Modification of WLTC Ver.5

Prepared by Japan

13th DHC group
under GRPE/WLTP informal group
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the Palais des Nations (Geneva/Switzerland)

Overview of our proposal

- The WLTC should be sufficiently representative for all participating regions.

- Through the validation test for WLTC-ver.5, some major vehicles ***came under the engine protection region***, in which ordinary driving rarely steps.

- The WLTC should be the cycle in which major vehicles in the current market can be operated perfectly without coming under the engine protection region.

- Japan proposes the modification of the WLTC-ver.5 to eliminate points where some major vehicles come under the engine protection region without decreasing the amount of CO2.

Engine Protection Region

1. Necessity of Engine Protection region

In general, engine temperature depends on the balance between combustion heat and emitted heat from surface of cylinder and cylinder head, valve sheet etc.

In the condition of high engine speed/high load, the engine cannot emit its heat enough, therefore engine temperature rises rapidly, resulting in melting exhaust valve, pistons or catalyst. Moreover, under such condition, catalysts could also be overheated and damaged.

To prevent such problems, "**engine protection**" **is needed**.

To protect engines and catalysts from such damages, Air/Fuel ratio should be enriched under the certain conditions to reduce the temperatures of engine valves and cylinders' interface by latent heat of vaporization of incomplete combustion fuels. It also leads to reduce oxidation reaction in catalyst due to the lack of oxygen, resulting in reducing exhaust and catalyst temperatures. In such cases, however, three-way catalyst won't work and emissions will worsen. (As a result, CO emissions drastically increase).

Engine Protection Region

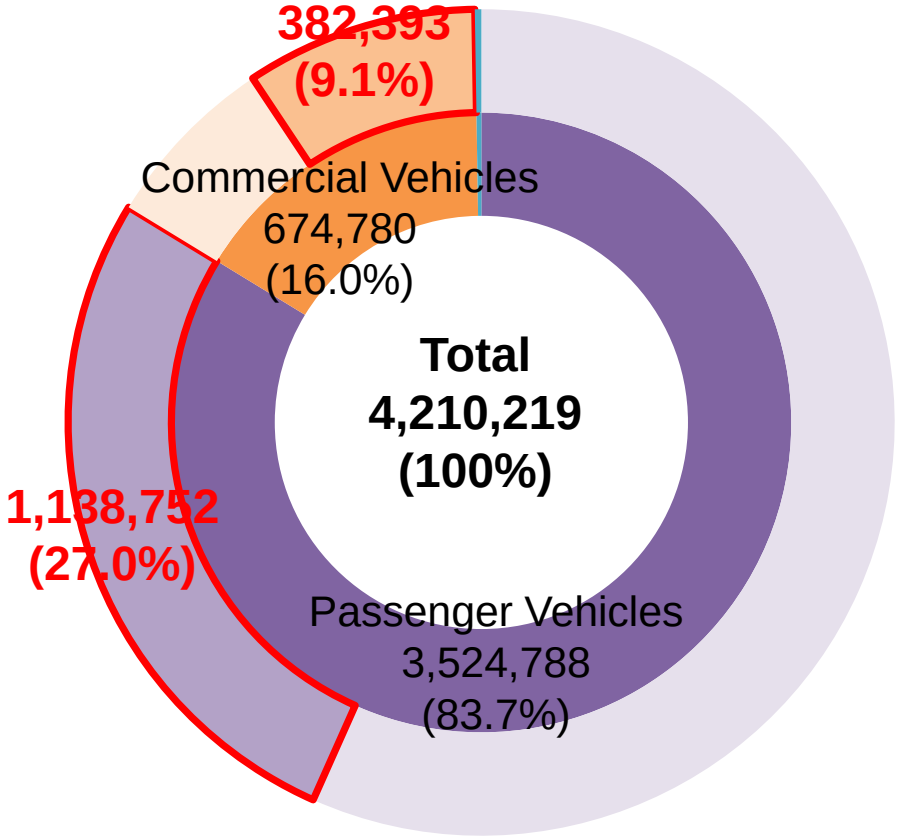
2. Rareness of the driving under the engine protection region

According to our study, engine protection region for specific major vehicles was observed in rare case even when intentionally driving on many steep slopes in Tokyo.

