55   70   90 105 120 100 140 200,
3 25 50   70   80 130 120 130 120 160 200,
3 30 60   80 100 120 130 140 150 160 200,
4 40 70   90 110 125 140 150 160 170 200,
4 50 60 100 120 130 150 160 170 180 200,
5 55 70 110 130 140 160 170 180 190 200,
5 60 80 120 140 150 170 180 190 200 210];

motor_elepower_drive(1:11,1:11,2) = [
1   1   1   1    1    1    1    1    1    1   1,
1   5 10   15   20   25   30   35   40   45 120,
2 10 20   30   40   50   60   70   80   90 150,
2 15 30   50   60   80 100 110 130 140 200,
2 17 35   55   70   90 105 120 100 140 200,
3 25 50   70   80 130 120 130 120 160 200,
3 30 60   80 100 120 130 140 150 160 200,
4 40 70   90 110 125 140 150 160 170 200,
4 50 60 100 120 130 150 160 170 180 200,
5 55 70 110 130 140 160 170 180 190 200,
5 60 80 120 140 150 170 180 190 200 210];

motor_elepower_drive(1:11,1:11,3) = [
1   1   1   1    1    1    1    1    1    1   1,
1   5 10   15   20   25   30   35   40   45 120,
2 10 20   30   40   50   60   70   80   90 150,
2 15 30   50   60   80 100 110 130 140 200,
2 17 35   55   70   90 105 120 100 140 200,
3 25 50   70   80 130 120 130 120 160 200,
```

```
3 30 60    80 100 120 130 140 150 160 200,
4 40 70    90 110 125 140 150 160 170 200,
4 50 60 100 120 130 150 160 170 180 200,
5 55 70 110 130 140 160 170 180 190 200,
5 60 80 120 140 150 170 180 190 200 210];

% Electric motor regenerative electric power [kW]
motor_elepower_reduction(1:11,1:11,1) = [
0    0    0      0      0      0      0      0      0      0      0,
0    5 10    15    20    25    30    35    40    45    120,
0 10 20    30    40    50    60    70    80    90 150,
0 15 30    50    60    80 100 110 130 140 200,
0 17 35    55    70    90 105 120 100 140 200,
0 25 50    70    80 130 120 130 120 160 200,
0 30 60    80 100 120 130 140 150 160 200,
0 40 70    90 110 125 140 150 160 170 200,
0 50 60 100 120 130 150 160 170 180 200,
0 55 70 110 130 140 160 170 180 190 200,
0 60 80 120 140 150 170 180 190 200 210]*(-1);

motor_elepower_reduction(1:11,1:11,2) = [
0    0    0      0      0      0      0      0      0      0      0,
0    5 10    15    20    25    30    35    40    45    120,
0 10 20    30    40    50    60    70    80    90 150,
0 15 30    50    60    80 100 110 130 140 200,
0 17 35    55    70    90 105 120 100 140 200,
0 25 50    70    80 130 120 130 120 160 200,
0 30 60    80 100 120 130 140 150 160 200,
0 40 70    90 110 125 140 150 160 170 200,
0 50 60 100 120 130 150 160 170 180 200,
0 55 70 110 130 140 160 170 180 190 200,
0 60 80 120 140 150 170 180 190 200 210]*(-1);

motor_elepower_reduction(1:11,1:11,3) = [
0    0    0      0      0      0      0      0      0      0      0,
0    5 10    15    20    25    30    35    40    45    120,
0 10 20    30    40    50    60    70    80    90 150,
0 15 30    50    60    80 100 110 130 140 200,
0 17 35    55    70    90 105 120 100 140 200,
0 25 50    70    80 130 120 130 120 160 200,
0 30 60    80 100 120 130 140 150 160 200,
0 40 70    90 110 125 140 150 160 170 200,
0 50 60 100 120 130 150 160 170 180 200,
0 55 70 110 130 140 160 170 180 190 200,
```

```
0 60 80 120 140 150 170 180 190 200 210]*(-1);

% Generator revolutions [rpm]
gen_rpm = [0 1300 2600 3900 5200 6500 7800 9100 10400 11700 13000];
% Generator torque [Nm]
gen_trq= [0 10 20 30 40 50 60 70 80 90 100];
% Generator voltage [V]
gen_vol = [300 310 320];

% Generator drive electric power [kW]
gen_elepower_drive(1:11,1:11,1) = [
0   2    5    7    9   11   13   15   18   20   22,
0   2    5    7    9   11   13   15   18   20   22,
0   5    9   10   20   25   28   30   40   50   60,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70];

gen_elepower_drive(1:11,1:11,2) = [
0   2    5    7    9   11   13   15   18   20   22,
0   2    5    7    9   11   13   15   18   20   22,
0   5    9   10   20   25   28   30   40   50   60,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70];

gen_elepower_drive(1:11,1:11,3) = [
0   2    5    7    9   11   13   15   18   20   22,
0   2    5    7    9   11   13   15   18   20   22,
0   5    9   10   20   25   28   30   40   50   60,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
```

```
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70];

% Generator regenerative electric power [kW]
gen_elepower_reduction(1:11,1:11,1) = [
0   2    5    7    9   11   13   15   18   20   22,
0   2    5    7    9   11   13   15   18   20   22,
0   5    9   10   20   25   28   30   40   50   60,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70]*(-1);

gen_elepower_reduction(1:11,1:11,2) = [
0   2    5    7    9   11   13   15   18   20   22,
0   2    5    7    9   11   13   15   18   20   22,
0   5    9   10   20   25   28   30   40   50   60,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70]*(-1);

gen_elepower_reduction(1:11,1:11,3) = [
0   2    5    7    9   11   13   15   18   20   22,
0   2    5    7    9   11   13   15   18   20   22,
0   5    9   10   20   25   28   30   40   50   60,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70,
0   7   15   20   26   30   40   45   50   60   70]*(-1);
```

```
% Generator drive torque [Nm]
gen_tq_drive(1:11,1:11,1) = [
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0    5 10 20 30 40 50 60 70 80 90,
      0    5 10 20 30 40 50 60 70 80 90,
      0    5 10 20 30 40 50 60 70 80 90,
      0    3    5 10 20 30 40 50 60 70 80,
      0    2    3    5 10 20 30 40 50 60 70,
      0    1    2    3    5 10 20 30 40 50 60,
      0    1    2    3    5 10 20 30 40 50 55];

gen_tq_drive(1:11,1:11,2) = [
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0    5 10 20 30 40 50 60 70 80    90,
      0    5 10 20 30 40 50 60 70 80    90,
      0    5 10 20 30 40 50 60 70 80    90,
      0    3    5 10 20 30 40 50 60 70 80,
      0    2    3    5 10 20 30 40 50 60 70,
      0    1    2    3    5 10 20 30 40 50 60,
      0    1    2    3    5 10 20 30 40 50 55];

gen_tq_drive(1:11,1:11,3) = [
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0 10 20 30 40 50 60 70 80 90 100,
      0    5 10 20 30 40 50 60 70 80    90,
      0    5 10 20 30 40 50 60 70 80    90,
      0    5 10 20 30 40 50 60 70 80    90,
      0    3    5 10 20 30 40 50 60 70 80,
      0    2    3    5 10 20 30 40 50 60 70,
      0    1    2    3    5 10 20 30 40 50 60,
      0    1    2    3    5 10 20 30 40 50 55];

% Generator regenerative torque [Nm]
gen_tq_reduction(1:11,1:11,1) = [
      0 10 20 30 40 50 60 70 80 90 100,
```

```
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0  5 10 20 30 40 50 60 70 80  90,
    0  5 10 20 30 40 50 60 70 80  90,
    0  5 10 20 30 40 50 60 70 80  90,
    0  3  5 10 20 30 40 50 60 70 80,
    0  2  3  5 10 20 30 40 50 60 70,
    0  1  2  3  5 10 20 30 40 50 60,
    0  1  2  3  5 11 20 30 40 50 55]*(-1);

gen_tq_reduction(1:11,1:11,2) = [
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0  5 10 20 30 40 50 60 70 80  90,
    0  5 10 20 30 40 50 60 70 80  90,
    0  5 10 20 30 40 50 60 70 80  90,
    0  3  5 10 20 30 40 50 60 70 80,
    0  2  3  5 10 20 30 40 50 60 70,
    0  1  2  3  5 10 20 30 40 50 60,
    0  1  2  3  5 11 20 30 40 50 55]*(-1);

gen_tq_reduction(1:11,1:11,3) = [
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0 10 20 30 40 50 60 70 80 90 100,
    0  5 10 20 30 40 50 60 70 80  90,
    0  5 10 20 30 40 50 60 70 80  90,
    0  5 10 20 30 40 50 60 70 80  90,
    0  3  5 10 20 30 40 50 60 70 80,
    0  2  3  5 10 20 30 40 50 60 70,
    0  1  2  3  5 10 20 30 40 50 60,
    0  1  2  3  5 11 20 30 40 50 55]*(-1);

% Engine ----------------------------------------------------------------
% Engine characteristics
% ECU commanded throttle valve opening angle [%] 2006.07.20 Dummy
eg_tq(1:11) = [0 10 20 30 40 50 60 70 80 90 100];
% Engine revolution speed [r/min]
eg_rev(1:7) = [0.0    570.0    800.0 1400.0 3000.0 3200.0 3400.0];
% Engine revolution speed [r/min] 2006.07.20 Dummy
```

```
ilI_eg_rev_acc = 7;
eg_rev_acc(1:ilI_eg_rev_acc) = [0.0  570.0  800.0 1400.0 3000.0 3200.0
3400.0];
% Torque limit rate (0 – 1) 2006.07.20 Dummy
eg_tq_lim_rate = [0  1];
% Throttle valve opening angle [%]      %20060210 Fuel injection amount
for idle-speed adjustment and for driver demand
isc(1, 1:6) = [0  20  40  60  80  100];
% Idle-speed command [r/min] 2006.07.20 Dummy
eg_idle_ref(1,1:5) = [-100  0  600  1000  4000];
% Engine revolution speed for fuel economy map [r/min] 2006.07.20
Dummy
eg_fuel_rev(1:7) = [0  600  900  1400  2000  2600  3200];
% Engine torque for fuel economy map [Nm] 2006.07.20 Dummy
eg_fuel_tq(1:9) = [-160.0 0.0 50.0 100.0 200.0 300.0 400.0 450.0 500.0];

% Actual torque map (auxiliary brake ON) [Nm] 2006.07.20 Dummy
% Described by two-dimensional map of eg_tq (command opening angle)
and eg_rev_acc (engine revolution speed).
eg_tq_exbr_map(1:ilI_eg_rev_acc, 1:11) = [
    0    0    0    0    0    0    0    0    0    0    0,
    0    0    3   40   78  116  153  191  228  266  304,
-131  -77  -24   29   83  136  190  243  297  351  404,
-227 -169 -111  -52    5   63  121  180  238  296  354,
-401 -339 -276 -213 -151  -88  -25   37   99  162  225,
-413 -359 -305 -251 -197 -143  -89  -34   19   73  127,
-413 -398 -382 -367 -352 -336 -321 -305 -290 -275 -259];

% Actual torque map (auxiliary brake OFF) [Nm] 2006.07.20 Dummy
% Described by two-dimensional map of eg_tq (command opening angle)
and eg_rev_acc (engine revolution speed).
eg_tq_map(1:ilI_eg_rev_acc, 1:11) = [
   0    0    0    0    0    0    0    0    0    0    0,
-50  -10    3   40   78  116  153  191  228  266  304,
-75  -21   31   85  138  192  246  299  353  406  460,
-82  -24   34   92  150  208  266  325  383  441  499,
-145 -82  -19   43  105  168  231  293  356  419  482,
-154 -100  -46   7   61  115  169  223  278  332  386,
-154 -139 -124 -108  -93  -77  -62  -47  -31 -16  -1]; %070126A Map
changed

%eg_tq_map(1:ilI_eg_rev_acc, 1:11) = [
%    0    0    0    0    0    0    0    0    0    0    0,
%    0    0    3   40   78  116  153  191  228  266  304,
```

```
%   -75   -21   31   85   138   192   246   299   353   406   460,
%   -82   -24   34   92   150   208   266   325   383   441   499,
% -145   -82   -19   43   105   168   231   293   356   419   482,
% -154   -100   -46   7   61   115   169   223   278   332   386,
% -154   -139 -124 -108   -93   -77   -62   -47   -31   -16   -1];

% Maximum torque map [Nm] 2006.07.20 Dummy
% Described by one-dimensional map of eg_rev (engine revolution speed).
eg_max_trq(1:7) = [0.1 380 540 580 630 540 155];

% Friction torque map [Nm] 2006.07.20 Minus
% Described by one-dimensional map of eg_rev (engine revolution speed).
eg_loss(1:7) = [0    72    75    82 145 154 154]*(-1);

% Friction torque map of accessories [Nm] 2006.11.27 Added
% Described by one-dimensional map of eg_rev (engine revolution speed).
accessory_loss(1:7) = [1    1    1    1    1    1    1]*(-1);

% Torque limit map [Nm] 2006.07.20 Dummy
% Described by two-dimensional map of eg_rev (engine revolution speed)
and eg_tq_lim_rate (torque limit rate).
eg_tq_limit_map(1:7,1:2) = [
600 600,
600 600,
600 600,
600 600,
600 600,
600 600,
600 600];

% Driver demand combustion injection amount [mm3/st] 2006.07.20
Dummy
% Described by two-dimensional map of isc (throttle valve opening angle)
and eg_idle_ref (idle-speed command).
acc_rev_map(1:5,1:6) = [
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0]';

% Injection amount for idle-speed control [mm3/st] 2006.07.20 Dummy
% Described by two-dimensional map of isc (throttle valve opening angle)
```

```
and eg_idle_ref (idle-speed command).
idle_rev_map(1:5,1:6) = [
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0,
0   0   0   0   0]';

% Fuel consumption rate map [L/h] --> 10^6/3600/(EgRev rpm/60*number of cylinders/2) --> [mm3/st]
% Described by two-dimensional map of eg_fuel_rev (engine revolution speed) and eg_fuel_tq (actual torque).
fuel_consumption(1:7,1:9) = [
0.0 0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0,
0.0 0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0,
0.0 2.0   2.5   3.0   5.0   7.0 10.0 11.0 13.0,
0.0 2.0   3.0   5.0   7.0 11.0 15.0 18.0 20.0,
0.0 4.0   6.0   8.0 12.0 17.0 23.0 26.0 29.0,
0.0 6.0   8.0 10.0 15.0 22.0 29.0 33.0 37.0,
0.0 9.0 12.0 15.0 22.0 30.0 40.0 45.0 50.0];

% Engine torque response delay
eg_time_SIM = [0 1000 9000 10000 20000];
eg_m_SIM = [0.0100 0.0100 0.0100 0.0100 0.0100];
eg_j_SIM = [0.0100 0.0100 0.0100 0.0100 0.0100];
% ------------------------------------------------------------------------

