

Japan Emission Test

KES T – E064

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1. Scope of Application

This test is applicable for exhaust gas measurement test of all gasoline and LPG cars exported for to Japan.

2. Purpose

This standard prescribes the mileage accumulation driving test and measurement test of exhaust and fuel evaporative gas of a car that is exported for to Japan.

3. Establishment of Mileage Accumulation Driving Program

3.1 Mileage accumulation driving prescription

Table 1. Long mileage accumulation driving prescription in Japanese regulation

Total driving distance		100,000km (EM Warrantable driving distance is 30,000km)
Speed condition		Driving ratio per total driving distance
Type of driving	Speed	
Normal speed driving	It includes idle, acceleration, deceleration and constant speed driving at the speed of 30 ~ 60km / hr range in the main	More than 60%
High speed driving	Light weight car : 80 ± 5km / hr Other cars : 100 ± 5km / hr However, if a car can not be driven at the regulated speed because of its performance, drive it at the maximum speed possible in according to its specification	

3.2 Security of consumption goods for a test car.

(1) Test fuel

Driving has to be carried out by using the fuel prescribed in the following table.

(a) Test fuel for a gasoline car

Emission test has to be carried out by using the fuel corresponding to the state prescribed in JIS M 2612.

Table 2. Test fuel standard of a gasoline car

Item		Standard	Remark
Classified State	Initial Branch Point(IBP)	25 ~ 47 ℃	
	10% Evaporation Point	40 ~ 65 ℃	
	50% Evaporation Point	85 ~ 115 ℃	
	90% Evaporation Point	140 ~ 175 ℃	
	Evaporation Point(EP)	Less than 210℃	
Sulfuret(S) content		0.03% per weight	
Plumbum(Pb:4Ethyl Plumbum)		0.05 ml / l	
Reid Vapor Pressure (RVP)		0.45 ~ 0.85 kg/cm ²	

(b) Test fuel of a LPG car

Emission test has to be carried out by using the fuel composed of propane+propylene of 20~30mole% and butane + butylene of 70 ~ 80mole%, which corresponds to the fuel state prescribed in JIS K 2240. In Korea, it corresponds to a winter grade fuel.

(c) Test fuel supply

Before test, an emission test car is filled with the fuel suitable to the previous standard up to the quantity of 40%~80% per authorized fuel tank capacity. In the case of evaporative fuel gas measurement, a test car filled up to 40% per nominal fuel tank capacity.

(2) Engine oil, antifreezing solution

Use the oil and coolant decided by manufacturer of a car.

(3) Preparation of exchange part in the periodical inspection of long mileage accumulation driving

At least, prepare exchange parts of 5 times per a cooling fan belt, engine oil filter and ignition plug.

3.3 Driving resistance measurement of a previous tested car

The methods of measuring the driving resistance used to set up chassis dynamometer for long mileage accumulation driving and exhaust gas measurement permitted by Japanese regulation are compressed into 3 methods in the main. They are the Road

coastdown method, wheel torque method and inner pressure method, and the road coastdown method that is the most general and precise is used mainly.

(1) Coastdown method

In this method, driving resistance is calculated by using the coastdown time, which is acquired by measuring the deceleration time when a test car is in coastdown driving. Chassis dynamometer load is set up with this value by using the following method.

- (a) Locate a transmission at neutral position in dry conditioned direct and flat road, start coastdown driving, and then measure the coastdown time at the speed from specified speed+5km/h to specified speed-5km/h. Specified speeds are 20, 30, 40, 50, 60 and 70km/hr. At this time, the difference of the minimum and maximum measured time can not exceed 10% per average time.
- (b) Calculate driving resistance per each specified speed by using the coastdown time measured in (a). Express driving resistance as the 2nd order function per car speed with the least square method about this value, and then compensate it with the standard atmospheric pressure in the following way.

- ① Calculate coastdown time with driving resistance (force) by using the equation shown as below.

$$F = \frac{W + W_1}{3.53t}$$

F = Driving resistance at each specified speed

W = Weight of each test car

W₁ = Befitting inertia weight of rotational part of a test car (3.5% of designed weight)

t = Average coastdown time at each specified speed.