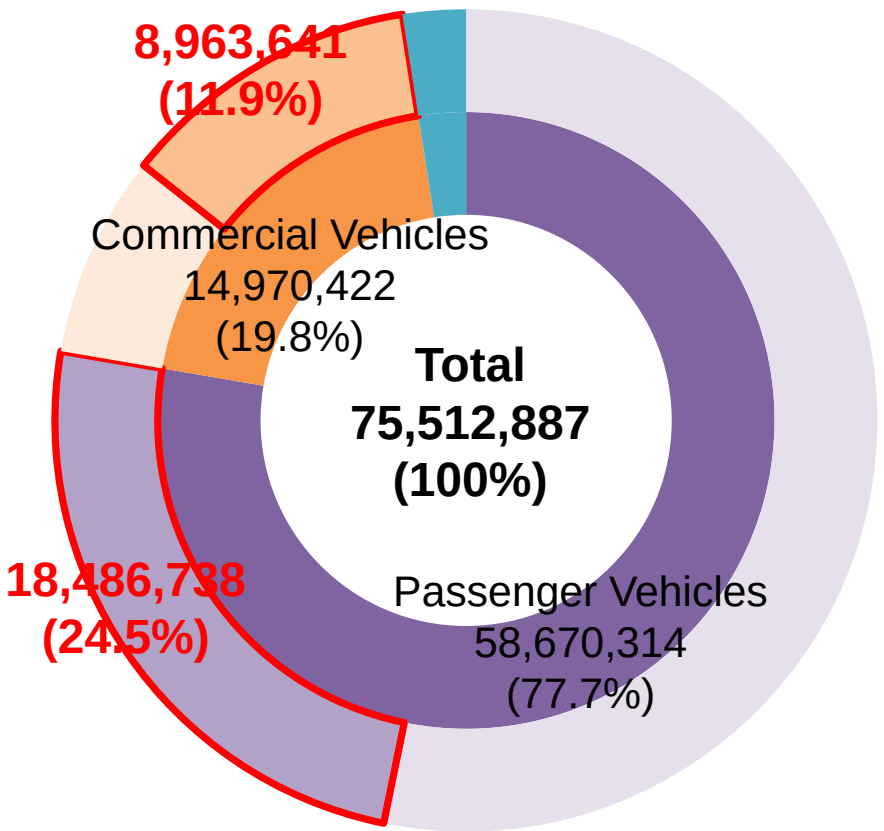
On the other hand, these vehicles ***came under the engine protection region*** at many points of WLTC ver.5.

In this sense, **the cycle is far from representative cycle of usual conditions for specific major vehicles**.

Assessment of the impacts in market



Total domestic sales of new vehicles in Japan (FY2011)



Number of vehicles owned in Japan (FY2011)

About 40% of total vehicles in Japan are estimated to be tested with the “engine protection region” in WLTC-ver.5.

