



Sample Collection and Analysis of the Dynamometer Exhaust Emissions Test CCVS-75, HWFET

KES T – E028

(EST)1989-11-30

Contents

1. Scope of Application
2. Purpose
3. Test Preparation
4. Test Method
5. Data Recording
6. Data Processing
7. Estimation and Treatment Outline
8. Report and Record
9. Notice

Supplementary Provisions

Supplementary Documents



1. Scope of Application

This standard shall provide for sample collection and analysis of the dynamometer exhaust emissions test based on mode driving of exhaust emissions test car equipped with gasoline engine.

2. Purpose

This standard shall be for improving the efficiency of the test by standardizing the method of sample collection and analysis of the dynamometer exhaust emissions test based on mode driving of CVS-75, ECE-15, 10 modes.

3. Test Preparation

(1) For the terminology for ECE-15, HWFET, CVS-75, 10 modes, see specially regulated CVS-75 preliminary driving method, exhaust emissions test based on ECE-15 mode, exhaust emissions test based on 10 mode and fuel consumption test based on high speed driving mode.

(2) Test procedure

Follow this regulation when collecting sample for analysis with mode driving.

For major nations, there are various methods of the dynamometer exhaust emissions test of mode driving such as CVS-75 and HWFET(USA, Korea, Canada, etc.), ECE-15(EC, Taiwan, etc.) and 10 mode and 11 mode(Japan, etc.). For each test mode, there are some differences of sample collection method.

(3) The condition of an objective car

(a) CVS-75 test

This test must be carried out within 1 hour after hot soak loss test or alternative fuel heating method, which are preceded by CVS-75 preliminary driving method (ESE1-0009) and following 12~36 hours of soak.

(b) HWFET

- ① This test must be carried out within 3 hours after exhaust emissions test
- ② This test must be carried out within 3 hours after CVS-75 preliminary driving for high speed driving fuel consumption test.

(4) Test condition

Interior temperature must be $25 \pm 5^{\circ}\text{C}$ at the time of test.

(5) Facilities and instruments

(a) Chassis dynamometer and car fixing device

There must be PAU (Power Absorption Unit) for reproducing car driving resistance and flywheel for reproducing inertial weight.

- ① Chocks
- ② Anchor hooks : Use when fixing front wheel driving car.

(b) CFV-CVS (Critical Flow Venturi-Constant Volume Sampler)

Flow rate must be $8.43\text{m}^3 / \text{min} \sim 9.83\text{m}^3 / \text{min}$ (300~350Cfm).

- ① CFV-CVS controller (Located in the analysis room)
- ② CFV-CVS sampling device (Located in the dynamometer chamber)
- ③ CFV-CVS remote control switch (Place in the car during test.)

(c) Exhaust tube

(d) Exhaust tube adapter

(e) Driver's aid : CRSD-1000 and mode

(f) Tire pressure controller and compressed air

(g) Cooling fan : Constant speed type (5300Cfm($150\text{m}^3/\text{min}$))

(h) Temperature recorder : Psychrometer and recorder

(i) Dynamometer roller tachometer or driving distance indicator

(j) Barometer

(k) MEXA-8420 or 8220 analyzer

- ① HC analyzer (FIA-34-2)
- ② CO analyzer (AIA-23(AS))

- ③ CO₂ analyzer (AIA-23(AS))
- ④ NOx analyzer (CLA-53)
- (l) Chart recorder : Prepare one which basically records CO, CO₂, NOx, HC, actual car speed and required car speed. And if necessary, prepare one which can record engine RPM and engine negative pressure additionally.
- (m) DVM (Digital Volt Meter)

4. Test Method

4.1 Preparation before test

- (1) Preliminary items prepared under the driver's responsibility
 - (a) Investigating usage record of chassis dynamometer for test, if it has not been used for 2 hours before starting mode driving test, install a car for warming up chassis dynamometer and warm up it as following outline.
 - ① Set the inertia weight of the chassis dynamometer with the same values as in the case of test car.
 - ② Release the brake of the chassis dynamometer and rotating roller with feet, check if the car for warming-up is balanced on the roller and runs on it with relevant inertia weight.
 - ③ Connect exhaust tail pipe to ventilation system of test room.
 - ④ Drive the car for warming-up at the speed of 30mph (50Kph) for 15 minutes.
 - (b) Authenticate AHP value of test car through test order, supervisor, foreman and a client of the test and record it into check form (E1-11-02). Then, obtain IHP using KES U-H006 (correction record of the chassis dynamometer) for test and record that value to check form (E1-11-02). And, set that value to the chassis dynamometer.
 - (c) Check if mode for test car was programmed. If it was already programmed, use it. If not, program the mode and input it into driver's aid. See instructions for driver's

aid for the details.