% Accessory consumption current    070125A    Added
% Voltage[V]
vol_accessory = [0 200 400 600 800];
% Current [A]
curr_accessory1 = [0 1.0 1.0 1.0 1.0];
curr_accessory2 = [0 2.0 2.0 2.0 2.0];
```

Attached Sheet 3

RESULTS OF SILS REFERENCE CALCULATION FOR PARALLEL HEV MODEL

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.1	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.2	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.3	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.4	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.5	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.6	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.7	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.8	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
0.9	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.0	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.1	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.2	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.3	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.4	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.5	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.6	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.7	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.8	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
1.9	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
2.0	0.00	0.00	0.00	0.00	0.00	60.00	285.00	2	0.00
2.1	0.00	25.03	5.90	0.00	1.54	60.00	285.00	2	0.00
2.2	0.00	126.95	13.26	0.00	3.72	60.00	285.00	2	0.00
2.3	0.00	271.03	20.16	0.00	5.26	60.00	284.99	2	0.01
2.4	0.00	412.41	26.98	0.00	7.69	59.99	284.99	2	0.06
2.5	0.00	520.33	33.32	0.00	9.84	59.99	284.99	2	0.18
2.6	0.00	584.60	39.70	0.00	11.88	59.98	284.98	2	0.39
2.7	0.00	621.96	46.53	0.00	14.71	59.98	284.98	2	0.65
2.8	0.00	656.99	53.16	0.00	17.75	59.97	284.97	2	0.95
2.9	0.00	703.62	58.96	0.00	21.31	59.96	284.97	2	1.28
3.0	0.00	776.45	65.23	0.00	25.92	59.95	284.96	2	1.64
3.1	0.00	878.72	67.40	0.00	29.82	59.94	284.95	2	2.02
3.2	0.00	968.18	68.27	0.00	32.98	59.92	284.95	2	2.41
3.3	0.00	1057.10	69.20	0.00	35.91	59.91	284.94	2	2.81
3.4	0.00	1161.98	70.22	0.00	39.06	59.89	284.93	2	3.20
3.5	0.00	1291.80	71.29	0.00	42.90	59.87	284.92	2	3.59
3.6	0.00	1447.23	72.42	0.00	47.49	59.85	284.92	2	3.98
3.7	0.00	1622.03	73.61	0.00	52.69	59.83	284.90	2	4.36
3.8	0.00	1806.08	74.83	0.00	58.25	59.80	284.89	2	4.75
3.9	0.00	1988.91	76.07	0.00	63.88	59.77	284.88	2	5.15
4.0	0.00	2161.67	77.05	0.00	69.78	59.74	284.87	2	5.56
4.1	0.00	2319.07	77.98	0.00	75.44	59.71	284.85	2	5.98

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
4.2	0.00	2464.26	78.90	0.00	80.84	59.67	284.84	2	6.42
4.3	0.00	2603.34	79.66	0.00	86.23	59.63	284.82	2	6.86
4.4	0.00	2742.94	80.40	0.00	91.69	59.59	284.81	2	7.31
4.5	0.00	2890.16	81.15	0.00	97.43	59.55	284.79	2	7.76
4.6	0.00	3049.09	81.89	0.00	103.61	59.50	284.77	2	8.21
4.7	0.00	3220.15	82.63	0.00	110.26	59.45	284.75	2	8.65
4.8	0.00	3400.58	83.37	0.00	117.30	59.40	284.73	2	9.10
4.9	0.00	3585.81	84.11	0.00	124.60	59.34	284.71	2	9.55
5.0	0.00	3771.16	84.85	0.00	132.00	59.29	284.69	2	10.01
5.1	0.00	3950.70	85.00	0.00	138.29	59.22	284.67	2	10.47
5.2	0.00	4117.63	84.95	0.00	144.09	59.16	284.65	2	10.94
5.3	0.00	4275.02	84.87	0.00	149.65	59.09	284.62	2	11.41
5.4	0.00	4429.24	84.79	0.00	155.09	59.02	284.60	2	11.89
5.5	0.00	4586.50	84.71	0.00	160.61	58.95	284.58	2	12.36
5.6	0.00	4750.91	84.63	0.00	166.37	58.87	284.55	2	12.82
5.7	0.00	4923.66	84.55	0.00	172.43	58.79	284.53	2	13.29
5.8	0.00	5102.38	84.08	0.00	177.82	58.71	284.50	2	13.74
5.9	0.00	5276.95	83.20	0.00	182.15	58.63	284.47	2	14.20
6.0	0.00	5445.13	82.36	0.00	186.32	58.54	284.45	2	14.65
6.1	13.31	5608.38	81.54	5.77	190.37	58.45	284.42	2	15.10
6.2	26.62	5768.73	80.74	23.10	194.34	58.37	284.40	2	15.54
6.3	39.94	5928.07	79.94	51.98	198.28	58.27	284.37	2	15.98
6.4	53.41	6086.79	78.75	92.49	204.09	58.18	284.34	2	16.42
6.5	67.08	6238.18	77.15	144.77	211.87	58.09	284.31	2	16.84
6.6	85.13	6383.77	75.62	210.43	219.34	57.99	284.28	2	17.26
6.7	83.64	6527.48	74.11	288.64	226.70	57.88	284.24	2	17.67
6.8	61.49	6671.68	72.60	351.33	234.08	57.78	284.21	2	18.07
6.9	43.84	6816.98	71.07	396.72	241.52	57.67	284.17	2	18.46
7.0	57.16	6962.58	69.55	439.29	248.98	57.55	284.14	2	18.84
7.1	76.35	7106.77	67.98	499.04	255.08	57.44	284.10	2	19.21
7.2	91.05	7247.34	66.43	571.49	260.33	57.32	284.07	2	19.56
7.3	118.41	7383.36	64.93	661.28	265.40	57.19	284.03	2	19.92
7.4	156.91	5562.28	80.52	779.99	195.60	57.08	284.07	3	20.57
7.5	178.86	3815.19	84.98	929.17	139.23	57.01	284.11	3	21.24
7.6	184.94	3204.68	85.00	1140.91	114.92	56.95	284.12	3	21.58
7.7	193.49	3825.20	85.00	1346.79	132.97	56.89	284.09	3	21.64
7.8	195.95	4529.54	84.77	1599.68	156.98	56.82	284.05	3	21.61
7.9	193.79	5158.08	83.97	1818.81	178.52	56.75	284.01	3	21.67
8.0	193.60	5574.31	81.78	1956.28	189.45	56.66	283.98	3	21.91
8.1	192.11	5722.40	80.91	1996.89	193.78	56.57	283.95	3	22.39
8.2	192.73	5642.37	81.21	1958.59	192.31	56.48	283.93	3	23.05
8.3	194.61	5431.84	82.22	1878.27	187.34	56.39	283.91	3	23.82
8.4	196.70	5205.77	83.37	1797.23	181.70	56.31	283.90	3	24.60
8.5	198.13	5060.66	84.15	1748.74	177.86	56.23	283.88	3	25.31
8.6	198.35	5051.00	84.27	1750.31	177.28	56.14	283.86	3	25.90
8.7	197.29	5182.37	83.68	1801.90	180.21	56.06	283.84	3	26.37
8.8	195.25	5419.46	82.54	1889.35	185.86	55.98	283.81	3	26.74
8.9	192.73	5704.09	81.12	1991.18	192.85	55.89	283.78	3	27.07

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
9.0	190.29	5976.02	79.75	2086.06	199.66	55.80	283.75	3	27.40
9.1	188.35	6188.60	77.71	2158.22	209.61	55.70	283.72	3	27.78
9.2	187.14	6320.96	76.24	2200.93	216.82	55.60	283.68	3	28.23
9.3	186.59	6380.67	75.54	2218.41	220.22	55.50	283.66	3	28.73
9.4	186.48	6394.64	75.36	2220.88	221.12	55.40	283.63	3	29.26
9.5	186.49	6396.45	75.34	2220.46	221.23	55.30	283.60	3	29.80
9.6	191.76	5080.93	83.19	1948.79	182.75	55.20	283.62	4	30.59
9.7	203.41	4172.35	84.88	1461.45	149.43	55.13	283.63	4	31.61
9.8	201.39	3498.95	85.00	1154.96	126.46	55.06	283.64	4	32.40
9.9	199.55	3324.46	85.00	1134.49	117.93	55.01	283.63	4	32.79
10.0	203.47	3733.40	85.00	1310.99	130.24	54.95	283.61	4	32.87
10.1	204.75	4323.68	84.87	1529.85	150.50	54.89	283.57	4	32.89
10.2	200.90	4718.69	84.65	1660.84	165.48	54.81	283.54	4	33.03
10.3	200.11	4788.67	84.60	1669.65	169.07	54.73	283.51	4	33.36
10.4	201.55	4631.97	84.67	1602.16	164.10	54.66	283.50	4	33.82
10.5	203.44	4437.67	84.77	1530.40	157.13	54.58	283.49	4	34.28
10.6	204.38	4349.77	84.82	1503.67	153.55	54.51	283.47	4	34.67
10.7	203.97	4403.42	84.80	1529.27	154.99	54.44	283.46	4	34.99
10.8	202.71	4543.39	84.74	1583.07	159.76	54.37	283.43	4	35.25
10.9	201.38	4686.01	84.66	1633.77	164.90	54.29	283.41	4	35.53
11.0	200.53	4775.19	84.62	1662.63	168.28	54.21	283.39	4	35.83
11.1	200.27	4803.83	84.60	1669.50	169.49	54.14	283.36	4	36.16
11.2	200.32	4800.63	84.60	1666.37	169.45	54.06	283.35	4	36.51
11.3	200.35	4801.86	84.60	1666.58	169.45	53.98	283.33	4	36.86
11.4	200.15	4828.68	84.59	1676.97	170.30	53.90	283.30	4	37.19
11.5	199.70	4880.72	84.56	1696.36	172.08	53.82	283.28	4	37.51
11.6	199.14	4943.79	84.53	1719.02	174.31	53.74	283.26	4	37.82
11.7	198.61	5002.51	84.50	1739.37	176.42	53.66	283.24	4	38.13
11.8	198.20	5048.90	84.28	1754.95	177.65	53.58	283.22	4	38.45
11.9	197.89	5084.57	84.09	1766.74	178.56	53.50	283.20	4	38.77
12.0	197.62	5116.69	83.93	1777.62	179.37	53.41	283.17	4	39.10
12.1	197.32	5151.80	83.76	1789.89	180.24	53.33	283.15	4	39.42
12.2	196.97	5192.38	83.56	1804.24	181.25	53.25	283.13	4	39.73
12.3	196.61	4639.10	84.19	1770.38	173.76	53.16	283.12	5	40.07
12.4	205.76	3948.67	84.96	1307.93	144.06	53.09	283.13	5	40.78
12.5	200.15	3378.17	85.00	1127.04	121.23	53.03	283.14	5	41.25
12.6	200.95	3450.55	85.00	1199.14	121.87	52.97	283.12	5	41.41
12.7	204.93	3828.45	85.00	1350.79	134.29	52.91	283.09	5	41.47
12.8	206.40	4077.66	84.97	1431.77	143.54	52.85	283.07	5	41.62
12.9	206.38	4078.36	84.96	1417.34	144.35	52.78	283.05	5	41.88
13.0	206.46	3968.17	85.00	1371.12	140.62	52.72	283.04	5	42.19
13.1	205.71	3903.68	85.00	1350.44	138.18	52.65	283.02	5	42.46
13.2	205.95	3931.29	85.00	1365.53	138.84	52.59	283.01	5	42.69
13.3	206.69	4003.14	85.00	1393.63	141.21	52.52	282.99	5	42.90
13.4	206.76	4058.94	84.97	1412.34	143.29	52.46	282.97	5	43.12
13.5	206.57	4079.18	84.96	1417.29	144.13	52.39	282.95	5	43.36
13.6	206.57	4082.69	84.96	1417.34	144.28	52.32	282.94	5	43.61
13.7	206.51	4092.29	84.95	1420.89	144.59	52.26	282.92	5	43.85

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
13.8	206.31	4114.79	84.94	1429.45	145.35	52.19	282.90	5	44.09
13.9	206.05	4143.55	84.93	1439.87	146.37	52.12	282.88	5	44.32
14.0	205.82	4170.26	84.92	1449.08	147.34	52.05	282.87	5	44.55
14.1	205.62	4192.28	84.90	1456.45	148.14	51.99	282.85	5	44.79
14.2	205.46	4211.89	84.90	1463.10	148.85	51.92	282.83	5	45.03
14.3	205.28	4232.14	84.88	1470.15	149.57	51.85	282.81	5	45.26
14.4	205.09	4254.05	84.87	1477.85	150.35	51.78	282.79	5	45.50
14.5	204.89	4276.80	84.86	1485.81	151.16	51.71	282.78	5	45.73
14.6	204.70	4299.32	84.85	1493.62	151.97	51.64	282.76	5	45.96
14.7	204.51	4321.19	84.84	1501.18	152.76	51.57	282.74	5	46.20
14.8	204.32	4342.70	84.83	1508.63	153.53	51.50	282.72	5	46.43
14.9	204.13	4364.25	84.82	1516.11	154.30	51.43	282.70	5	46.66
15.0	203.95	4385.99	84.81	1523.67	155.08	51.36	282.68	5	46.91
15.1	203.76	4407.82	84.80	1531.26	155.86	51.28	282.66	5	47.13
15.2	203.57	4429.60	84.79	1538.82	156.64	51.21	282.65	5	47.36
15.3	203.38	4451.27	84.78	1546.33	157.42	51.14	282.63	5	47.59
15.4	203.19	4472.86	84.76	1553.83	158.19	51.06	282.61	5	47.82
15.5	203.00	4494.43	84.75	1561.31	158.97	50.99	282.59	5	48.05
15.6	202.82	4515.99	84.74	1568.80	159.74	50.92	282.57	5	48.28
15.7	202.63	4537.54	84.73	1576.29	160.51	50.84	282.55	5	48.51