- ② Acquire the 2nd order relative function with least square method by using the following equation of the driving resistance, which is calculated at the each specified speed in step ①.

$$F = a + bV^2$$

$$a = \frac{\sum K_i^2 \cdot \sum F_i - \sum K_i \cdot \sum K_i \cdot \sum F_i}{n \sum K_i^2 - (\sum K_i)^2}$$

$$b = \frac{n \sum K_i \cdot F_i - \sum K_i \cdot \sum F_i}{n \sum K_i^2 - (\sum K_i)^2}$$

Where,

$$K = V^2$$

F= Driving resistance (kg)

a= Rolling resistance factor (kg)

b= Air resistance factor [kg/(km/hr)²]

V= Speed of a car (km/hr)

- ③ Compensate the factor acquired in step ② with the standard atmospheric pressure.

$$F_0 = a_0 + b_0V^2$$

$$a_0 = (a - b\bar{v}^2) [1 + 0.9864(T_e - 20)]$$

$$b_0 = 2.59b \frac{T_e + 273}{P}$$

Where,

F₀ = Target driving resistance

a₀ = Rolling resistance factor corresponding to standard state (kg)

b₀ = Air resistance factor corresponding to standard state [kg / (km / hr)²]

$\bar{v}$ = Average value of parallel speed component in test road (km / hr)

T_e = Average temperature in test road (°C)

P = Average atmospheric pressure in test road (mmHg)

V = Speed of a car (km / hr)

- (c) Decide the setting load corresponding to target coastdown time of dynamometer by locating a test car on a chassis dynamometer and carrying out coastdown

driving.

(d) Verification for setting load

Verify that the setting load (hereinafter, it is referred to as the set driving resistance.) is suited to target driving resistance in the following way.

① Speed for carrying out verification

- Multi-point setting method: 10, 20, 30, 40, 50, 60, 70 and 80km/hr
- Factor setting method: 20, 40, 60, 80km/hr
- One-point setting method: Verify it at the point of 80km/hr

② Accelerate a car for certification up to the speed of more than verification speed + 5km / hr. Carry out coastdown driving with a transmission in neutral. At this time, do not operate a brake, and then connect a clutch.

③ Calculate setting driving resistance of a chassis dynamometer from the average value acquired in step ② by using the following equation.

$$F_c = \frac{IW + W_2}{3.53t_c}$$

F_c = Setting driving resistance (kg)

IW = Equivalent inertia weight (kg)

W_2 = Inertia weight corresponding to a rotational part of power train (kg)

t_c = Average of coastdown time

④ The difference between driving and target resistance measured at each verification speed has to be within $\pm 5\%$.

(2) Wheel torque method

It is the method for setting chassis dynamometer load by using the wheel torque corresponding to that of driving wheel, which is imposed in the constant speed driving condition of a car having a wheel torque meter, as standard.

① Measure wheel torque per each specified speed by carrying out constant speed driving at each specified speed in straight and flat road with dry condition.

Specified speeds are 20, 30, 40, 50, 60, 70 and 80km/hr, and measure the speed

of a test car and torque of right & left driving wheel together for more than 5sec, with the sampling period of less than 0.25sec.

At this time, the difference between initial and final speed of a test car in measurement has to be within 0.5km/hr, the maximum and minimum speed in measurement can not exceed 5% of the specified speed, moreover measured and specified speed are within $\pm 2\text{km / hr}$.

For measured torque, the difference between the maximum and minimum value of a measured value is within 5%.

Do not measure torque and speed with only one direction.

- ② After acquiring each average value of the wheel torque and car speed measured in step ①, calculate the driving torque per each specified speed. After calculating driving torque with the least square method for this value, express it as the 2nd function for car speed and compensate this expression with the standard atmospheric pressure in the following method.

$$F = c + dV^2$$

$$c = \frac{\sum K_i^2 \cdot \sum T_i - \sum K_i \cdot \sum K_i \cdot \sum T_i}{n \sum K_i^2 - (\sum K_i)^2}$$

$$d = \frac{n \sum K_i \cdot T_i - \sum K_i \cdot \sum T_i}{n \sum K_i^2 - (\sum K_i)^2}$$

Where,

$$K = V^2$$

T= Driving torque (kg · m)

c = Value corresponding to rolling resistance factor (kg · m)

d = Value corresponding to air resistance factor [kg · m / (km / hr)²]

V = Speed of a car (km / hr)

$$T_0 = C_0 + d_0V^2$$

$$c_0 = (d - d_0^2) [1 + 0.00864(T_e - 20)]$$

$$d_0 = 2.59d \frac{T_e + 273}{P}$$

Where,

T_0 = Target driving torque ($\text{kg} \cdot \text{m}$)