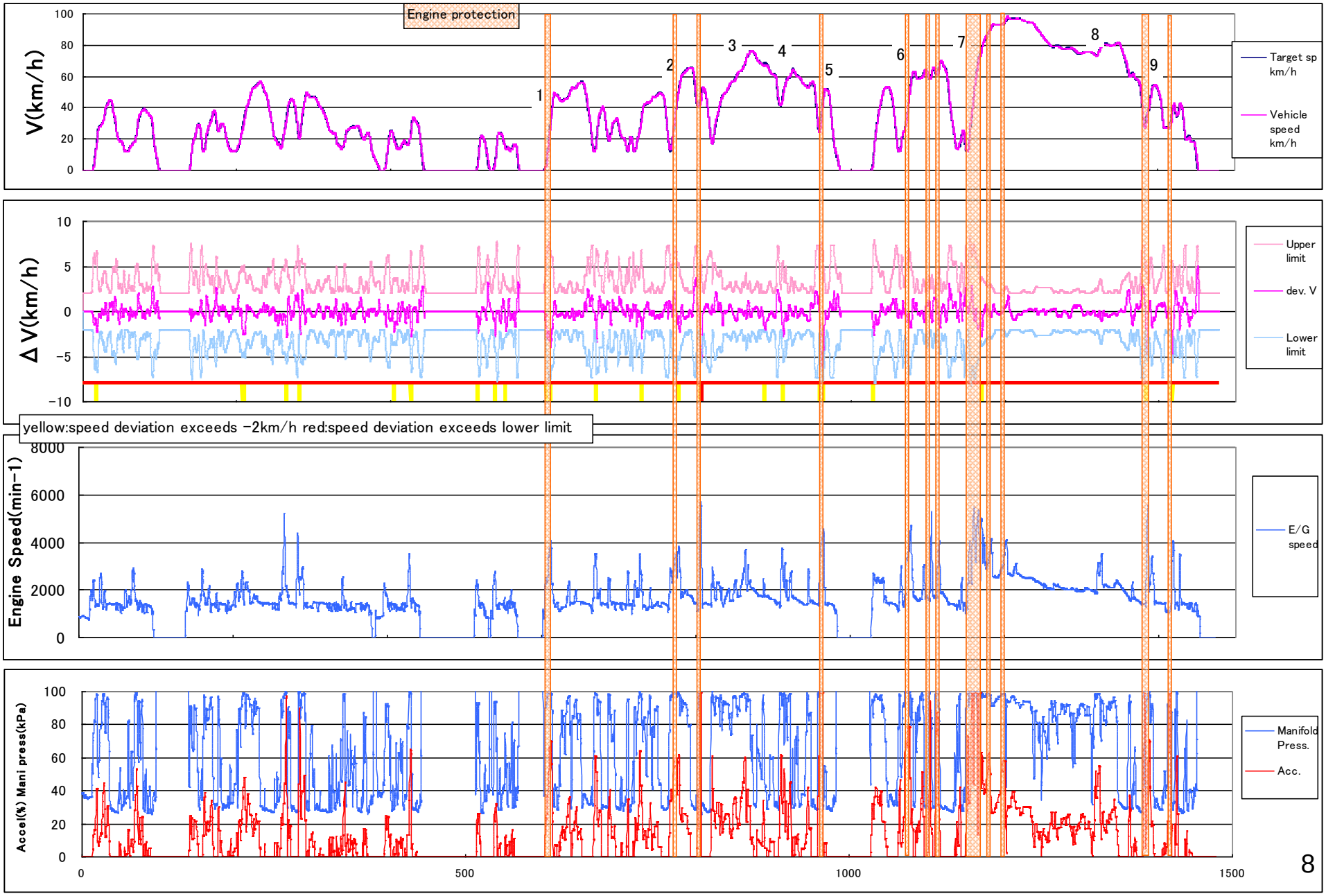
Test vehicles (PC)

Vehicle No.	A1	A2	A3	A4	B	C
Vehicle category	PC	PC	PC	PC	PC	PC
Fuel type	Petrol	Petrol	Petrol	Petrol	Petrol	Petrol
Engine capacity (cc)	658	658	658	658	658	658
Max. rated power (kW)	40 / 6500	40 / 6500	40 / 6500	40 / 6500	38 / 6800	38 / 6800
Curb vehicle mass (kg)	670 (assumed)	780	890	1000	790	970
Test mass (kg)	800	910	1020	1130	900	1106
Gross vehicle mass (kg)	890	1000	1110	1220	1090	1270
Power to mass ratio (KW/t) (Curb mass basis)	59.7	51.3	44.9	40.0	48.1	39.2
After treatment	TWC	TWC	TWC	TWC	TWC	TWC
Emission standard	2005	2005	2005	2005	2005	2005
Transmission	CVT	CVT	CVT	CVT	CVT	CVT