15.8	202.44	4559.06	84.72	1583.76	161.29	50.77	282.53	5	48.74
15.9	202.26	4580.53	84.71	1591.21	162.06	50.69	282.51	5	48.97
16.0	202.07	4601.97	84.70	1598.65	162.83	8062	282.49	5	49.20
16.1	201.89	4623.38	84.69	1606.08	163.60	50.54	282.47	5	49.43
16.2	201.70	4644.75	84.68	1613.51	164.37	50.47	282.45	5	49.66
16.3	201.51	4666.10	84.67	1620.92	165.13	50.39	282.43	5	49.89
16.4	204.96	3931.69	84.99	1351.92	139.71	50.32	282.44	6	50.22
16.5	199.56	3272.54	85.00	1107.71	119.18	50.26	282.44	6	50.65
16.6	199.48	3302.43	85.00	1138.89	117.53	50.20	282.43	6	50.78
16.7	202.62	3555.42	85.00	1253.73	125.83	50.15	282.41	6	50.82
16.8	203.93	3675.67	85.00	1284.55	130.63	50.09	282.39	6	50.95
16.9	203.36	3630.89	85.00	1257.07	129.47	50.03	282.38	6	51.13
17.0	202.73	3578.13	85.00	1238.26	127.56	49.97	282.36	6	51.31
17.1	202.81	3586.09	85.00	1245.35	127.65	49.91	282.35	6	51.47
17.2	203.18	3620.48	85.00	1259.19	128.80	49.85	282.33	6	51.61
17.3	203.40	3641.69	85.00	1265.91	129.58	49.79	282.32	6	51.77
17.4	203.44	3647.57	85.00	1266.55	129.82	49.73	282.30	6	51.93
17.5	203.47	3652.58	85.00	1268.23	129.98	49.67	282.29	6	52.08
17.6	203.57	3663.17	85.00	1272.31	130.33	49.61	282.27	6	52.24
17.7	203.70	3676.26	85.00	1277.03	130.77	49.55	282.26	6	52.39
17.8	203.81	3688.16	85.00	1281.08	131.19	49.49	282.24	6	52.55
17.9	203.90	3698.61	85.00	1284.61	131.55	49.43	282.23	6	52.71
18.0	204.00	3708.97	85.00	1288.19	131.91	49.37	282.21	6	52.86
18.1	204.10	3719.83	85.00	1292.00	132.28	49.31	282.19	6	53.02
18.2	204.20	3730.93	85.00	1295.87	132.66	49.24	282.18	6	53.17
18.3	204.30	3741.91	85.00	1299.68	133.04	49.18	282.16	6	53.33
18.4	204.40	3752.74	85.00	1303.43	133.41	49.12	282.15	6	53.48
18.5	204.50	3763.57	85.00	1307.19	133.78	49.06	282.13	6	53.64

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
18.6	204.61	3774.43	85.00	1310.96	134.15	49.00	282.12	6	53.79
18.7	204.71	3785.31	85.00	1314.71	134.53	48.93	282.10	6	53.95
18.8	204.81	3796.17	85.00	1318.51	134.90	48.87	282.08	6	54.10
18.9	204.91	3807.01	85.00	1322.27	135.27	48.81	282.07	6	54.26
19.0	205.01	3817.84	85.00	1326.04	135.65	48.75	282.05	6	54.41
19.1	205.11	3828.67	85.00	1329.80	136.02	48.68	282.03	6	54.56
19.2	205.21	3839.50	85.00	1333.55	136.39	48.62	282.02	6	54.72
19.3	205.31	3850.32	85.00	1337.31	136.76	48.56	282.00	6	54.87
19.4	205.41	3861.12	85.00	1341.06	137.13	48.49	281.99	6	55.03
19.5	205.51	3871.93	85.00	1344.81	137.51	48.43	281.97	6	55.18
19.6	205.61	3882.72	85.00	1348.56	137.88	48.37	281.95	6	55.33
19.7	205.71	3893.51	85.00	1352.31	138.25	48.30	281.94	6	55.49
19.8	205.81	3904.29	85.00	1356.05	138.62	48.24	281.92	6	55.64
19.9	205.91	3915.06	85.00	1359.79	138.99	48.17	281.90	6	55.79
20.0	206.01	3925.82	85.00	1363.53	139.36	48.11	281.89	6	55.95
20.1	206.11	3936.58	85.00	1367.26	139.73	48.05	281.87	6	56.10
20.2	206.21	3947.33	85.00	1370.99	140.10	47.98	281.86	6	56.25
20.3	206.31	3958.07	85.00	1374.72	140.47	47.92	281.84	6	56.41
20.4	206.41	3968.81	85.00	1378.45	140.85	47.85	281.82	6	56.56
20.5	206.50	3979.53	85.00	1382.17	141.22	47.79	281.81	6	56.71
20.6	206.60	3990.25	85.00	1385.90	141.58	47.72	281.79	6	56.87
20.7	206.70	4000.97	85.00	1389.62	141.96	47.65	281.77	6	57.02
20.8	206.80	4011.67	84.99	1393.33	142.34	47.59	281.75	6	57.17
20.9	206.90	4022.36	84.99	1397.04	142.73	47.52	281.74	6	57.32
21.0	206.99	4033.04	84.98	1400.75	143.12	47.46	281.72	6	57.48
21.1	206.91	4043.67	84.98	1404.42	143.50	47.39	281.70	6	57.63
21.2	206.82	4054.24	84.97	1408.09	143.89	47.32	281.69	6	57.78
21.3	206.72	4064.88	84.97	1411.79	144.27	47.26	281.67	6	57.93
21.4	206.63	4075.54	84.96	1415.49	144.66	47.19	281.65	6	58.08
21.5	206.54	4086.18	84.96	1419.18	145.05	47.12	281.64	6	58.23
21.6	206.45	4096.78	84.95	1422.86	145.43	47.06	281.62	6	58.39
21.7	206.36	4107.36	84.95	1426.53	145.82	46.99	281.60	6	58.54
21.8	206.26	7117.93	84.94	1430.21	146.20	46.92	281.58	6	58.69
21.9	206.17	4128.50	84.94	1433.87	146.59	46.85	281.57	6	58.84
22.0	206.08	4139.05	84.93	1437.54	146.97	46.79	281.55	6	58.99
22.1	205.99	4149.58	84.93	1441.19	147.35	46.72	281.53	6	59.14
22.2	205.90	4160.09	84.92	1444.84	147.74	46.65	281.51	6	59.29
22.3	205.81	4170.60	84.92	1448.49	148.12	46.58	281.50	6	59.44
22.4	205.71	4181.08	84.91	1452.13	148.50	46.51	281.48	6	59.59
22.5	205.62	4191.56	84.90	1455.77	148.88	46.44	281.46	6	59.74
22.6	205.53	4202.02	84.90	1459.40	149.26	46.37	281.44	6	59.88
22.7	205.44	4212.46	84.89	1463.02	149.64	46.30	281.43	6	60.03
22.8	205.35	4222.89	84.89	1466.64	150.02	46.24	281.39	6	60.18
22.9	205.26	4233.30	84.88	1470.26	150.40	46.17	281.37	6	60.33
23.0	205.17	4243.71	84.88	1473.87	150.78	46.10	281.36	6	60.48
23.1	205.08	4254.09	84.87	1477.48	151.16	46.03	281.34	6	60.63
23.2	204.99	4264.46	84.87	1481.08	151.54	45.96	281.32	6	60.77
23.3	204.90	4274.82	84.86	1484.67	151.92	45.89	281.30	6	60.92

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
23.4	204.81	4285.16	84.86	1488.26	152.30	45.82	281.28	6	61.07
23.5	204.72	4295.49	84.85	1491.85	152.67	45.74	281.27	6	61.22
23.6	204.63	4305.80	84.85	1495.43	153.05	45.67	281.25	6	61.36
23.7	204.54	4316.09	84.84	1499.00	153.43	45.60	281.35	6	61.51
23.8	204.48	4290.24	16.08	1497.96	32.52	45.54	281.37	6	61.65
23.9	205.52	4244.36	1.00	1458.09	11.54	45.54	281.37	6	61.73
24.0	204.88	4283.22	1.00	1491.93	11.64	45.53	281.37	6	61.74
24.1	204.17	4353.45	1.00	1516.28	11.90	45.53	281.37	6	61.76
24.2	204.08	4363.16	1.00	1515.52	11.96	45.52	281.37	6	61.81
24.3	204.29	4344.17	1.00	1507.00	11.89	45.51	281.37	6	61.86
24.4	204.38	4336.34	1.00	1505.01	11.86	45.51	281.37	6	61.91
24.5	204.31	4343.39	1.00	1508.50	11.88	45.50	281.36	6	61.95
24.6	204.22	4352.05	1.00	1511.63	11.91	45.50	281.36	6	61.99
24.7	204.19	4355.76	1.00	1512.57	11.93	45.49	281.36	6	62.03
24.8	204.18	4356.94	1.00	1512.80	11.93	45.49	281.36	6	62.08
24.9	204.17	4359.00	1.00	1513.58	11.94	45.48	281.36	6	62.12
25.0	204.14	4362.34	1.00	1514.83	11.95	45.48	281.36	6	62.16
25.1	204.10	4365.84	1.00	1516.06	11.96	45.47	281.36	6	62.21
25.2	204.08	4368.92	1.00	1517.10	11.97	45.46	281.35	6	62.25
25.3	204.05	4371.77	1.00	1518.07	11.98	45.46	281.35	6	62.29
25.4	204.03	4374.69	1.00	1519.09	11.99	45.45	281.35	6	62.33
25.5	204.00	4377.72	1.00	1520.15	12.00	45.45	281.35	6	62.38
25.6	203.98	4380.75	1.00	1521.20	12.02	45.44	281.35	6	62.42
25.7	203.95	4383.75	1.00	1522.24	12.03	45.44	281.35	6	62.46
25.8	203.92	4386.72	1.00	1523.27	12.04	45.43	281.35	6	62.50
25.9	203.90	4389.70	1.00	1524.30	12.05	45.43	281.34	6	62.55
26.0	203.87	4392.68	1.00	1525.34	12.06	45.42	281.34	6	62.59
26.1	203.85	4395.66	1.00	1526.37	12.07	45.41	281.34	6	62.63
26.2	206.82	4398.63	1.00	1527.41	12.08	45.41	281.34	6	62.67
26.3	203.79	4401.59	1.00	1528.43	12.09	45.40	281.34	6	62.72
26.4	203.77	4404.56	1.00	1529.46	12.10	45.40	281.34	6	62.76
26.5	203.74	4407.51	1.00	1530.49	12.11	45.39	281.34	6	62.80
26.6	203.72	4410.47	1.00	1531.52	12.12	45.39	281.33	6	62.84
26.7	203.69	4413.42	1.00	1532.54	12.13	45.38	281.33	6	62.89
26.8	203.67	4416.36	1.00	1533.56	12.14	45.38	281.33	6	62.93
26.9	203.64	4419.30	1.00	1534.58	12.15	45.37	281.33	6	62.97
27.0	203.62	4422.24	1.00	1535.60	12.16	45.36	281.33	6	63.01
27.1	203.59	4425.17	1.00	1536.62	12.17	45.36	281.33	6	63.05
27.2	203.56	4428.10	1.00	1537.64	12.18	45.35	281.33	6	63.09
27.3	203.54	4431.03	1.00	1538.65	12.19	45.35	281.32	6	63.14
27.4	203.51	4433.95	1.00	1539.67	12.21	45.34	281.32	6	63.18
27.5	203.49	4436.86	1.00	1540.68	12.22	45.34	281.32	6	63.22
27.6	203.46	4439.77	1.00	1541.69	12.23	45.33	281.32	6	63.26
27.7	203.44	4442.68	1.00	1542.70	12.24	45.32	281.32	6	63.30
27.8	203.41	4445.59	1.00	1543.71	12.25	45.32	281.32	6	63.34
27.9	203.39	4448.49	1.00	1544.71	12.26	45.31	281.32	6	63.38
28.0	203.36	4451.38	1.00	1545.72	12.27	45.31	281.31	6	63.43
28.1	203.34	4454.27	1.00	1546.72	12.28	45.30	281.31	6	63.47

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
28.2	203.31	4457.16	1.00	1547.73	12.29	45.30	281.31	6	63.51
28.3	203.29	4460.04	1.00	1548.73	12.30	45.29	281.31	6	63.55
28.4	203.26	4462.92	1.00	1549.73	12.31	45.28	281.31	6	63.59
28.5	203.24	4465.80	1.00	1550.72	12.32	45.28	281.31	6	63.63
28.6	203.21	4468.67	1.00	1551.72	12.33	45.27	281.31	6	63.67
28.7	203.19	4471.54	1.00	1552.72	12.34	45.27	281.30	6	63.71
28.8	203.16	4474.40	1.00	1553.71	12.35	45.26	281.30	6	63.75
28.9	203.14	4477.26	1.00	1554.70	12.36	45.26	281.30	6	63.79
29.0	203.11	4480.11	1.00	1555.69	12.37	45.25	281.30	6	63.84
29.1	203.09	4482.96	1.00	1556.68	12.38	45.24	281.30	6	63.88
29.2	203.06	4485.81	1.00	1557.67	12.39	45.24	281.30	6	63.92
29.3	203.04	4488.65	1.00	1558.66	12.40	45.23	281.30	6	63.96
29.4	203.01	4491.49	1.00	1559.64	12.41	45.23	281.29	6	64.00
29.5	202.99	4494.32	1.00	1560.63	12.42	45.22	281.29	6	64.04
29.6	202.96	4497.15	1.00	1561.61	12.43	45.22	281.29	6	64.08
29.7	202.94	4499.98	1.00	1562.59	12.44	45.21	281.29	6	64.12
29.8	202.92	4502.80	1.00	1563.57	12.45	45.20	281.29	6	64.16
29.9	202.89	4505.62	1.00	1564.55	12.46	45.20	281.29	6	64.20
30.0	202.87	4508.43	1.00	1565.53	12.47	45.19	281.29	6	64.24
30.1	-86.46	4358.65	1.00	1486.85	12.03	45.19	281.28	6	64.24
30.2	-87.30	4675.75	1.00	1518.78	11.96	45.18	281.28	6	64.10
30.3	-88.03	4347.40	-99.57	1513.48	-183.37	45.23	281.49	6	63.87
30.4	-87.12	4355.75	-99.91	1512.00	-184.49	45.32	281.51	6	63.55
30.5	-88.41	4430.46	-99.47	1542.58	-186.73	45.40	281.54	6	63.20
30.6	-88.93	4454.49	-99.26	1549.40	-187.74	45.49	281.56	6	62.87
30.7	-88.37	4417.30	-99.46	1532.21	-186.63	45.58	281.58	6	62.57
30.8	-87.61	4367.97	-99.78	1514.08	-184.93	45.66	281.60	6	62.28
30.9	-87.20	4339.41	-99.96	1505.46	-183.87	45.75	281.62	6	61.97
31.0	-87.04	4326.22	-100.05	1501.93	-183.37	45.83	281.64	6	61.66
31.1	-86.86	4311.80	-100.13	1496.89	-182.88	45.92	281.66	6	61.35
31.2	-86.57	4290.29	-100.25	1488.97	-182.15	46.00	281.68	6	61.05