- (d) Check the correction condition of the driver's aid by inspecting the indicated condition on the screen with naked eyes after accelerating the car from 0 to 50mph. Adjust the condition at this point and check indicated condition at 0 point again. Since the correction is finished when 0 adjustment condition shall be rightly corrected, the condition of 0 point and 50mph point must be in accordance exactly.
- (e) Shift switch of driver's aid on RLPC to 'Front', and driving the car for warming up at the speed of 50mph, check the difference between the value of 'Horsepower' and the value set in (b) step is within $\pm 0.5\text{HP}$. If not, report to one's superior immediately. In the opposite case, shift switch of driver's aid to 'Rear'.
- (f) Write down test number, test date, car number, chassis dynamometer number, inertia weight, IHP, air conditioner installation, driver name, etc. into driving speed record chart.
- (g) Detach the car for warming up from chassis dynamometer and drive it to out of test room.
- (h) Push a test car onto chassis dynamometer and fix it with fixing device.
 - ① Release the brake of the chassis dynamometer and rotating roller a few rounds with feet, check if the test car runs on it with relevant inertia weight and is balanced on the roller.
 - ② Fix the car with chains, chocks, etc..
 - ③ Connect exhaust tail pipe to sampling device of CFV-CVS.
In this moment, don't connect more than 2 flexible connection tubes.
 - ④ Open the bonnet (hood) of the car and install a cooling fan so that one faces the car at the point of 12inch (30cm) distance from the car. If engine is mounted in rear part of the car, place the cooling fan so that it blows cooling air

sufficient for cooling the car.

- ⑤ Check driving wheel tire pressure, and adjust it to 45Psi (3.2kg/cm²) in case of no special order.

(2) Preliminary items prepared under the responsibility of a person in charge of instruments

- (a) Check temperature and humidity in the test room (analysis room and dynamometer chamber). Dry-bulb temperature must be within 73°F~76°F (23℃ ~25℃) at the time of test start and wet-bulb temperature must be within the range where NOx correction factor(K_H) shall be about 1.0.

Relation between dry-bulb temperature, wet-bulb temperature and NOx correction factor is indicated in following Table 1.

Table 1 NOx correction factor

H ₂ O grains/LB		H=21.8	37.4	51.4	63.8	75.0	85.1	
NOx correction factor		.8000	.8500	.9000	.9500	1.000	1.050	
Dry-bulb temperature(℃)	21.1	10	12.22	14.17	15.83	17.22	18.33	Wet-bulb temperature(℃)
	22.2	10.55	12.78	14.56	16.17	17.5	18.72	
	23.3	10.94	13.22	15	16.67	17.89	19.06	
	24.4	11.39	13.61	15.56	16.94	18.33	19.44	
	25.5	11.9	14	15.94	17.33	18.61	19.72	
	26.7	12.2	14.44	16.22	17.78	18.94	20	
Dry-bulb temperature(℃)	21.1	20	34	47	58	68	78	Relative humidity(%)
	22.2	19	32	44	54	64	72	
	23.3	18	30	41	51	59	68	
	24.4	17	28	39	48	56	63	
	25.5	16	27	37	45	52	59	
	26.7	15	25	34	42	49	56	

Remark : Interior condition during the test shall be that K_H is within 0.9500 ~ 1.050.

- (b) Check all contents of (1) ~ (8) items are correctly written down and in case of any insufficiency, report it to a superior and supplement it.
- (c) Operate NEXA analyzer and CVS instruments so that they can analyze and collect samples. (The alarm lamp shall be off and warming up shall be finished.)
- (d) Reset Vmix counter on CVS controller.
- (e) Reset Y_1 , Y_2 and Y_3 on driving distance indicator altogether.

4.2 Test procedure

During the test, the person in charge of instruments should check if the test is carried out as the regulation and if instruments are working without trouble. If there is any problem, the person in charge of instruments must bear the responsibility of reporting it to a superior beyond supervisor and treating it.

- (1) Push 'Start OK' on remote controller of driver's aid and get into the car if mode starting point is indicated on the screen without problem.
- (2) The person in charge of instruments turns on CVS blower.
- (3) With the sign of the person in charge of instruments, driver shall start the car with starting method adequate to the test car simultaneously with pushing 'Sample 1.4' switch of CVS. After starting the car, immediately set the key to 'ON' position and push 'Start' switch of driver's aid.

The person in charge of instruments shall operate driving speed and EM chart recorder and push 'Meas' switch of analyzer. Then, record EM test start time in corresponding column of inspection form (E1-12-02) and mark test start point on temperature record chart.

In case of HWFFT, there is no need to record sample and EM chart.

(4) Management method in case of starting failure

- (a) In case that the starting fails in spite of 10 seconds of cranking, crank for 10 seconds after 5 seconds of pause.

If starting failure continues in spite of above method up to the initial acceleration mode of test mode, hold operation of driver's aid and immediately report this problem to a person in charge of instruments and a superior beyond supervisor.

If starting problem is managed without starting engine, restarting may be allowed but test should be continued without resetting sampled V_{mix} or driving distance indicator.

