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75th GRPE, 6-9 June 2017,
Agenda item 13

Future Policy for Motor Vehicle Emission Reduction (Thirteenth Report) (31 May 2017 Central Environment Council) Overview

Environmental Control Technology Office, Environmental Management Bureau, Ministry of the Environment

Background to Central Environment Council Discussions

- Based on an inquiry by the Minister for the Environment on 21 May 1996, successive reports have been made by the Central Environment Council from the interim report (1996) through to the Twelfth Report (2015), to sequentially strengthen regulating of motor vehicle emissions.
- The Central Environment Council commenced discussions on the three key issues raised in the Twelfth Report from October 2015.

The Three Issues discussed in the Twelfth Report

- Measures to reduce fuel evaporative emissions
  - Discussion of measures to reduce fuel evaporative emission during fueling
  - Discussion of strengthening measures to reduce fuel evaporative emission when parking
- Measures for fine particulate matter (PM2.5)
  - Introduction of PM regulations for stoichiometric direct-injection vehicles
- Discussion of measures to reduce two-wheeled vehicle emissions
  - Promotion of further emission reductions

- A draft report was compiled by the 59th experts committee on motor vehicle emissions on 22 March 2017, and later reported to the Minister of the Environment by the Central Environment Council on 31 May 2017.

Contents

I Measures to Reduce Fuel Evaporative Emissions ① Control Technology Options

(1) Unloading Measure (Stage 1) *

This measure deals with fuel evaporative emissions that occur when tanker trucks unload fuel into underground tanks at gasoline service stations. By adding a vapor return pipe to tanker trucks, the tanker trunks can collect fuel evaporative emissions, and take them back to the oil terminal.

*A number of Western and Asian Countries have already introduced this measure. Domestically, the measure has been introduced via ordinances in 14 prefectures and cities ⁑, mainly cored around urban local governments.

⁑ Saitama pref., Saitama city, Chiba pref., Chiba city, Tokyo, Kanagawa pref., Yokohama city, Kawasaki city, Sagamihara city, Fukui pref., Aichi pref., Kyoto pref., Osaka pref., Amagasaki city

(2) Fueling Measure

① Gasoline Station Measure (Stage 2)*

This is a measure to retrieve fuel evaporative emissions that occur when fueling motor vehicles via fuel pumps. By installing a suction unit to fuel pumps, vapors can be collected by the pumps, and stored in the underground tank, or liquefied and returned to the fueling nozzles to be reused in fueling motor vehicles.

* A number of Western and Asian Countries have already introduced this measure. Domestically, the liquefying recovery system in Stage 2 is gradually being popularized, while a certain fuel pump manufacturer is domestically shipping 30% of its products with this Stage 2 measure.

② Vehicle Measure (ORVR)*

This is a vehicle measure to retrieve fuel evaporative emissions that occur when fueling motor vehicles. A large charcoal filled collector is installed on vehicles to adsorb vapors.

*Already introduced in the USA.

(3) Parking Measure

This is a parking measure for fuel evaporative emissions due to temperature changes from fuel tank and fuel evaporative emissions due to filtering out from exhaust pipe while vehicles are parked. By equipping vehicles with charcoal filled vapor collectors, fuel vapors emitted from fuel tanks can be adsorbed and materials, such as exhaust pipe ones, that are altered in terms of properties can be prevented from filtering out from exhaust pipes.

*The GTRs are being discussed at WP.29.