31.3	-86.23	4265.82	-100.40	1480.26	-181.31	46.09	281.70	6	60.75
31.4	-85.91	4242.93	-100.54	1472.40	-180.51	46.17	281.72	6	60.44
31.5	-85.63	4222.07	-100.66	1465.29	-179.78	46.25	281.74	6	60.13
31.6	-85.35	4201.57	-100.78	1458.20	-179.07	46.34	281.76	6	59.83
31.7	-85.06	4180.39	-100.91	1450.81	-178.33	46.42	281.78	6	59.53
31.8	-84.76	4158.76	-101.04	1443.26	-177.58	46.50	281.80	6	59.22
31.9	-84.47	4137.19	-101.16	1435.78	-176.83	46.58	281.82	6	58.92
32.0	-84.18	4115.88	-101.29	1428.39	-176.09	46.67	281.84	6	58.61
32.1	-83.89	4094.67	-101.42	1421.04	-175.35	46.75	281.86	6	58.31
32.2	-83.60	4073.43	-101.54	1413.66	-174.61	46.83	281.88	6	58.01
32.3	-83.30	4052.14	-101.67	1406.26	-173.87	46.91	281.90	6	57.70
32.4	-83.02	4030.86	-101.79	1398.87	-173.13	46.99	281.92	6	57.40
32.5	-82.92	4009.56	-101.91	1391.46	-172.39	47.07	281.94	6	57.10
32.6	-82.83	3988.27	-101.98	1384.05	-171.61	47.15	281.96	6	56.80
32.7	-82.75	3967.23	-101.97	1376.78	-170.77	47.23	281.98	6	56.49
32.8	-82.66	3946.25	-101.96	1369.49	-169.94	47.31	282.00	6	56.19
32.9	-82.58	3925.12	-101.95	1362.15	-169.11	47.39	282.02	6	55.89

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
33.0	-82.49	3903.92	-101.94	1354.78	-168.27	47.46	282.03	6	55.59
33.1	-82.40	3882.78	-101.93	1347.44	-167.44	47.54	282.05	6	55.29
33.2	-82.32	3861.71	-101.92	1340.13	-166.60	47.62	282.07	6	54.99
33.3	-82.23	3840.68	-101.91	1332.83	-165.77	47.70	282.09	6	54.69
33.4	-82.15	3819.66	-101.90	1325.53	-164.94	47.77	282.11	6	54.39
33.5	-82.06	3798.65	-101.90	1318.24	-164.11	47.85	282.13	6	54.09
33.6	-81.98	3777.67	-101.89	1310.95	-163.28	47.92	282.14	6	53.79
33.7	-81.89	3756.72	-101.88	1303.68	-162.46	48.00	282.16	6	53.49
33.8	-81.81	3735.80	-101.87	1296.41	-161.63	48.08	282.18	6	53.19
33.9	-81.72	3714.90	-101.86	1289.16	-160.81	48.15	282.20	6	52.90
34.0	-81.64	3694.02	-101.85	1281.91	-159.99	48.22	282.22	6	52.60
34.1	-81.55	3673.17	-101.84	1274.67	-159.16	48.30	282.23	6	52.30
34.2	-81.47	3652.34	-101.83	1267.44	-158.34	48.37	282.25	6	52.01
34.3	-81.39	3631.53	-101.82	1260.22	-157.52	48.44	282.27	6	51.71
34.4	-81.30	3610.75	-101.81	1253.00	-156.70	48.52	282.29	6	51.41
34.5	-81.22	3590.00	-101.80	1245.79	-155.89	48.59	282.30	6	51.12
34.6	-81.13	3569.26	-101.79	1238.60	-155.07	48.66	282.32	6	50.82
34.7	-81.05	3548.55	-101.78	1231.41	-154.26	48.73	282.34	6	50.53
34.8	-80.97	3527.87	-101.77	1224.22	-153.44	48.80	282.35	6	50.23
34.9	-80.96	3970.37	-101.77	1275.39	-164.71	48.88	282.38	5	49.90
35.0	-87.13	4396.99	-99.84	1544.61	-181.71	48.96	282.42	5	49.19
35.1	-94.48	4831.36	-96.83	1710.36	-198.08	49.04	282.46	5	48.60
35.2	-95.31	4876.57	-96.28	1700.47	-201.02	49.14	282.49	5	48.24
35.3	-91.62	4630.52	-97.69	1596.51	-193.30	49.23	282.50	5	48.01
35.4	-87.79	4384.01	-99.25	1508.46	-184.69	49.32	282.51	5	47.76
35.5	-86.36	4295.01	-99.89	1485.46	-181.12	49.40	282.53	5	47.42
35.6	-86.99	4333.83	-99.70	1506.77	-182.10	49.48	282.55	5	47.03
35.7	-87.94	4390.01	-99.33	1528.30	-184.03	49.57	282.58	5	46.63
35.8	-88.04	4389.93	-99.29	1525.61	-184.22	49.65	282.60	5	46.26
35.9	-87.27	4334.51	-99.59	1503.08	-182.48	49.74	282.62	5	45.92
36.0	-86.24	4265.05	-100.01	1477.76	-180.11	49.82	282.64	5	45.59
36.1	-85.51	4214.67	-100.32	1461.09	-178.31	49.91	282.65	5	45.24
36.2	-85.14	4187.54	-100.49	1453.01	-177.31	49.99	282.67	5	44.88
36.3	-84.91	4168.85	-100.60	1447.16	-176.65	50.07	282.69	5	44.52
36.4	-84.59	4144.23	-100.73	1438.39	-175.83	50.15	282.71	5	44.16
36.5	-84.13	4110.15	-100.93	1426.02	-174.68	50.23	282.73	5	43.81
36.6	-83.59	4071.64	-101.15	1412.34	-173.37	50.31	282.75	5	43.46
36.7	-83.08	4034.75	-101.37	1399.58	-172.09	50.39	282.77	5	43.11
36.8	-82.89	4001.54	-101.56	1388.22	-170.94	50.47	282.79	5	42.76
36.9	-82.76	3970.54	-101.58	1377.58	-169.75	50.55	282.81	5	42.40
37.0	-82.64	3939.60	-101.57	1366.88	-168.55	50.63	282.83	5	42.05
37.1	-82.51	3907.32	-101.56	1355.60	-167.30	50.71	282.84	5	41.70
37.2	-82.37	3873.85	-101.55	1343.90	-166.00	50.79	282.86	5	41.35
37.3	-82.24	3840.18	-101.54	1332.19	-164.70	50.86	282.88	5	41.00
37.4	-82.10	3807.02	-101.53	1320.70	-163.41	50.94	282.90	5	40.65
37.5	-81.97	3774.42	-101.52	1309.41	-162.14	51.01	282.92	5	40.30
37.6	-81.85	4072.33	-101.43	1326.67	-167.20	51.09	282.94	4	39.92
37.7	-86.84	4430.50	-99.40	1538.52	-182.27	51.17	282.97	4	39.07

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
37.8	-96.16	5027.24	-95.67	1776.04	-203.14	51.26	283.02	4	38.14
37.9	-102.65	5448.35	-90.23	1916.84	-238.54	51.36	283.08	4	37.39
38.0	-103.65	5486.52	-89.27	1913.53	-244.80	51.47	283.11	4	36.91
38.1	-99.75	5199.51	-92.53	1796.86	-223.34	51.58	283.12	4	36.64
38.2	-93.82	4791.73	-96.49	1645.85	-198.28	51.68	283.12	4	36.42
38.3	-89.07	4475.37	-98.47	1537.81	-187.11	51.77	283.13	4	36.12
38.4	-87.14	4353.55	-99.31	1503.76	-182.32	51.85	283.15	4	35.69
38.5	-87.75	4399.09	-99.11	1528.29	-183.37	51.94	283.17	4	35.14
38.6	-89.43	4509.95	-98.45	1571.48	-187.00	52.02	283.19	4	34.57
38.7	-90.62	4581.91	-97.97	1596.00	-189.63	52.11	283.22	4	34.02
38.8	-90.47	4560.98	-98.03	1584.88	-189.23	52.20	283.24	4	33.55
38.9	-89.04	4455.24	-98.61	1543.83	-185.88	52.29	283.26	4	33.12
39.0	-87.02	4312.44	-99.45	1491.73	-181.11	52.37	283.27	4	32.72
39.1	-85.17	4184.53	-100.21	1447.32	-176.68	52.45	283.29	4	32.30
39.2	-83.95	4100.65	-100.73	1419.97	-173.67	52.53	283.31	4	31.86
39.3	-83.37	4059.46	-100.99	1407.81	-172.14	52.61	283.33	4	31.38
39.4	-83.12	4038.83	-101.11	1401.98	-171.39	52.69	283.34	4	30.89
39.5	-82.95	4012.99	-101.24	1393.11	-170.54	52.77	283.36	4	30.41
39.6	-82.77	4161.87	-100.93	1390.74	-171.95	52.85	283.38	3	29.91
39.7	-86.09	4377.58	-99.41	1507.20	-180.80	52.93	283.41	3	28.83
39.8	-93.89	4912.14	-96.33	1723.04	-198.28	53.02	283.45	3	27.43
39.9	-103.45	5588.99	-88.94	1967.12	-245.61	53.12	283.53	3	25.96
40.0	-111.98	6174.27	-81.26	2170.76	-285.95	53.25	283.60	3	24.63
40.1	-117.05	6501.82	-76.25	2277.03	-292.82	53.38	283.64	3	23.61
40.2	-117.33	6485.52	-75.98	2258.76	-290.47	53.52	283.67	3	22.96
40.3	-112.82	6134.08	-80.47	2122.67	-280.33	53.65	283.69	3	22.65
40.4	-104.74	5541.37	-87.56	1904.79	-243.47	53.77	283.69	3	22.55
40.5	-95.14	4854.96	-94.58	1659.82	-197.65	53.87	283.67	3	22.50
40.6	-86.33	4241.16	-96.79	1446.55	-174.34	53.96	283.66	3	22.35
40.7	-82.16	3819.63	-97.25	1305.79	-157.17	54.04	283.67	3	22.00
40.8	-81.31	3633.95	-96.52	1250.74	-148.24	54.11	283.67	3	21.41
40.9	-81.39	3662.65	-95.79	1270.20	-147.37	54.17	283.69	3	20.60
41.0	-82.12	3751.75	-95.07	1334.57	-150.67	54.24	283.71	2	19.56
41.1	-82.47	3952.81	-94.34	1373.40	-155.37	54.31	283.73	2	18.03
41.2	-85.22	4247.39	-93.29	1481.84	-164.13	54.39	283.76	2	16.19
41.3	-90.57	4628.86	-92.25	1620.54	177.10	54.47	283.79	2	14.21
41.4	-96.03	5014.94	-91.49	1756.73	190.85	54.55	283.83	2	12.23
41.5	-100.56	5329.74	-88.71	1864.55	-197.91	54.64	283.86	2	10.40
41.6	-103.34	5511.56	-86.79	1924.07	-200.26	54.73	283.88	2	8.84
41.7	-103.70	5514.79	-86.10	1919.48	-199.44	54.83	283.91	2	7.62
41.8	-101.27	5316.27	-86.87	1843.42	-194.24	54.92	283.92	2	6.78
41.9	-96.06	4918.51	-88.64	1697.71	-183.78	55.01	283.94	2	6.30
42.0	-88.50	4358.35	-88.15	1496.11	-162.18	55.09	283.93	2	6.13
42.1	-81.92	3685.44	-87.62	1257.25	-137.15	55.16	283.93	2	6.17
42.2	-78.92	2949.87	-87.00	997.97	-111.19	55.21	283.91	2	6.33
42.3	-77.68	1208.98	-85.51	930.10	-55.37	55.25	283.87	2	6.42
42.4	-76.89	305.30	-27.30	863.01	-16.21	55.27	283.83	2	6.23
42.5	-76.11	483.45	-38.36	796.59	-21.33	55.28	283.84	2	5.77

TIME sec	Eng Tq	Motor Rev	Motor Tq	Ne_rpm Out	RESS Current	RESS SOC	RESS Voltage	shift_p	Speed Out
42.6	-58.99	706.89	-57.00	737.20	-29.95	55.29	283.85	2	5.13
42.7	-43.67	864.49	-70.06	692.98	-35.95	55.30	283.86	2	4.36
42.8	-32.33	957.07	-77.55	660.24	-39.97	55.32	283.87	2	3.52
42.9	-23.93	990.61	-80.08	636.00	-40.49	55.34	283.88	2	2.66
43.0	-17.71	972.87	-78.37	618.06	-39.64	55.36	283.88	2	1.83
43.1	-13.11	912.77	-73.23	604.78	-37.23	55.38	283.88	2	1.06
43.2	-9.71	819.90	-65.51	594.95	-33.63	55.39	283.88	2	0.38
43.3	-7.19	15.40	-5.92	587.67	-6.24	55.40	283.86	2	0.00
43.4	-5.32	0.00	0.00	582.28	-3.52	55.41	283.86	2	0.00
43.5	-3.94	0.01	0.00	578.30	-3.52	55.41	283.86	2	0.00
43.6	-2.91	0.01	0.00	575.35	-3.52	55.41	283.86	2	0.00
43.7	-2.16	0.01	0.00	573.16	-3.52	55.41	283.86	2	0.00
43.8	-1.60	0.01	0.00	571.54	-3.52	55.41	283.86	2	0.00
43.9	-1.18	0.01	0.00	570.35	-3.52	55.41	283.86	2	0.00
44.0	-1.00	0.01	0.00	569.43	-3.52	55.42	283.86	2	0.00
44.1	-1.00	0.00	0.00	568.57	-3.52	55.42	283.86	2	0.00
44.2	-1.00	0.00	0.00	567.70	-3.52	55.42	283.86	2	0.00
44.3	-0.99	0.00	0.00	566.84	-3.52	55.42	283.86	2	0.00
44.4	-0.99	0.00	0.00	565.97	-3.52	55.42	283.86	2	0.00
44.5	-0.99	0.00	0.00	565.11	-3.52	55.42	283.86	2	0.00
44.6	-0.99	0.00	0.00	564.25	-3.52	55.43	283.86	2	0.00
44.7	-0.99	0.00	0.00	563.39	-3.52	55.43	283.86	2	0.00
44.8	-0.99	0.00	0.00	562.54	-3.52	55.43	283.86	2	0.00
44.9	-0.99	0.00	0.00	561.68	-3.52	55.43	283.86	2	0.00
45.0	-0.98	0.00	0.00	560.82	-3.52	55.43	283.86	2	0.00

Attached Sheet 4

RESULTS OF SILS REFERENCE CALCULATION FOR SERIES HEV MODEL

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.1	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	60.00	310.00	0.00
0.2	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	60.00	310.00	0.00
0.3	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	60.00	309.99	0.00
0.4	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
0.5	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
0.6	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
0.7	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
0.8	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
0.9	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
1.0	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.99	309.99	0.00