C_0 = Rolling resistance factor corresponding to standard state ($\text{kg} \cdot \text{m}$)

d_0 = Air resistance factor corresponding to standard state [$\text{kg} \cdot \text{m} / (\text{km} / \text{hr})^2$]

v = Average of parallel speed component in test road (km / hr)

T_e = Average temperature in test road ($^{\circ}\text{C}$)

P = Average atmospheric pressure in test road (mmHg)

V = Speed of a car (km / hr)

- ③ Decide the setting load corresponding to target torque of dynamometer by locating a test car at a chassis dynamometer and carrying out constant speed driving.

(3) Intake Manifold inner pressure method (Boost method)

It is the method for setting chassis dynamometer load by using the value corresponding to the intake manifold pressure, which is measured in the constant speed driving condition of a test car having a negative pressure gauge in intake manifold, as standard.

- (a) Measure intake manifold inner pressure per each specified speed by carrying out constant speed driving at each specified speed in straight and flat road with dry condition. At this time, specified speeds are 20, 40, 60 and 80km/hr. The allowable error in setting a load has to be within $\pm 5\text{mmHg}$, and the negative pressure gauge used in this test has to be one used in road test. Moreover, if necessary, carry out this test at 10, 30, 50 and 70km/hr too in addition to the above speed, and then use this value to set chassis dynamometer load.
- (b) After acquiring the intake manifold pressure per each speed measured in step (a), decide the setting load corresponding to the target intake manifold inner pressure in a chassis dynamometer by carrying out constant speed driving per each specified speed in a chassis dynamometer.
- (c) Intake pressure used for setting chassis dynamometer load is acquired in the

following equation.

$\Delta P_{m2} = P_{a2} - P_m$	
ΔP_{m2} = Intake manifold pressure used for setting chassis dynamometer load	[mmHg]
P_{a2} = Atmospheric pressure in a test room	[mmHg]
P_m = Test result compensated with absolute pressure = $P_{a1} - \Delta P_{m1}$	[mmHg]
P_{a1} = Atmospheric pressure during measurement	[mmHg]
P_{m1} = Intake manifold pressure during measurement	[mmHg]

3.4 Condition of a test room

The condition of a test room has to be the following one.

(1) Test room temperature

It has to be $25 \pm 5^{\circ}\text{C}$ at the neighborhood of a ventilation device for cooling an engine of a test car.

(2) Background

Hc, Co, Nox and Co2 in a test room must have stable level.

3.5 Correction for a test device

(1) Correction

The accuracy of a test device such as a chassis dynamometer, exhaust gas measurement device and so on has to be validated, and they are exchanged and corrected with the method decided by manufacturers of them.

(2) Setting up of equivalent inertia weight

If the equivalent inertia weight in the next table can not be set exactly, it can be set in the range of +10%. In case that it is set with the standard of the test room belonging to KIA P/T, the setting value is expressed as the correction Lb in table 3.

Table 3. Setting table of equivalent inertia weight

Weight of a test car = Weight of a empty car + 110kg	Equivalent inertia weight		
	kg	Lb	Correction Lb
~ 562	500	1102.3	1125
563 ~ 687	625	1377.9	1500
688 ~ 812	750	1653.4	1750
813 ~ 937	875	1929.0	2000
938 ~ 1125	1000	2204.6	2250
1126 ~ 1375	1250	2755.7	2875
1376 ~ 1625	1500	3306.9	3375
1626 ~ 1875	1750	3858.0	3875
1876 ~ 2125	2000	4409.2	4500
2126 ~ 2375	2250	4960.3	5000
2376 ~ 2625	2500	5511.5	5625
2626 ~ 2875	2750	6062.6	6125
2876 ~ 3250	3000	6613.8	6750

3.6 Establishment of mileage accumulation driving program for exhaust gas measurement

(1) Regulation assignment requisite

(a) Time for car inspection and overhaul

Every time driving distance reaches 1,000, 5,000, 10,000, 20,000 and 30,000 ± 500km, inspection and overhaul of a test car is carried out with appointed method for them. At this time, in the case of 1,000 and 5,000km they are carried out with the method decided by manufacturer, and per 10,000km since than(convert into 6 months), with the inspection and overhaul item applicable for a private passenger car in the next table.