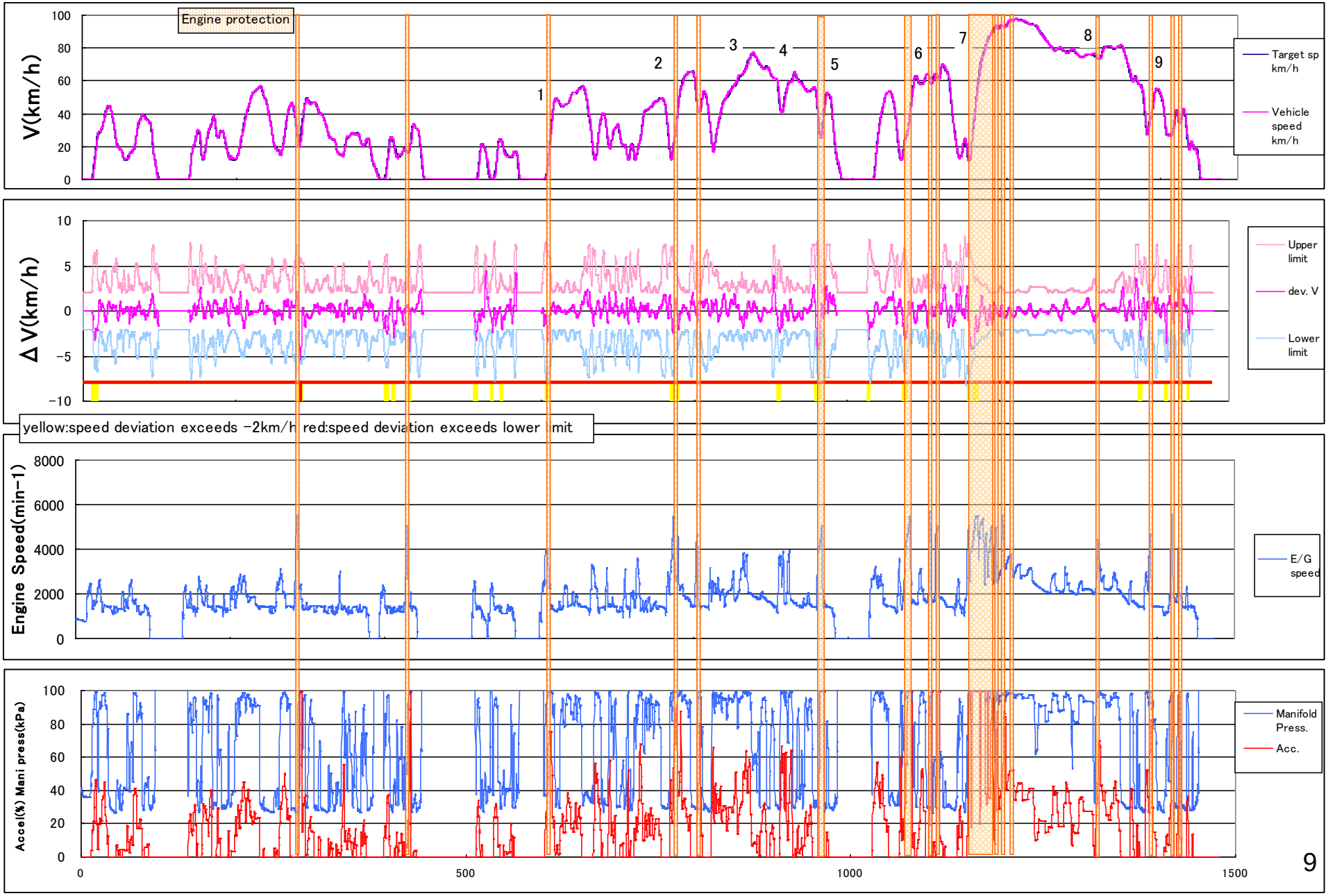
Test vehicles (LDCV)

Vehicle No.	D1	D2	D3	D4	D5	E
Vehicle category	LDCV	LDCV	LDCV	LDCV	LCVD	LDCV
Fuel type	Petrol	Petrol	Petrol	Petrol	Petrol	Petrol
Engine capacity (cc)	658	658	658	658	658	658
Max. rated power (kW)	36/ 5800	36/ 5800	36/ 5800	36/ 5800	36/ 5800	39 / 7000
Curb vehicle mass (kg)	560 (assumed)	670	780	870	990	970
Test mass (kg)	800	910	1020	1130	1250	1232
Gross vehicle mass (kg)	1060	1170	1280	1420	1540	1520
Power to mass ratio (KW/t) (Curb mass basis)	64.3	53.7	46.2	41.4	36.4	40.2
After treatment	TWC	TWC	TWC	TWC	TWC	TWC
Emission standard	2005	2005	2005	2005	2005	2005
Transmission	3AT	3AT	3AT	3AT	3AT	4AT