1.1	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.2	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.3	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.4	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.5	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.6	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.7	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.99	0.00
1.8	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.98	309.98	0.00
1.9	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.0	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.1	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.2	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.3	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.4	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.5	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.97	309.98	0.00
2.6	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.96	309.98	0.00
2.7	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.96	309.98	0.00
2.8	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.96	309.98	0.00
2.9	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.96	309.98	0.00
3.0	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.96	309.98	0.00
3.1	-1.00	0.00	0.00	0.00	0.00	1.44	6.23	59.96	309.97	0.00
3.2	-1.00	0.00	0.00	0.00	0.00	3.32	6.23	59.95	309.97	0.00
3.3	-1.00	0.00	0.00	0.00	0.00	5.28	6.24	59.95	309.97	0.00
3.4	-1.00	0.00	0.00	0.00	0.00	7.28	6.27	59.95	309.97	0.00
3.5	-1.00	0.00	0.00	0.00	0.00	9.31	6.30	59.94	309.97	0.00
3.6	-1.00	0.00	0.00	0.00	0.00	11.33	6.35	59.94	309.96	0.00
3.7	-1.00	0.00	0.00	0.00	0.00	13.35	6.42	59.94	309.96	0.00
3.8	-1.00	0.00	0.00	0.00	0.00	15.35	6.50	59.94	309.96	0.00
3.9	-1.00	0.00	0.00	0.00	0.75	17.31	6.60	59.93	309.96	0.00
4.0	-1.00	0.00	0.00	0.00	3.80	19.24	6.72	59.93	309.96	0.02
4.1	-1.00	0.00	0.00	0.00	13.27	20.92	6.79	59.93	309.96	0.06
4.2	-1.00	0.00	0.00	0.00	45.63	22.34	6.78	59.92	309.95	0.21

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
4.3	-1.00	0.00	0.00	0.00	96.63	23.58	6.67	59.92	309.95	0.45
4.4	-1.00	0.00	0.00	0.00	138.44	24.96	6.58	59.92	309.95	0.65
4.5	-1.00	0.00	0.00	0.00	158.74	26.68	6.63	59.91	309.95	0.74
4.6	-1.00	0.00	0.00	0.00	156.82	28.69	6.89	59.91	309.95	0.73
4.7	-1.00	0.00	0.00	0.00	143.49	30.77	7.35	59.91	309.95	0.67
4.8	-1.00	0.00	0.00	0.00	135.19	32.70	7.86	59.90	309.94	0.63
4.9	-1.00	0.00	0.00	0.00	145.36	34.39	8.27	59.90	309.94	0.68
5.0	-1.00	0.00	0.00	0.00	177.76	35.85	8.48	59.90	309.94	0.83
5.1	-1.00	0.00	0.00	0.00	225.15	37.23	8.49	59.89	309.94	1.05
5.2	-1.00	0.00	0.00	0.00	276.15	38.63	8.45	59.89	309.94	1.29
5.3	-1.00	0.00	0.00	0.00	316.94	40.12	8.53	59.88	309.93	1.48
5.4	-1.00	0.00	0.00	0.00	338.44	42.30	8.91	59.88	309.93	1.59
5.5	-1.00	0.00	0.00	0.00	342.34	44.50	9.63	59.88	309.93	1.60
5.6	-1.00	0.00	0.00	0.00	340.34	46.70	10.57	59.87	309.93	1.59
5.7	-1.00	0.00	0.00	0.00	347.99	48.90	11.51	59.87	309.92	1.63
5.8	-1.00	0.00	0.00	0.00	376.70	51.10	12.23	59.86	309.92	1.76
5.9	-1.00	0.00	0.00	0.00	427.94	53.29	12.67	59.85	309.91	2.00
6.0	-1.00	0.00	0.00	0.00	492.56	55.49	12.93	59.85	309.91	2.31
6.1	-1.00	0.00	0.00	0.00	555.62	57.69	13.25	59.84	309.91	2.60
6.2	-1.00	0.00	0.00	0.00	604.14	59.89	13.90	59.84	309.90	2.83
6.3	-1.00	0.00	0.00	0.00	633.67	62.09	15.01	59.83	309.90	2.97
6.4	-1.00	0.00	0.00	0.00	650.55	64.28	16.53	59.82	309.89	3.05
6.5	-1.00	0.00	0.00	0.00	668.49	66.48	18.21	59.81	309.89	3.13
6.6	-1.00	0.00	0.00	0.00	701.50	68.68	19.75	59.81	309.88	3.29
6.7	-1.00	0.00	0.00	0.00	756.67	70.88	20.95	59.80	309.88	3.55
6.8	-1.00	0.00	0.00	0.00	830.60	73.07	21.82	59.79	309.87	3.89
6.9	-1.00	0.00	0.00	0.00	911.31	75.27	22.61	59.78	309.87	4.27
7.0	-1.00	0.00	0.00	0.00	984.40	77.47	23.65	59.77	309.86	4.61
7.1	-1.00	0.00	0.00	0.00	1040.55	79.67	25.22	59.75	309.85	4.87
7.2	-1.00	0.00	0.00	0.00	1080.15	81.87	27.37	59.74	309.84	5.06
7.3	-1.00	0.00	0.00	0.00	1113.09	84.06	29.92	59.73	309.83	5.21
7.4	-1.00	0.00	0.00	0.00	1153.50	86.26	32.49	59.71	309.82	5.40
7.5	-1.00	0.00	0.00	0.00	1212.52	88.46	34.77	59.70	309.81	5.68
7.6	-1.00	0.00	0.00	0.00	1292.56	90.52	36.72	59.68	309.80	6.06
7.7	-1.00	0.00	0.00	0.00	1386.20	92.28	38.36	59.66	309.79	6.49
7.8	-1.00	0.00	0.00	0.00	1479.93	94.04	40.07	59.65	309.78	6.93
7.9	-1.00	0.00	0.00	0.00	1561.12	95.80	42.30	59.63	309.77	7.31
8.0	-1.00	0.00	0.00	0.00	1624.47	97.56	45.30	59.61	309.76	7.61
8.1	-1.00	0.00	0.00	0.00	1674.69	99.32	48.98	59.59	309.74	7.85
8.2	-1.00	0.00	0.00	0.00	1723.91	101.07	52.95	59.56	309.73	8.08
8.3	-1.00	0.00	0.00	0.00	1785.42	102.83	56.73	59.54	309.71	8.36
8.4	-1.00	0.00	0.00	0.00	1866.83	104.59	59.98	59.51	309.69	8.75
8.5	-1.00	0.00	0.00	0.00	1966.23	106.35	62.72	59.48	309.68	9.21
8.6	-1.00	0.00	0.00	0.00	2073.26	108.11	65.27	59.45	309.66	9.71
8.7	-1.00	0.00	0.00	0.00	2174.54	109.87	68.15	59.42	309.64	10.19
8.8	-1.00	0.00	0.00	0.00	2260.54	111.62	71.80	59.39	309.62	10.59
8.9	-1.00	0.00	0.00	0.00	2330.44	113.38	76.31	59.35	309.60	10.92
9.0	-1.00	0.00	0.00	0.00	2392.45	115.14	81.42	59.32	309.58	11.21
9.1	-1.00	0.00	0.00	0.00	2459.50	116.90	86.62	59.28	309.55	11.52

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
9.2	-1.00	0.00	0.00	0.00	2542.55	118.43	91.59	59.24	309.53	11.91
9.3	-1.00	0.00	0.00	0.00	2644.96	119.29	96.46	59.19	309.50	12.39
9.4	-1.00	0.00	0.00	0.00	2760.61	120.33	100.78	59.15	309.47	12.93
9.5	-1.00	0.00	0.00	0.00	2877.04	121.38	105.19	59.10	309.45	13.48
9.6	-1.00	0.00	0.00	0.00	2982.02	122.26	110.46	59.05	309.42	13.97
9.7	-1.00	0.00	0.00	0.00	3069.69	122.87	117.01	59.00	309.38	14.38
9.8	-1.00	0.00	0.00	0.00	3143.46	123.25	124.74	58.94	309.35	14.73
9.9	-1.00	0.00	0.00	0.00	3214.03	123.63	132.67	58.88	309.31	15.06
10.0	-1.00	0.00	0.00	0.00	3293.74	124.07	139.87	58.82	309.27	15.43
10.1	-1.00	0.00	0.00	0.00	3390.30	124.65	146.08	58.75	309.23	15.88
10.2	-1.00	0.00	0.00	0.00	3502.85	125.40	151.31	58.68	309.19	16.41
10.3	-1.00	0.00	0.00	0.00	3622.66	126.21	156.08	58.61	309.15	16.97
10.4	-1.00	0.00	0.00	0.00	3737.66	126.85	161.14	58.54	309.11	17.51
10.5	-1.00	0.00	0.00	0.00	3838.67	127.16	167.09	58.46	309.07	17.98
10.6	-1.00	0.00	0.00	0.00	3923.99	127.07	174.07	58.39	309.02	18.38
10.7	-1.00	0.00	0.00	0.00	3999.98	125.77	178.59	58.30	308.97	18.74
10.8	-1.00	0.00	0.00	0.00	4077.38	124.30	182.20	58.22	308.93	19.10
10.9	-1.00	0.00	0.00	0.00	4165.44	123.25	185.67	58.13	308.88	19.52
11.0	-1.00	0.00	0.00	0.00	4267.25	122.72	188.89	58.05	308.84	19.99
11.1	-1.00	0.00	0.00	0.00	4378.43	122.57	191.93	57.96	308.79	20.51
11.2	-1.00	0.00	0.00	0.00	4489.68	122.47	195.02	57.87	308.74	21.03
11.3	-1.00	0.00	0.00	0.00	4591.68	122.16	198.40	57.78	308.69	21.51
11.4	-1.00	0.00	0.00	0.00	4679.81	121.47	202.22	57.69	308.64	21.92
11.5	-1.00	0.00	0.00	0.00	4756.39	120.48	206.43	57.59	308.59	22.28
11.6	-1.00	0.00	0.00	0.00	4829.21	119.44	210.85	57.50	308.54	22.62
11.7	-1.00	0.00	0.00	0.00	4907.42	118.62	215.22	57.40	308.48	22.99
11.8	-1.00	0.00	0.00	0.00	4996.85	118.20	219.35	57.30	308.43	23.41
11.9	-1.00	0.00	0.00	0.00	5097.23	118.17	223.23	57.19	308.37	23.88
12.0	-1.00	0.00	0.00	0.00	5202.51	118.32	227.01	57.09	308.32	24.37
12.1	-1.00	0.00	0.00	0.00	5304.23	118.43	230.97	56.98	308.26	24.85
12.2	-1.00	0.00	0.00	0.00	5395.80	115.33	231.55	56.88	308.21	25.28
12.3	-1.00	0.00	0.00	0.00	5475.25	111.43	231.52	56.77	308.15	25.65
12.4	-1.00	0.00	0.00	0.00	5545.25	107.58	231.74	56.66	308.10	25.98
12.5	-1.00	0.00	0.00	0.00	5611.51	103.91	232.03	56.55	308.05	26.29
12.6	-1.00	0.00	0.00	0.00	5679.91	100.56	232.18	56.45	307.99	26.61
12.7	-1.00	0.00	0.00	0.00	5753.58	97.59	232.06	56.34	307.94	26.96
12.8	-1.00	0.00	0.00	0.00	5831.48	94.93	231.70	56.23	307.88	27.32
12.9	-1.00	0.00	0.00	0.00	5909.14	92.46	231.25	56.13	307.83	27.68
13.0	-1.00	0.00	0.00	0.00	5981.11	90.05	230.91	56.02	307.78	28.02
13.1	-1.00	0.00	0.00	0.00	6043.78	87.63	230.86	55.91	307.72	28.32
13.2	-1.00	0.00	0.00	0.00	6097.29	85.20	231.11	55.80	307.67	28.57
13.3	-1.00	0.00	0.00	0.00	6145.34	82.84	231.54	55.70	307.62	28.79
13.4	-1.00	0.00	0.00	0.00	6193.32	80.64	231.93	55.59	307.56	29.02
13.5	-1.00	0.00	0.00	0.00	6245.54	78.67	232.10	55.48	307.51	29.26
13.6	-1.00	0.00	0.00	0.00	6303.16	76.91	231.97	55.38	307.46	29.53
13.7	-1.00	0.00	0.00	0.00	6363.70	75.31	231.64	55.27	307.40	29.81
13.8	-1.00	0.00	0.00	0.00	6422.42	73.78	231.30	55.16	307.35	30.09
13.9	-1.00	0.00	0.00	0.00	6474.89	72.28	231.17	55.05	307.30	30.33
14.0	-1.00	0.00	0.00	0.00	6519.22	70.79	231.36	54.95	307.24	30.54

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
14.1	-1.00	0.00	0.00	0.00	6557.02	69.32	230.72	54.84	307.19	30.72
14.2	-1.00	0.00	0.00	0.00	6592.57	67.85	228.83	54.73	307.14	30.89
14.3	-1.00	0.00	0.00	0.00	6630.57	66.43	226.80	54.63	307.09	31.06
14.4	-1.00	0.00	0.00	0.00	6673.75	65.08	224.53	54.52	307.04	31.27
14.5	-1.00	0.00	0.00	0.00	6721.52	63.80	222.04	54.42	306.99	31.49
14.6	-1.00	0.00	0.00	0.00	6770.34	62.55	219.44	54.32	306.94	31.72
14.7	-1.00	0.00	0.00	0.00	6815.58	61.29	216.88	54.22	306.89	31.93
14.8	-1.00	0.00	0.00	0.00	6853.94	59.99	214.46	54.12	306.84	32.11
14.9	-1.00	0.00	0.00	0.00	6885.08	58.63	212.20	54.02	306.80	32.26
15.0	-1.00	0.00	0.00	0.00	6911.78	57.25	210.03	53.92	306.75	32.38
15.1	-1.00	0.00	0.00	0.00	6938.41	55.88	207.81	53.82	306.70	32.51
15.2	-1.00	0.00	0.00	0.00	6968.72	54.57	205.41	53.73	306.66	32.65
15.3	-1.00	0.00	0.00	0.00	7003.92	53.33	202.78	53.63	306.61	32.81
15.4	-1.00	0.00	0.00	0.00	7042.10	52.14	199.99	53.54	306.57	32.99
15.5	-1.00	0.00	0.00	0.00	7079.30	50.96	197.15	53.45	306.53	33.17
15.6	-1.00	0.00	0.00	0.00	7111.57	49.75	194.40	53.36	306.48	33.32
15.7	-1.00	0.00	0.00	0.00	7136.98	48.50	191.80	53.27	306.44	33.44
15.8	-1.00	0.00	0.00	0.00	7156.59	47.21	189.33	53.18	306.40	33.53
15.9	-1.00	0.00	0.00	0.00	7173.83	45.91	186.88	53.09	306.36	33.61
16.0	-1.00	0.00	0.00	0.00	7192.73	44.64	184.33	53.01	306.32	33.70