- (b) In case that the engine started but stops with 'Key On' operation, repeatedly attempt 10 seconds of cranking and 5 seconds of pause 3 times.
- (c) In case that the engine started but stops when initially idling the car, attempt starting the car as cold start method. In case that the engine started but stops before initially accelerating the car, start the car after holding operation of driver's aid and carry out test. If the test car would not start within 1 minute, the test is treated as invalid.
- (5) According to the direction of driver's aid, drive the car with the mode of UDDS (Urban Dynamometer Driving Schedule) and HWFET (Highway Fuel Economy Test Procedure) specified by EPA. Allowable speed range during driving shall be between maximum speed (in the interval of 1 second before and after the corresponding point) + 2mph and minimum speed (in the same range as above) - 2mph. In case that car speed is out of allowable speed range due to shifting of manual transmission gear, sudden braking, engine misfire and stumbling, the interval must be within 2 seconds. Allowable speed range is diagrammatized in following Figure 1.
- (6) Gear shifting point in course of mode driving must be programmed into the driver's aid. And in case of UDDS, shift gear down at the time of 187 seconds and 840 seconds only if this times are marked on the mode or downshift is determinately required in order to prevent engine from stopping. When carrying out downshift in

case of no mark on the mode, record this content on driving speed recording chart.

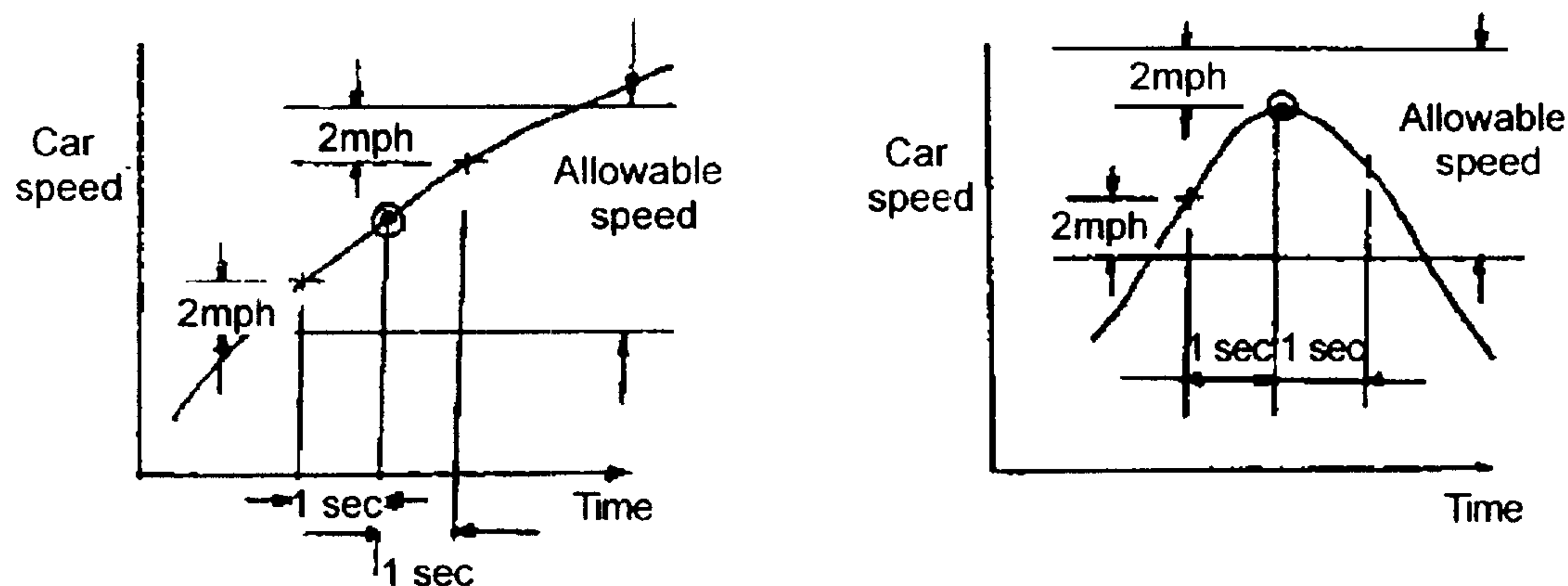


Figure 1 : Allowable speed range during mode driving

(7) Management method at engine stop during mode driving

- (a) In case of engine stop during idle mode driving : Immediately start the car as hot start method and continue the test. If the car would not start until next acceleration time, stop driver's aid and after starting the car immediately, run driver's aid again. Then continue the test. If the car would not start immediately, continuing sampling (in case of UDDS), attempt starting the car with 10 seconds of cranking and 5 seconds of pause for 1 minute. If the test car would not start within 1 minute, the test is treated as invalid.
- (b) In case of engine stop in cases except idle mode driving : Immediately stop driver's aid and continuing sampling, attempt restarting. (However, there is no need to make car speed zero.) If the car starts, accelerate it to required speed and run driver's aid again. Then continue the test. In spite of attempting starting the car with 10 seconds of cranking and 5 seconds of pause for 1 minute, the test is treated as invalid.

- (8) In case of driving with MAP (Maximum Available Power), that is, treading accelerator pedal fully, during mode driving, mark those points altogether on driving speed record chart.