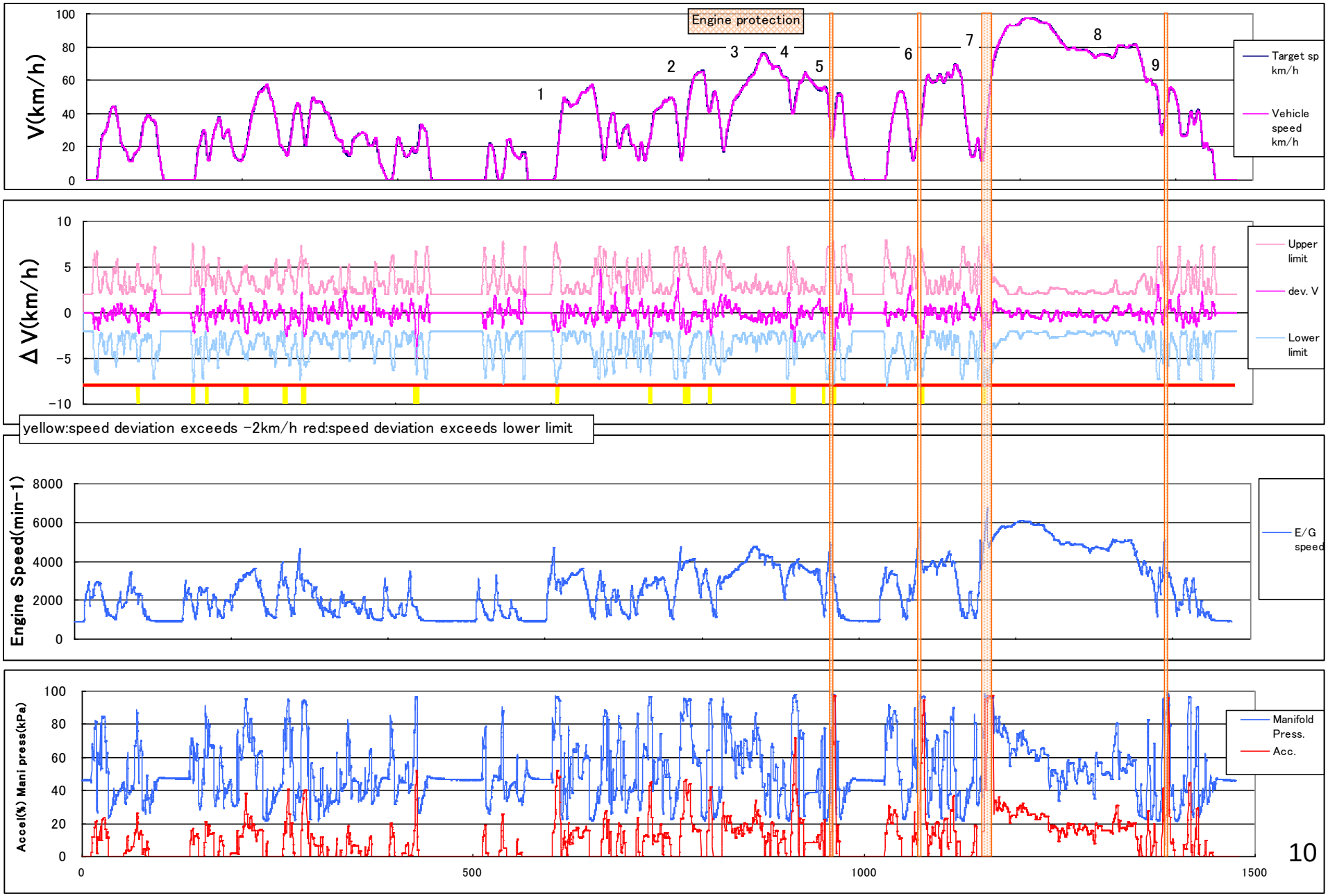
Test Results PC



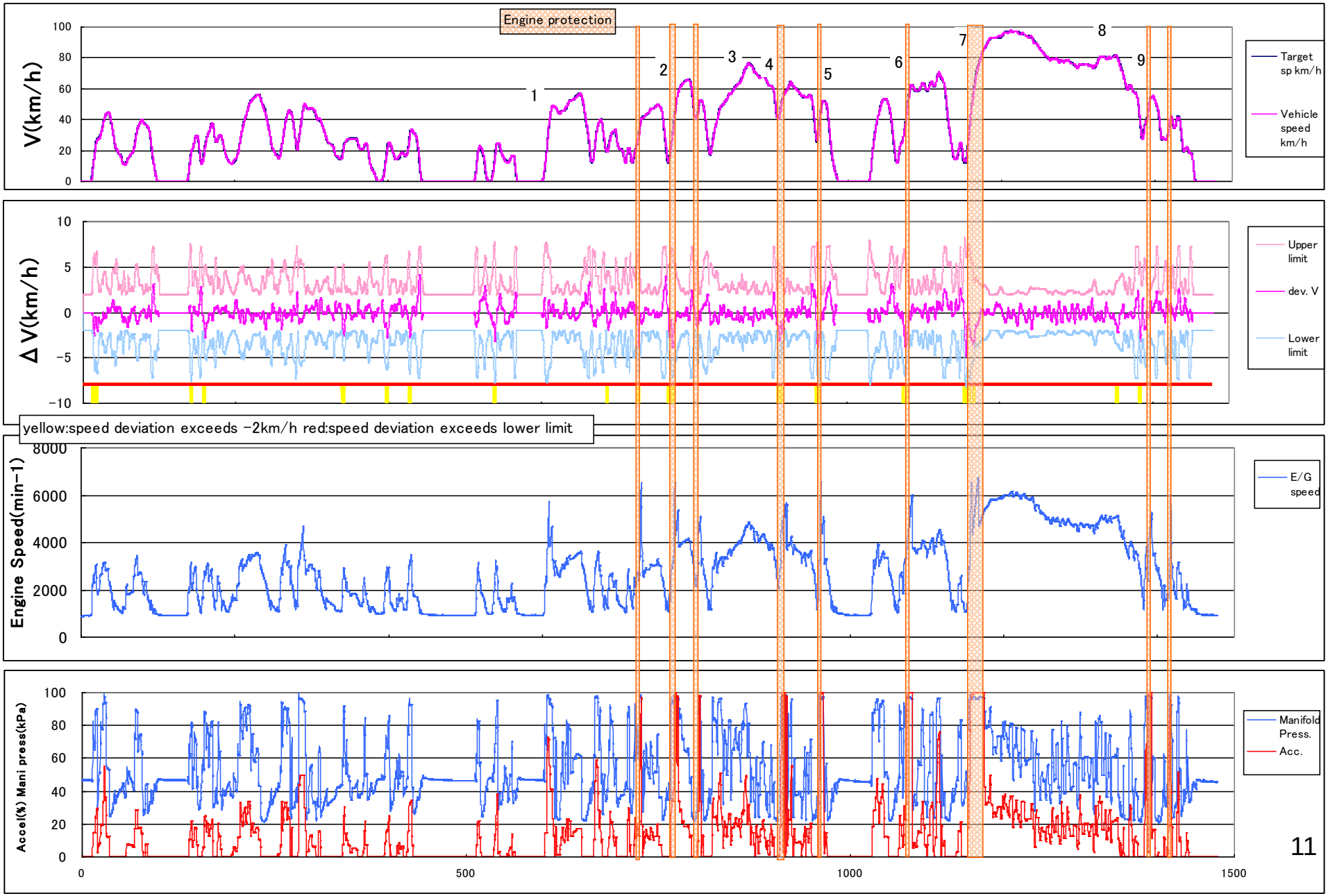
Test Results PC



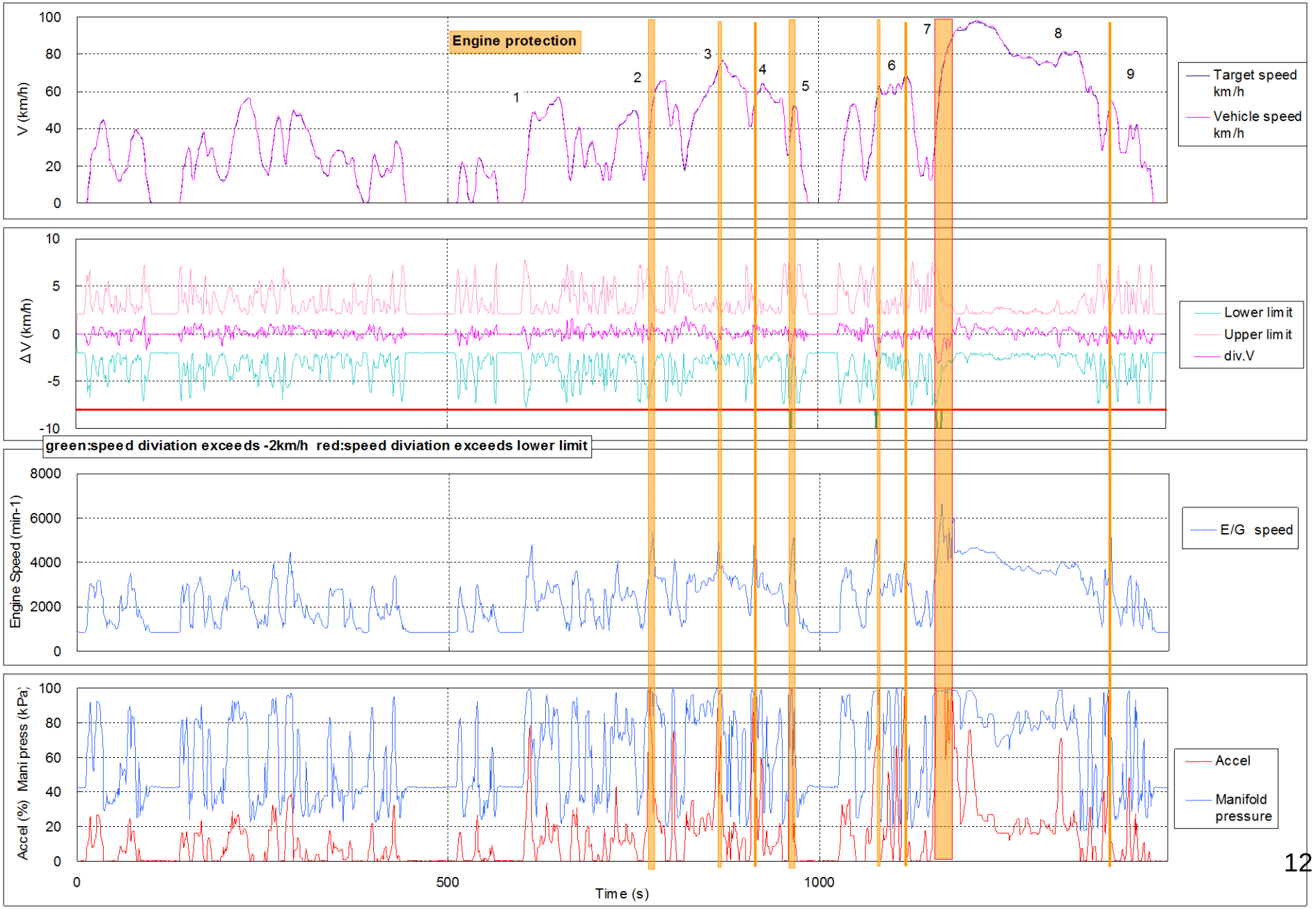
Test Results LDCV



Test Results LDCV

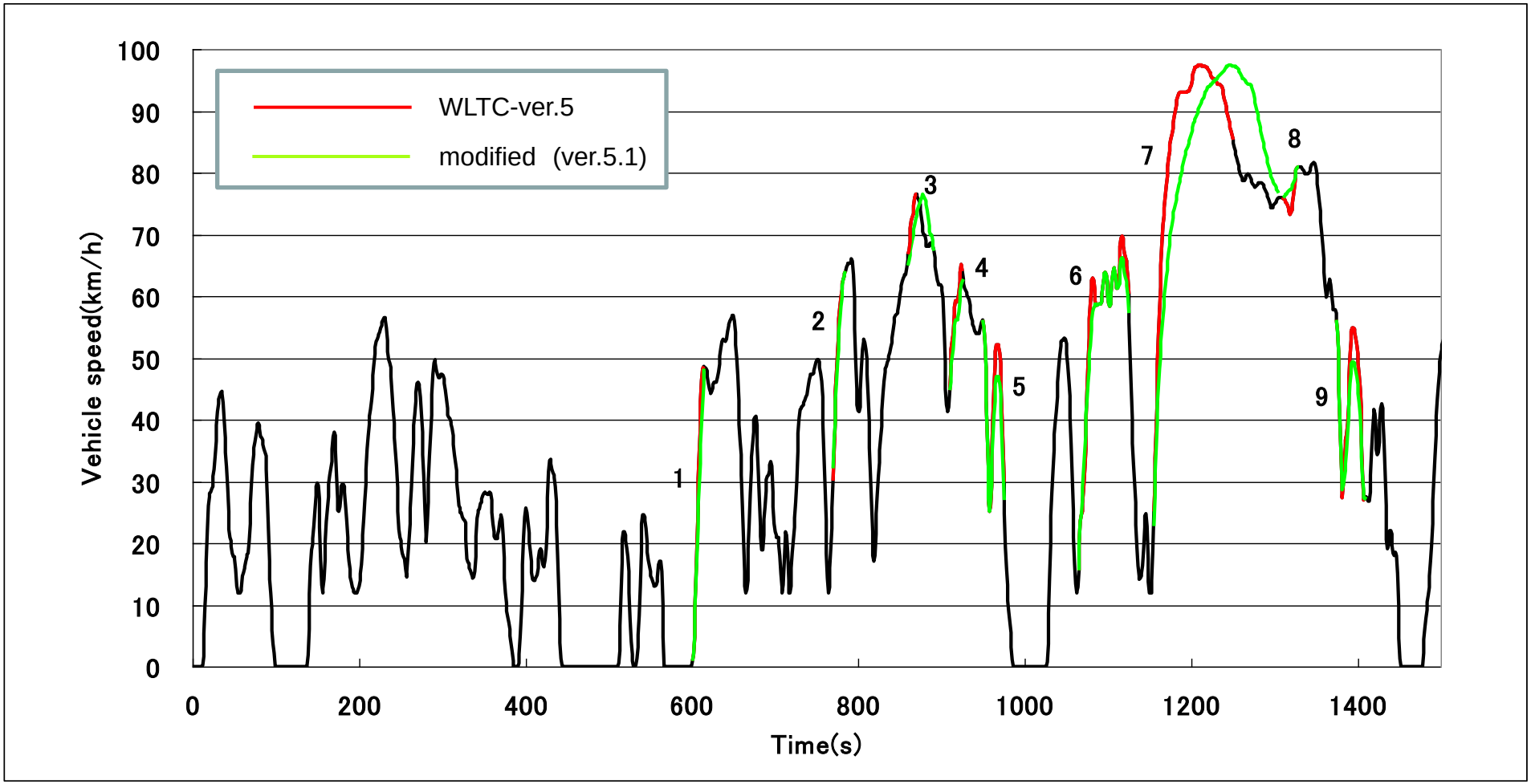


Test Results LDCV



Japanese Proposal

9 points for modification



Characteristics of Ver.5 & Ver.5.1

	Driving distance (km)	Driving time (s)	Average speed (km/h)	Maximum speed (km/h)	Maximum acceleration (km/h/s)	Average positive acceleration (*1) (m/s2)	Average positive acceleration*speed (*1) (m2/s3)	RPA (m/s2)	Relative workload (*2)
Middle Phase									
Ver.5	4.756	433	39.54	76.60	5.65	0.4640	4.755	0.1950	1.000
Ver.5.1	4.717	433	39.22	76.60	4.60	0.4300	4.359	0.1894	0.986
High Phase									
Ver.5	7.158	455	56.63	97.40	5.7	0.5053	6.092	0.1328	1.000
Ver.5.1	7.124	455	56.24	97.40	5.7	0.4018	4.634	0.1177	0.988

*1:It calculates for acceleration>0.05m/s2.

*2:Relative workload per unit mileage. A negative value is calculated as zero.
(example of trial calculation in 1.5L passenger car)