16.1	-1.00	0.00	0.00	0.00	7215.84	43.33	180.38	52.92	306.28	33.81
16.2	-1.00	0.00	0.00	0.00	7242.92	42.08	176.10	52.84	306.24	33.93
16.3	-1.00	0.00	0.00	0.00	7271.14	40.86	171.69	52.76	306.21	34.07
16.4	-1.00	0.00	0.00	0.00	7296.55	39.65	167.29	52.68	306.17	34.18
16.5	-1.00	0.00	0.00	0.00	7316.14	38.40	162.97	52.60	306.14	34.28
16.6	-1.00	0.00	0.00	0.00	7329.36	37.13	158.74	52.53	306.11	34.34
16.7	-1.00	0.00	0.00	0.00	7338.37	35.84	154.56	52.46	306.07	34.38
16.8	-1.00	0.00	0.00	0.00	7346.88	34.58	150.31	52.39	306.04	34.42
16.9	-1.00	0.00	0.00	0.00	7358.25	33.35	145.92	52.32	306.01	34.47
17.0	-1.00	0.00	0.00	0.00	7373.76	32.18	141.36	52.25	305.98	34.55
17.1	-1.00	0.00	0.00	0.00	7392.05	31.93	140.50	52.19	305.95	34.63
17.2	-1.00	0.00	0.00	0.00	7409.99	31.90	140.60	52.12	305.92	34.72
17.3	-1.00	0.00	0.00	0.00	7424.64	31.86	140.77	52.06	305.89	34.78
17.4	-1.00	2.36	5.27	33.78	7434.72	31.78	141.08	51.99	305.85	34.83
17.5	-6.22	73.18	163.19	46.31	7441.31	31.67	143.76	51.93	305.82	34.86
17.6	-12.21	141.42	315.37	48.72	7447.18	31.56	146.80	51.86	305.78	34.89
17.7	-18.18	209.44	467.06	51.45	7455.42	31.47	150.08	51.79	305.74	34.93
17.8	-24.14	277.34	618.47	54.22	7467.79	31.40	153.55	51.72	305.71	34.99
17.9	-30.09	345.17	769.72	57.01	7483.88	31.37	157.22	51.65	305.67	35.06
18.0	-36.03	412.95	920.87	59.82	7501.34	31.34	161.14	51.57	305.63	35.14
18.1	-41.98	480.70	1071.96	62.62	7517.14	31.31	165.38	51.50	305.58	35.22
18.2	142.44	518.99	1157.36	-6.18	7529.11	31.25	138.84	51.43	305.58	35.27
18.3	218.65	639.55	1426.20	-18.23	7537.04	31.16	127.62	51.37	305.56	35.31
18.4	286.33	784.97	1750.48	-30.23	7542.75	31.06	116.79	51.31	305.54	35.34
18.5	314.09	950.90	2120.51	-42.23	7549.14	30.96	89.94	51.26	305.54	35.37
18.6	321.05	1103.62	2461.08	-54.23	7558.66	30.88	64.38	51.23	305.55	35.41
18.7	297.56	1233.91	2751.62	-66.23	7572.10	30.83	44.12	51.20	305.56	35.48
18.8	262.42	1314.84	2932.10	-78.23	7588.18	30.81	10.56	51.19	305.58	35.55
18.9	246.28	1355.72	3023.25	-90.23	7604.27	30.78	-30.42	51.19	305.63	35.63

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
19.0	244.46	1369.02	3052.91	-102.23	7617.73	30.74	-70.41	51.21	305.68	35.69
19.1	253.12	1364.00	3041.71	-114.23	7627.31	30.67	-109.23	51.26	305.74	35.73
19.2	268.58	1350.30	3011.18	-119.99	7633.69	30.58	-127.01	51.31	305.78	35.76
19.3	281.42	1345.10	2999.58	-120.00	7639.18	30.48	-126.35	51.37	305.81	35.79
19.4	289.74	1347.73	3005.44	-120.00	7646.45	30.39	-126.17	51.43	305.84	35.82
19.5	294.83	1355.31	3022.33	-120.00	7657.19	30.33	-126.36	51.49	305.87	35.87
19.6	297.64	1365.79	3045.71	-120.00	7671.23	30.30	-126.80	51.55	305.90	35.94
19.7	298.88	1377.75	3072.38	-120.00	7686.71	30.27	-127.38	51.61	305.93	36.01
19.8	299.04	1390.20	3100.14	-120.00	7701.02	30.25	-127.97	51.66	305.96	36.08
19.9	298.46	1402.48	3127.52	-120.00	7712.17	30.20	-128.48	51.72	305.99	36.13
20.0	296.91	1413.92	3153.04	-120.00	7719.78	30.12	-128.87	51.78	306.02	36.17
20.1	295.39	1424.19	3175.95	-120.00	7725.25	30.03	-129.14	51.84	306.05	36.19
20.2	293.96	1433.36	3196.38	-120.00	7731.04	29.94	-129.35	51.90	306.08	36.22
20.3	292.65	1441.49	3214.52	-120.00	7739.36	29.87	-129.57	51.96	306.11	36.26
20.4	291.47	1448.69	3230.58	-120.00	7751.04	29.82	-129.81	52.02	306.14	36.31
20.5	290.40	1455.04	3244.74	-120.00	7765.16	29.79	-130.07	52.08	306.17	36.38
20.6	289.44	1460.63	3257.20	-120.00	7779.55	29.77	-130.30	52.14	306.20	36.45
20.7	288.59	1465.54	3268.16	-120.00	7791.88	29.73	-130.44	52.20	306.23	36.50
20.8	287.84	1469.85	3277.77	-120.00	7800.91	29.67	-130.48	52.26	306.26	36.55
20.9	287.18	1473.63	3286.21	-120.00	7807.06	29.60	-130.42	52.32	306.29	36.58
21.0	286.59	1476.95	3293.59	-120.00	7812.20	29.52	-130.21	52.39	306.32	36.60
21.1	286.08	1479.85	3300.06	-120.00	7818.65	29.45	-130.01	52.45	306.35	36.63
21.2	285.63	1482.39	3305.72	-120.00	7827.99	29.40	-129.89	52.51	306.38	36.67
21.3	285.23	1484.61	3310.67	-120.00	7840.28	29.37	-129.84	52.57	306.41	36.73
21.4	284.88	1486.55	3315.00	-120.00	7854.02	29.35	-129.84	52.63	306.44	36.80
21.5	284.58	1488.25	3318.79	-120.00	7867.00	29.33	-129.81	52.69	306.47	36.86
21.6	284.32	1489.73	3322.10	-120.00	7877.38	29.29	-129.69	52.75	306.50	36.91
21.7	284.08	1491.03	3324.99	-120.00	7884.68	29.24	-129.46	52.81	306.53	36.94
21.8	283.88	1492.16	3327.52	-120.00	7889.96	29.17	-129.16	52.87	306.56	36.96
21.9	283.70	1493.15	3329.72	-120.00	7895.27	29.10	-128.84	52.93	306.59	36.99
22.0	283.55	1494.02	3331.65	-120.00	7902.00	29.04	-128.58	52.99	306.62	37.02
22.1	283.41	1494.77	3333.34	-120.00	7912.84	29.00	-128.41	53.04	306.65	37.07
22.2	283.29	1495.43	3334.81	-120.00	7925.33	28.98	-128.32	53.10	306.68	37.13
22.3	283.19	1496.01	3336.10	-120.00	7938.28	28.96	-128.24	53.16	306.71	37.19
22.4	283.10	1496.51	3337.23	-120.00	7949.65	28.93	-128.12	53.22	306.74	37.24
22.5	283.02	1496.95	3338.21	-120.00	7958.22	28.89	-127.90	53.28	306.77	37.28
22.6	282.95	1497.34	3339.07	-120.00	7964.19	28.83	-127.61	53.34	306.80	37.31
22.7	282.89	1497.68	3339.82	-120.00	7969.09	28.76	-127.27	53.40	306.83	37.34
22.8	282.83	1497.97	3340.47	-120.00	7974.91	28.70	-126.95	53.46	306.86	37.36
22.9	282.79	1498.23	3341.04	-120.00	7983.14	28.65	-126.72	53.52	306.89	37.40
23.0	282.75	1498.45	3341.54	-120.00	7993.98	28.62	-126.56	53.58	306.91	37.45
23.1	282.71	1498.65	3341.98	-120.00	8006.25	28.60	-126.46	53.64	306.94	37.51
23.2	282.68	1498.82	3342.36	-120.00	8018.06	28.58	-126.35	53.69	306.97	37.56
23.3	282.66	1498.97	3342.70	-120.00	8027.75	28.55	-126.18	53.75	307.00	37.61
23.4	282.63	1499.10	3342.99	-120.00	8034.75	28.50	-125.92	53.81	307.03	37.64
23.5	282.61	1499.21	3343.24	-120.00	8039.85	28.44	-125.60	53.87	307.06	37.67
23.6	282.59	1499.31	3343.46	-120.00	8044.79	28.37	-125.28	53.93	307.09	37.69
23.7	282.58	1499.40	3343.66	-120.00	8051.31	28.32	-125.00	53.98	307.12	37.72
23.8	282.56	1499.47	3343.83	-120.00	8060.32	28.28	-124.80	54.04	307.15	37.76

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
23.9	282.55	1499.54	3343.98	-120.00	8071.40	28.26	-124.67	54.10	307.17	37.81
24.0	282.54	1499.60	3344.11	-120.00	8083.05	28.24	-124.57	54.16	307.20	37.87
24.1	282.53	1499.65	3344.22	-120.00	8093.50	28.22	-124.43	54.22	307.23	37.92
24.2	282.52	1499.69	3344.32	-120.00	8101.59	28.18	-124.23	54.27	307.26	37.96
24.3	282.52	1499.73	3344.40	-120.00	8107.36	28.13	-123.95	54.33	307.29	37.98
24.4	282.51	1499.77	3344.48	-120.00	8112.02	28.07	-123.63	54.39	307.32	38.00
24.5	282.51	1499.80	3344.54	-120.00	8117.30	28.01	-123.33	54.45	307.35	38.03
24.6	282.50	1499.82	3344.60	-120.00	8124.57	27.97	-123.10	54.50	307.37	38.06
24.7	282.50	1499.84	3344.65	-120.00	8134.13	27.94	-122.94	54.56	307.40	38.11
24.8	282.49	1499.86	3344.70	-120.00	8145.08	27.92	-122.83	54.62	307.43	38.16
24.9	282.49	1499.88	3344.73	-120.00	8155.80	27.90	-122.72	54.67	307.46	38.21
25.0	282.49	1499.90	3344.77	-120.00	8164.81	27.87	-122.56	54.73	307.49	38.25
25.1	282.49	1499.91	3344.80	-120.00	8171.48	27.83	-122.33	54.79	307.52	38.28
25.2	282.48	1499.92	3344.82	-120.00	8176.39	27.77	-122.04	54.84	307.54	38.31
25.3	282.48	1499.93	3344.85	-120.00	8180.98	27.72	-121.74	54.90	307.57	38.33
25.4	282.48	1499.94	3344.87	-120.00	8186.81	27.67	-121.48	54.96	307.60	38.36
25.5	282.48	1499.95	3344.88	-120.00	8194.75	27.63	-121.28	55.01	307.63	38.39
25.6	282.48	1499.95	3344.90	-120.00	8204.57	27.61	-121.16	55.07	307.66	38.44
25.7	282.48	1499.96	3344.91	-120.00	8215.04	27.59	-121.05	55.12	307.68	38.49
25.8	282.48	1499.96	3344.92	-120.00	8224.62	27.57	-120.93	55.18	307.71	38.53
25.9	282.48	1499.97	3344.93	-120.00	8232.21	27.53	-120.75	55.24	307.74	38.57
26.0	282.47	1499.97	3344.94	-120.00	8237.75	27.49	-120.50	55.29	307.77	38.59
26.1	282.47	1499.98	3344.95	-120.00	8242.18	27.43	-120.22	55.35	307.79	38.61
26.2	282.47	1499.98	3344.95	-120.00	8247.00	27.38	-119.94	55.40	307.82	38.64
26.3	282.47	1499.98	3344.96	-120.00	8253.44	27.34	-119.72	55.46	307.85	38.67
26.4	282.47	1499.98	3344.97	-120.00	8261.87	27.31	-119.57	55.51	307.88	38.71
26.5	282.47	1499.99	3344.97	-120.00	8271.63	27.29	-119.46	55.57	307.90	38.75
26.6	282.47	1499.99	3344.97	-120.00	8281.34	27.28	-119.35	55.62	307.93	38.80
26.7	282.47	1499.99	3344.98	-120.00	8289.68	27.25	-119.21	55.68	307.96	38.84
26.8	282.47	1499.99	3344.98	-120.00	8296.01	27.21	-119.01	55.73	307.99	38.87
26.9	282.47	1499.99	3344.98	-120.00	8300.72	27.17	-118.76	55.79	308.01	38.89
27.0	282.47	1499.99	3344.98	-120.00	8305.00	27.11	-118.49	55.84	308.04	38.91
27.1	282.47	1499.99	3344.99	-120.00	8310.23	27.07	-118.24	55.90	308.07	38.93
27.2	282.47	1499.99	3344.99	-120.00	8317.24	27.04	-118.06	55.95	308.10	38.97
27.3	282.47	1500.00	3344.99	-120.00	8325.94	27.01	-117.94	56.01	308.12	39.01
27.4	282.47	1500.00	3344.99	-120.00	8335.33	27.00	-117.84	56.06	308.15	39.05
27.5	282.47	1500.00	3344.99	-120.00	8344.09	26.98	-117.72	56.12	308.18	39.09
27.6	282.47	1500.00	3344.99	-120.00	8351.19	26.95	-117.56	56.07	308.20	39.13
27.7	282.47	1500.00	3344.99	-120.00	8356.48	26.91	-117.35	56.23	308.23	39.15
27.8	282.47	1500.00	3344.99	-120.00	8360.69	26.86	-117.09	56.28	308.26	39.17
27.9	282.47	1500.00	3345.00	-120.00	8365.09	26.81	-116.85	56.34	308.28	39.19
28.0	282.47	1500.00	3345.00	-120.00	8370.81	26.77	-116.64	56.39	308.31	39.22
28.1	282.47	1500.00	3345.00	-120.00	8378.26	26.75	-116.49	56.44	308.34	39.25
28.2	282.47	1500.00	3345.00	-120.00	8386.95	26.73	-116.38	56.50	308.37	39.29
28.3	282.47	1500.00	3345.00	-120.00	8395.73	26.71	-116.29	56.55	308.39	39.33
28.4	282.47	1500.00	3345.00	-120.00	8403.42	26.69	-116.16	56.60	308.42	39.37
28.5	282.47	1500.00	3345.00	-120.00	8409.40	26.65	-115.98	56.66	308.45	39.40
28.6	282.47	1500.00	3345.00	-120.00	8413.90	26.61	-115.76	56.71	308.47	39.42
28.7	282.47	1500.00	3345.00	-120.00	8417.90	26.57	-115.51	56.77	308.50	39.44

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
28.8	282.47	1500.00	3345.00	-120.00	8422.61	26.53	-115.29	56.82	308.52	39.46
28.9	282.47	1500.00	3345.00	-120.00	8428.81	26.49	-115.12	56.87	308.55	39.49
29.0	282.47	1500.00	3345.00	-120.00	8436.51	26.47	-115.00	56.93	308.58	39.52
29.1	282.47	1500.00	3345.00	-120.00	8444.93	26.46	-114.91	56.98	308.60	39.56
29.2	282.47	1500.00	3345.00	-120.00	8452.91	26.44	-114.80	57.03	308.63	39.60
29.3	282.47	1500.00	3345.00	-120.00	8459.53	26.41	-114.66	57.09	308.66	39.63
29.4	282.47	1500.00	3345.00	-120.00	8464.55	26.38	-114.47	57.14	308.68	39.66
29.5	282.47	1500.00	3345.00	-120.00	8468.54	26.33	-114.24	57.19	308.71	39.67
29.6	282.47	1500.00	3345.00	-120.00	8472.58	26.29	-114.02	57.24	308.74	39.69
29.7	282.47	1500.00	3345.00	-120.00	8477.68	26.26	-113.83	57.30	308.76	39.72
29.8	282.47	1500.00	3345.00	-120.00	8484.27	26.23	-113.69	57.35	308.79	39.75
29.9	282.47	1500.00	3345.00	-120.00	8492.00	26.21	-113.58	57.40	308.81	39.78
30.0	282.47	1500.00	3345.00	-120.00	8499.93	26.20	-113.49	57.45	308.84	39.82
30.1	282.47	1500.00	3345.00	-120.00	8507.00	26.17	-113.38	57.51	308.87	39.86
30.2	282.47	1500.00	3345.00	-120.00	8512.62	26.15	-113.22	57.56	308.89	39.88
30.3	282.47	1500.00	3345.00	-120.00	8516.90	26.11	-113.02	57.61	308.92	39.90
30.4	282.47	1500.00	3345.00	-120.00	8520.65	26.07	-112.80	57.66	308.95	39.92
30.5	282.47	1500.00	3345.00	-120.00	8524.90	26.03	-112.60	57.72	308.97	39.94
30.6	282.47	1500.00	3345.00	-120.00	8530.39	26.00	-112.44	57.77	309.00	39.96
30.7	282.47	1500.00	3345.00	-120.00	8537.22	25.98	-112.32	57.82	309.02	40.00
30.8	282.47	1500.00	3345.00	-120.00	8544.75	25.96	-112.23	57.87	309.05	40.03
30.9	282.47	1500.00	3345.00	-120.00	8552.02	25.95	-112.14	57.92	309.07	40.07
31.0	282.47	1500.00	3345.00	-120.00	8558.16	25.92	-112.01	57.98	309.10	40.09
31.1	282.47	1500.00	3345.00	-120.00	8562.91	25.89	-111.84	58.03	309.13	40.12
31.2	282.47	1500.00	3345.00	-120.00	8566.69	25.85	-111.64	58.08	309.15	40.13
31.3	282.47	1500.00	3345.00	-120.00	8570.41	25.82	-111.44	58.13	309.18	40.15
31.4	282.47	1500.00	3345.00	-120.00	8574.96	25.78	-111.26	58.18	309.20	40.17
31.5	282.47	1500.00	3345.00	-120.00	8580.79	25.76	-111.13	58.23	309.23	40.20
31.6	282.47	1500.00	3345.00	-120.00	8587.67	25.74	-111.03	58.29	309.25	40.23
31.7	282.47	1500.00	3345.00	-120.00	8594.81	25.73	-110.94	58.34	309.28	40.27
31.8	282.47	1500.00	3345.00	-120.00	8601.30	25.71	-110.84	58.39	309.31	40.30
31.9	282.47	1500.00	3345.00	-120.00	8606.56	25.68	-110.70	58.44	309.33	40.32
32.0	282.47	1500.00	3345.00	-120.00	8610.62	25.65	-110.53	58.49	309.36	40.34
32.1	282.47	1500.00	3345.00	-120.00	8614.13	25.61	-110.33	58.54	309.38	40.36
32.2	282.47	1500.00	3345.00	-120.00	8617.98	25.58	-110.15	58.59	309.41	40.38
32.3	282.47	1500.00	3345.00	-120.00	8622.86	25.55	-110.00	58.64	309.43	40.40
32.4	282.47	1500.00	3345.00	-120.00	8628.91	25.53	-109.88	58.70	309.46	40.43
32.5	282.47	1500.00	3345.00	-120.00	8635.65	25.52	-109.80	58.75	309.48	40.46
32.6	282.47	1500.00	3345.00	-120.00	8642.24	25.50	-109.71	58.80	309.51	40.49
32.7	282.47	1500.00	3345.00	-120.00	8647.92	25.48	-109.60	58.85	309.53	40.52
32.8	282.47	1500.00	3345.00	-120.00	8652.40	25.45	-109.45	58.90	309.56	40.54
32.9	282.47	1500.00	3345.00	-120.00	8655.97	25.42	-109.27	58.95	309.58	40.55
33.0	282.47	1500.00	3345.00	-120.00	8659.40	25.38	-109.09	59.00	309.61	40.57
33.1	282.47	1500.00	3345.00	-120.00	8663.48	25.35	-108.93	59.05	309.63	40.59
33.2	282.47	1500.00	3345.00	-120.00	8668.65	25.33	-108.80	59.10	309.66	40.61
33.3	282.47	1500.00	3345.00	-120.00	8674.77	25.31	-108.70	59.15	309.68	40.64
33.4	282.47	1500.00	3345.00	-120.00	8681.19	25.30	-108.62	59.20	309.71	40.67
33.5	282.47	1500.00	3345.00	-120.00	8687.13	25.28	-108.53	59.25	309.73	40.70
33.6	282.47	1500.00	3345.00	-120.00	8692.03	25.26	-108.41	59.30	309.76	40.72

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
33.7	282.47	1500.00	3345.00	-120.00	8695.87	25.23	-108.25	59.35	309.78	40.74
33.8	282.47	1500.00	3345.00	-120.00	8699.16	25.20	-108.08	59.40	309.81	40.76
33.9	282.47	1500.00	3345.00	-120.00	8702.66	25.17	-107.91	59.45	309.83	40.77
34.0	282.47	1500.00	3345.00	-120.00	8707.00	25.14	-107.77	59.50	309.86	40.79
34.1	282.47	1500.00	3345.00	-120.00	8712.37	25.12	-107.66	59.55	309.88	40.82
34.2	282.47	1500.00	3345.00	-120.00	8718.39	25.11	-107.58	59.60	309.91	40.85
34.3	282.47	1500.00	3345.00	-120.00	8724.36	25.09	-107.50	59.65	309.93	40.87
34.4	282.47	1500.00	3345.00	-120.00	8729.61	25.08	-107.40	59.70	309.96	40.90
34.5	282.47	1500.00	3345.00	-120.00	8733.81	25.05	-107.27	59.75	309.98	40.92
34.6	282.47	1500.00	3345.00	-120.00	8737.18	25.02	-107.11	59.80	310.01	40.93
34.7	282.47	1500.00	3345.00	-120.00	8740.35	24.99	-106.94	59.85	310.03	40.95
34.8	282.47	1500.00	3345.00	-120.00	8744.01	24.96	-106.79	59.90	310.06	40.97
34.9	282.47	1500.00	3345.00	-120.00	8748.60	24.94	-106.67	59.95	310.08	40.99
35.0	282.47	1500.00	3345.00	-120.00	8754.04	24.93	-106.58	60.00	310.11	41.01
35.1	148.23	1467.00	3271.40	-110.77	8759.82	24.91	-75.35	60.04	310.10	41.04
35.2	-23.32	1328.98	2963.63	-98.78	8765.24	24.90	-29.54	60.07	310.06	41.06
35.3	-80.14	1112.62	2481.14	-86.78	8769.80	24.88	24.21	60.07	310.01	41.09
35.4	-77.75	911.08	2031.70	-74.78	8773.41	24.85	81.97	60.04	309.94	41.10
35.5	-72.26	732.71	1633.93	-62.78	8776.49	24.82	112.94	60.00	309.89	41.12
35.6	-55.56	584.95	1304.44	-50.78	8779.68	24.80	133.47	59.94	309.84	41.13
35.7	-43.99	469.12	1046.13	38.78	8783.55	24.77	142.57	59.88	309.80	41.15
35.8	-35.83	381.58	850.92	-26.78	8788.31	24.75	150.43	59.81	309.75	41.17
35.9	-30.01	320.40	714.48	-14.78	8793.69	24.74	159.96	59.74	309.71	41.20
36.0	-26.39	283.86	633.01	-2.78	8799.10	24.73	169.34	59.66	309.66	41.22
36.1	-24.48	263.98	588.68	0.00	8803.92	24.71	171.23	59.58	309.62	41.25
36.2	-22.90	246.14	548.90	0.00	8807.85	24.69	171.37	59.50	309.58	41.26
36.3	-21.41	229.46	511.70	0.00	8811.03	24.66	171.52	59.42	309.54	41.28
36.4	-20.03	213.86	476.91	0.00	8813.96	24.63	171.68	59.34	309.50	41.29
36.5	-18.73	199.27	444.37	0.00	8817.26	24.61	171.83	59.26	309.46	41.31
36.6	-17.52	185.62	413.94	0.00	8821.34	24.59	171.96	59.18	309.42	41.33
36.7	-16.38	172.86	385.48	0.00	8826.17	24.57	172.06	59.10	309.38	41.35
36.8	-15.32	160.93	358.87	0.00	8831.36	24.56	172.15	59.02	309.34	41.37
36.9	-14.33	149.77	333.98	0.00	8836.30	24.55	172.24	58.95	309.30	41.40
37.0	-13.40	139.33	310.71	0.00	8840.53	24.53	172.35	58.87	309.26	41.42
37.1	-12.53	129.57	288.94	0.00	8843.92	24.51	172.48	58.79	309.22	41.43
37.2	-11.72	120.44	268.58	0.00	8846.80	24.48	172.64	58.71	309.18	41.45
37.3	-10.96	111.90	249.54	0.00	8849.71	24.46	172.79	58.63	309.14	41.46
37.4	-10.25	103.92	231.74	0.00	8853.18	24.43	172.93	58.55	309.10	41.48
37.5	-9.59	96.45	215.08	0.00	8857.41	24.42	173.04	58.47	309.06	41.50
37.6	-8.97	89.47	199.51	0.00	8862.21	24.40	173.12	58.39	309.02	41.52
37.7	-8.39	84.92	184.95	0.00	8867.09	24.39	173.21	58.31	308.98	41.54
37.8	-7.84	76.83	171.33	0.00	8871.52	24.38	173.30	58.23	308.94	41.56
37.9	-7.34	71.12	158.59	0.00	8875.18	24.36	173.42	58.14	308.90	41.58
38.0	-6.86	65.77	146.68	0.00	8878.17	24.33	173.56	58.06	308.86	41.59
38.1	-6.42	60.78	135.54	0.00	8880.88	24.31	173.71	57.98	308.82	41.61
38.2	-6.00	56.11	125.12	0.00	8883.87	24.29	173.85	57.90	308.78	41.62
38.3	-5.61	51.74	115.37	0.00	8887.50	24.27	173.97	57.82	308.74	41.64
38.4	-5.25	47.65	106.26	0.00	8891.80	24.25	174.07	57.74	308.70	41.66
38.5	-4.91	43.83	97.74	0.00	8896.45	24.24	174.15	57.66	308.66	41.68

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
38.6	-4.59	40.25	89.77	0.00	8900.95	24.23	174.24	57.58	308.62	41.70
38.7	-4.30	36.91	82.31	0.00	8904.85	24.21	174.34	57.50	308.58	41.72
38.8	-4.02	33.79	75.34	0.00	8908.03	24.19	174.46	57.42	308.54	41.73
38.9	-3.76	30.86	68.83	0.00	8910.72	24.17	174.60	57.34	308.49	41.75
39.0	-3.51	28.13	62.73	0.00	8913.39	24.15	174.74	57.26	308.45	41.76
39.1	-3.29	25.57	57.03	0.00	8916.50	24.13	174.87	57.18	308.41	41.77
39.2	-.3.07	23.18	51.69	0.00	8920.26	24.11	174.98	57.10	308.37	41.79
39.3	-2.88	20.95	46.71	0.00	8924.54	24.10	175.06	57.02	308.33	41.81
39.4	-2.69	18.85	42.04	0.00	8928.95	24.09	175.14	56.93	308.29	41.83
39.5	-2.52	16.90	37.68	0.00	8933.00	24.07	175.23	56.85	308.25	41.85
39.6	-2.35	15.07	33.60	0.00	8936.41	24.06	175.34	56.77	308.21	41.87
39.7	-2.20	13.36	29.79	0.00	8939.20	24.03	175.47	56.69	308.17	41.88
39.8	-2.06	11.76	26.22	0.00	8941.72	24.01	175.60	56.61	308.13	41.89
39.9	-1.93	10.26	22.89	0.00	8944.43	23.99	175.74	56.53	308.09	41.90
40.0	-1.80	8.86	19.77	0.00	8947.66	23.97	175.85	56.45	308.05	41.92
40.1	-1.69	7.56	16.85	0.00	8951.49	23.96	175.94	56.37	308.01	41.94
40.2	-1.58	6.33	14.12	0.00	8955.66	23.95	176.02	56.28	307.97	41.96
40.3	-1.47	5.19	11.57	0.00	8959.74	23.94	176.10	56.20	307.93	41.98
40.4	-1.38	4.12	9.18	0.00	8963.34	23.92	176.20	56.12	307.88	41.99
40.5	-1.29	3.12	6.95	0.00	8966.31	23.91	176.31	56.04	307.84	42.01
40.6	-1.21	2.18	4.86	0.00	8968.83	23.89	176.44	55.96	307.80	42.02
40.7	-1.13	1.30	2.91	0.00	8971.28	23.86	176.57	55.88	307.76	42.03
40.8	-1.06	0.49	1.08	0.00	8974.06	23.85	176.69	55.79	307.72	42.04
40.9	-1.00	0.00	0.00	0.00	8977.41	23.83	176.79	55.71	307.68	42.06
41.0	-1.00	0.00	0.00	0.00	8981.24	23.82	176.87	55.63	307.64	42.08
41.1	-1.00	0.00	0.00	0.00	8985.21	23.81	176.95	55.55	307.60	42.10
41.2	-1.00	0.00	0.00	0.00	8988.91	23.80	177.03	55.47	307.56	42.11
41.3	-1.00	0.00	0.00	0.00	8992.07	23.78	177.13	55.38	307.52	42.13
41.4	-1.00	0.00	0.00	0.00	8994.69	23.76	177.25	55.30	307.47	42.14
41.5	-1.00	0.00	0.00	0.00	8997.02	23.74	177.37	55.22	307.43	42.15
41.6	-1.00	0.00	0.00	0.00	8999.47	23.72	177.49	55.14	307.39	42.16
41.7	-1.00	0.00	0.00	0.00	9002.37	23.71	177.60	55.06	307.35	42.18
41.8	-1.00	0.00	0.00	0.00	9005.78	23.69	177.69	54.97	307.31	42.19
41.9	-1.00	0.00	0.00	0.00	9009.51	23.68	177.77	54.89	307.27	42.21
42.0	-1.00	0.00	0.00	0.00	9013.21	23.67	177.85	54.81	307.23	42.23
42.1	-1.00	0.00	0.00	0.00	9016.52	23.66	177.93	54.73	307.19	42.24
42.2	-1.00	0.00	0.00	0.00	9019.29	23.65	178.04	54.64	307.14	42.26
42.3	-1.00	0.00	0.00	0.00	9021.64	23.63	178.15	54.56	307.10	42.27
42.4	-1.00	0.00	0.00	0.00	9023.89	23.61	178.27	54.48	307.06	42.28
42.5	-1.00	0.00	0.00	0.00	9026.39	23.59	178.39	54.40	307.02	42.29
42.6	-1.00	0.00	0.00	0.00	9029.38	23.58	178.48	54.31	306.98	42.30
42.7	-1.00	0.00	0.00	0.00	9032.79	23.57	178.56	54.23	306.94	42.32
42.8	-1.00	0.00	0.00	0.00	9036.37	23.56	178.64	54.15	306.90	42.34
42.9	-1.00	0.00	0.00	0.00	9039.74	23.55	178.71	54.07	306.85	42.35
43.0	-1.00	0.00	0.00	0.00	9042.51	17.16	50.34	54.01	306.95	42.36
43.1	-1.00	0.00	0.00	0.00	9042.95	17.17	15.86	54.00	306.98	42.37
43.2	-1.00	0.00	0.00	0.00	9039.53	17.17	15.84	53.99	306.98	42.35
43.3	-1.00	0.00	0.00	0.00	9025.43	-21.03	-151.82	54.01	307.15	42.28
43.4	-1.00	0.00	0.00	0.00	8997.21	-22.43	-158.81	54.08	307.20	42.15

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
43.5	-1.00	0.00	0.00	0.00	8954.28	-22.80	-158.65	54.15	307.23	41.95
43.6	-1.00	0.00	0.00	0.00	8894.47	-23.10	-158.94	54.23	307.27	41.67
43.7	-1.00	0.00	0.00	0.00	8824.97	-23.36	-159.50	54.30	307.31	41.34
43.8	-1.00	0.00	0.00	0.00	8758.06	-23.63	-160.01	54.37	307.35	41.03
43.9	-1.00	0.00	0.00	0.00	8704.41	-23.96	-160.18	54.45	307.38	40.78
44.0	-1.00	0.00	0.00	0.00	8666.83	-24.39	-159.88	54.52	307.42	40.60
44.1	-1.00	0.00	0.00	0.00	8639.81	-24.89	-159.19	54.60	307.46	40.48
44.2	-1.00	0.00	0.00	0.00	8613.09	-25.42	-158.43	54.67	307.49	40.35
44.3	-1.00	0.00	0.00	0.00	8576.14	-25.90	-157.95	54.74	307.53	40.18
44.4	-1.00	0.00	0.00	0.00	8522.81	-26.31	-157.90	54.82	307.57	39.93
44.5	-1.00	0.00	0.00	0.00	8454.87	-26.64	-158.24	54.89	307.60	39.61
44.6	-1.00	0.00	0.00	0.00	8382.26	-26.95	-158.72	54.96	307.64	39.27
44.7	-1.00	0.00	0.00	0.00	8317.00	-27.30	-159.02	55.04	307.68	38.96
44.8	-1.00	0.00	0.00	0.00	8267.03	-27.74	-158.91	55.11	307.71	38.73
44.9	-1.00	0.00	0.00	0.00	8231.28	-28.28	-158.35	55.18	307.75	38.56
45.0	-1.00	0.00	0.00	0.00	8201.92	-27.88	-157.53	55.26	307.79	38.43
45.1	-1.00	0.00	0.00	0.00	8168.18	-29.47	-156.79	55.33	307.82	38.27
45.2	-1.00	0.00	0.00	0.00	8121.13	-29.99	-156.40	55.40	307.86	38.05
45.3	-1.00	0.00	0.00	0.00	8057.37	-30.44	-156.43	55.47	307.89	37.75
45.4	-1.00	0.00	0.00	0.00	7982.72	-30.82	-156.75	55.55	307.93	37.40
45.5	-1.00	0.00	0.00	0.00	7908.44	-31.20	-157.08	55.62	307.97	37.05
45.6	-1.00	0.00	0.00	0.00	7845.28	-31.66	-157.12	55.69	308.00	36.75
45.7	-1.00	0.00	0.00	0.00	7797.85	-32.22	-156.72	55.76	308.04	36.53
45.8	-1.00	0.00	0.00	0.00	7761.73	-32.88	-156.04	55.84	308.07	36.36
45.9	-1.00	0.00	0.00	0.00	7727.50	-33.62	-155.47	55.91	308.11	36.20
46.0	-1.00	0.00	0.00	0.00	7684.81	-34.31	-155.05	55.98	308.15	36.00
46.1	-1.00	0.00	0.00	0.00	7626.29	-34.91	-154.94	56.05	308.18	35.73
46.2	-1.00	0.00	0.00	0.00	7552.69	-35.41	-155.12	56.12	308.22	35.38
46.3	-1.00	0.00	0.00	0.00	7472.54	-35.87	-155.45	56.20	308.25	35.01
46.4	-1.00	0.00	0.00	0.00	7397.38	-36.37	-155.65	56.27	308.29	34.66
46.5	-1.00	0.00	0.00	0.00	7335.81	-36.97	-155.54	56.34	308.33	34.37
46.6	-1.00	0.00	0.00	0.00	7289.05	-37.69	-155.04	56.41	308.36	34.15
46.7	-1.00	0.00	0.00	0.00	7249.99	-38.49	-154.27	56.48	308.40	33.97
46.8	-1.00	0.00	0.00	0.00	7208.37	-39.29	-153.48	56.55	308.43	33.77
46.9	-1.00	0.00	0.00	0.00	7154.40	-40.03	-152.92	56.63	308.47	33.52
47.0	-1.00	0.00	0.00	0.00	7083.93	-40.66	-152.69	56.70	308.50	33.19
47.1	-1.00	0.00	0.00	0.00	7001.35	-41.22	-152.71	56.77	308.54	32.80
47.2	-1.00	0.00	0.00	0.00	6916.88	-41.76	-152.77	56.84	308.57	32.41
47.3	-1.00	0.00	0.00	0.00	6841.33	-42.38	-152.60	56.91	308.61	32.05
47.4	-1.00	0.00	0.00	0.00	6780.53	-43.11	-152.05	56.98	308.64	31.77
47.5	-1.00	0.00	0.00	0.00	6732.40	-43.96	-151.14	57.05	308.68	31.54
47.6	-1.00	0.00	0.00	0.00	6687.92	-44.86	-150.04	57.12	308.71	31.33
47.7	-1.00	0.00	0.00	0.00	6636.20	-45.73	-149.03	57.19	308.74	31.09
47.8	-1.00	0.00	0.00	0.00	6569.39	-46.52	-148.31	57.26	308.78	30.78
47.9	-1.00	0.00	0.00	0.00	6487.17	-47.20	-147.42	57.32	308.81	30.39
48.0	-1.00	0.00	0.00	0.00	6396.69	-47.83	-146.65	57.39	308.84	29.97
48.1	-1.00	0.00	0.00	0.00	6308.94	-48.48	-145.75	57.46	308.88	29.56
48.2	-1.00	0.00	0.00	0.00	6233.06	-49.24	-144.37	57.53	308.91	29.20
48.3	-1.00	0.00	0.00	0.00	6171.68	-50.12	-142.36	57.59	308.94	28.91

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
48.4	-1.00	0.00	0.00	0.00	6119.61	-51.10	-139.88	57.66	308.97	28.67
48.5	-1.00	0.00	0.00	0.00	6066.50	-52.11	-137.28	57.72	309.00	28.42
48.6	-1.00	0.00	0.00	0.00	6002.18	-53.06	-134.97	57.79	309.03	28.12
48.7	-1.00	0.00	0.00	0.00	5921.80	-53.90	-133.16	57.85	309.06	27.74
48.8	-1.00	0.00	0.00	0.00	5828.36	-54.65	-131.80	57.91	309.09	27.31
48.9	-1.00	0.00	0.00	0.00	5731.06	-55.38	-130.55	57.97	309.12	26.85
49.0	-1.00	0.00	0.00	0.00	5640.62	-56.16	-129.00	58.03	309.14	26.43
49.1	-1.00	0.00	0.00	0.00	5563.76	-56.99	-126.85	58.09	309.17	26.07
49.2	-1.00	0.00	0.00	0.00	5499.80	-57.93	-124.11	58.15	309.20	25.77
49.3	-1.00	0.00	0.00	0.00	5441.05	-58.93	-121.06	58.21	309.22	25.49
49.4	-1.00	0.00	0.00	0.00	5376.78	-59.92	-118.11	58.26	309.25	25.19
49.5	-1.00	0.00	0.00	0.00	5298.70	-60.81	-115.60	58.31	309.27	24.82
49.6	-1.00	0.00	0.00	0.00	5205.19	-61.73	-114.31	58.37	309.30	24.39
49.7	-1.00	0.00	0.00	0.00	5102.09	-62.77	-114.25	58.42	309.32	23.90
49.8	-1.00	0.00	0.00	0.00	4999.58	-63.85	-114.17	58.47	309.35	23.42
49.9	-1.00	0.00	0.00	0.00	4906.88	-65.10	-113.94	58.53	309.38	22.99
50.0	-1.00	0.00	0.00	0.00	4827.55	-66.61	-113.51	58.58	309.40	22.62
50.1	-1.00	0.00	0.00	0.00	4757.58	-68.33	-112.91	58.63	309.43	22.29
50.2	-1.00	0.00	0.00	0.00	4687.46	-70.15	-112.25	58.68	309.45	21.96
50.3	-1.00	0.00	0.00	0.00	4606.96	-71.92	-111.68	58.74	309.48	21.58
50.4	-1.00	0.00	0.00	0.00	4510.41	-73.54	-111.26	58.79	309.50	21.13
50.5	-1.00	0.00	0.00	0.00	4399.53	-75.03	-111.00	58.84	309.53	20.61
50.6	-1.00	0.00	0.00	0.00	4282.58	-76.47	-110.79	58.89	309.56	20.06
50.7	-1.00	0.00	0.00	0.00	4170.09	-78.04	-110.51	58.94	309.58	19.54
50.8	-1.00	0.00	0.00	0.00	4069.46	-79.85	-110.04	58.99	309.61	19.07
50.9	-1.00	0.00	0.00	0.00	3981.13	-81.95	-109.35	59.04	309.63	18.65
51.0	-1.00	0.00	0.00	0.00	3898.27	-84.22	-108.34	59.09	309.65	18.26
51.1	-1.00	0.00	0.00	0.00	3810.27	-86.12	-105.27	59.14	309.68	17.85
51.2	-1.00	0.00	0.00	0.00	3708.25	-87.89	-102.41	59.19	309.70	17.37
51.3	-1.00	0.00	0.00	0.00	3589.65	-89.50	-99.93	59.24	309.72	16.82
51.4	-1.00	0.00	0.00	0.00	3459.57	-91.00	-97.70	59.28	309.74	16.21
51.5	-1.00	0.00	0.00	0.00	3328.15	-92.51	-95.40	59.33	309.76	15.59
51.6	-1.00	0.00	0.00	0.00	3205.35	-94.14	-92.69	59.37	309.78	15.02
51.7	-1.00	0.00	0.00	0.00	3095.85	-95.97	-89.37	59.41	309.80	14.50
51.8	-1.00	0.00	0.00	0.00	2996.62	-97.97	-85.49	59.45	309.81	14.04
51.9	-1.00	0.00	0.00	0.00	2898.49	-100.05	-81.33	59.49	309.83	13.58
52.0	-1.00	0.00	0.00	0.00	2790.82	-102.07	-77.25	59.53	309.84	13.07
52.1	-1.00	0.00	0.00	0.00	2666.92	-103.94	-73.51	59.56	309.86	12.49
52.2	-1.00	0.00	0.00	0.00	2527.52	-104.59	-70.60	59.60	309.87	11.84
52.3	-1.00	0.00	0.00	0.00	2380.62	-105.04	-67.95	59.63	309.88	11.15
52.4	-1.00	0.00	0.00	0.00	2237.67	-105.50	-65.16	59.66	309.90	10.48
52.5	-1.00	0.00	0.00	0.00	2107.75	-105.95	-61.94	59.69	309.91	9.87
52.6	-1.00	0.00	0.00	0.00	1992.95	-106.41	-58.17	59.72	309.92	9.34
52.7	-1.00	0.00	0.00	0.00	1887.40	-106.86	-54.02	59.74	309.93	8.84
52.8	-1.00	0.00	0.00	0.00	1780.33	-107.32	-49.82	59.77	309.93	8.34
52.9	-1.00	0.00	0.00	0.00	1661.63	-107.77	-45.88	59.79	309.94	7.78
53.0	-1.00	0.00	0.00	0.00	1526.98	-108.23	-42.38	59.81	309.95	7.15
53.1	-1.00	0.00	0.00	0.00	1380.03	-108.68	-39.23	59.83	309.95	6.47
53.2	-1.00	0.00	0.00	0.00	1230.40	-106.86	-36.15	59.85	309.96	5.76

TIME sec	EgDrive Tq	Eng_Ne	Gen speed	Gen_Tq Nm	Motor Speed	Motor Tq	RESS Current	RESS SOC	RESS Voltage	Vehicle Speed
53.3	-1.00	0.00	0.00	0.00	1089.24	-98.57	-33.12	59.86	309.96	5.10
53.4	-1.00	0.00	0.00	0.00	965.92	-90.05	-30.02	59.88	309.97	4.53
53.5	-1.00	0.00	0.00	0.00	864.68	-80.97	-26.70	59.89	309.97	4.05
53.6	-1.00	0.00	0.00	0.00	782.77	-71.59	-23.27	59.90	309.97	3.67
53.7	-1.00	0.00	0.00	0.00	712.12	-62.60	-19.98	59.91	309.98	3.34
53.8	-1.00	0.00	0.00	0.00	643.50	-54.72	-17.09	59.92	309.98	3.01
53.9	-1.00	0.00	0.00	0.00	570.87	-48.33	-14.75	59.93	309.98	2.67
54.0	-1.00	0.00	0.00	0.00	493.76	-43.29	-12.91	59.93	309.98	2.31
54.1	-1.00	0.00	0.00	0.00	416.77	-39.05	-11.36	59.94	309.98	1.95
54.2	-1.00	0.00	0.00	0.00	346.63	-34.92	-9.84	59.95	309.98	1.62
54.3	-1.00	0.00	0.00	0.00	288.53	-30.41	-8.19	59.95	309.98	1.35
54.4	-1.00	0.00	0.00	0.00	243.27	-25.44	-6.36	59.95	309.98	1.14
54.5	-1.00	0.00	0.00	0.00	20698	-20.27	-4.46	59.96	309.98	0.97
54.6	-1.00	0.00	0.00	0.00	176.23	-15.46	-2.69	59.96	309.98	0.83
54.7	-1.00	0.00	0.00	0.00	146.48	-11.53	-1.25	59.96	309.98	0.69
54.8	-1.00	0.00	0.00	0.00	114.72	-8.71	-0.21	59.96	309.98	0.54
54.9	-1.00	0.00	0.00	0.00	81.38	-6.82	0.48	59.96	309.98	0.38
55.0	-1.00	0.00	0.00	0.00	49.44	-5.44	0.99	59.96	309.98	0.23
55.1	-1.00	0.00	0.00	0.00	20.77	-4.08	1.49	59.96	309.98	0.10
55.2	-1.00	0.00	0.00	0.00	0.00	0.02	3.01	59.96	309.98	0.00
55.3	-1.00	0.00	0.00	0.00	0.00	0.04	3.02	59.95	309.97	0.00
55.4	-1.00	0.00	0.00	0.00	0.00	0.03	3.01	59.95	309.97	0.00
55.5	-1.00	0.00	0.00	0.00	0.00	0.02	3.01	59.95	309.97	0.00
55.6	-1.00	0.00	0.00	0.00	0.00	0.01	3.00	59.95	309.97	0.00
55.7	-1.00	0.00	0.00	0.00	0.00	0.01	3.00	59.95	309.97	0.00
55.8	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.95	309.97	0.00
55.9	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.95	309.97	0.00
56.0	-1.00	0.00	0.00	0.00	0.00	0.00	3.00	59.95	309.97	0.00