I Measures to Reduce Fuel Evaporative Emissions ② Cost-effectiveness of each control technology

Fueling Measures

(1) Cost-Effectiveness of Stage 2

Annual sales (kL/yr) per service station			1,000 or more	2,000 or more	3,000 or more
Annual expenditure (Mil. Yen/yr)	Period of service	7 yr	2,077	979	442
		14 yr	193	-173	-258
		21 yr	-435	-557	-491
Annual vapor cutback (Tons/yr)			16,250	12,720	9,193
Cost-effectiveness (Yen/ton)	Period of service	7 yr	127,800	77,010	48,070
		14 yr	11,890	-13,570	-28,070
		21 yr	-26,770	-43,770	-53,450

(2) Cost-Effectiveness of ORVR

	ORVR
Annual expenditure (Mil. Yen/yr)	42,780
Annual vapor cutback (Tons/yr)	66,910 * Including times of parking
Cost-effectiveness (Yen/ton)	639,300

Parking measure

	2DBL	3DBL
Annual expenditure (Mil. Yen/yr)	12,160	16,790
Annual vapor cutback (Tons/yr)	7,951	12,560
Cost-effectiveness (Yen/ton)	1,529,000	1,336,000

I Measures to Reduce Fuel Evaporative Emissions ③ Orientation of Measures

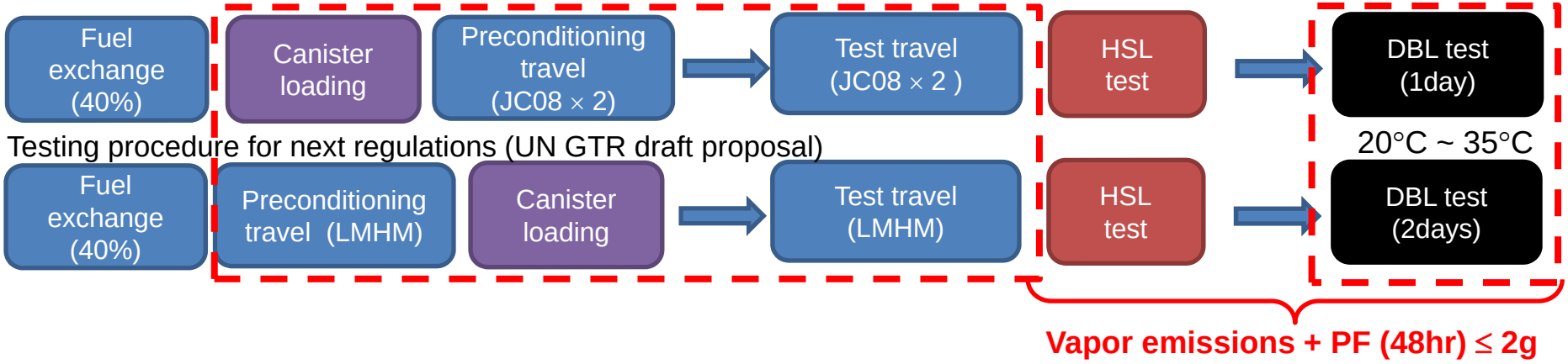
Stage1	• Mainly urban local governments have already introduced measures via ordinances, and the necessity for further measures is meagre.
Stage2	• Cost-effectiveness is excellent compared to ORVR. • Domestic control equipment is already at the practical application level, and there are examples of its introduction. • However, compared to other types of industries covered by the regulations, the scale of VOC emissions per workplace is small (according to PRTR data, the domestic maximum is 33 tons per year), which means the introduction would be unreasonable as a legal restriction. Furthermore, for a small-scale service station, the expenditure is a heavy burden, which needs to be given consideration.
ORVR	• Compared to Stage 2, cost-effectiveness (additional expenditure required for unit VOC cutback) weakens. • Runs counter to the flow of activities for international harmonization of technical regulations.
Parking measures	• The GTRs are already under discussion at GRPE.

Therefore, from the perspective of advancing measures that can be practically implemented for both service stations and motor vehicles as fuel evaporative emission measures, the following will be undertaken.
① For measures when fueling, we will promote introduction of Stage 2 on a voluntary basis.
② We will strengthen vehicle regulations as a parking measure.

I Measures to Reduce Fuel Evaporative Emissions ④ Details of Parking Measures

Regarding testing procedures and regulation values, and so the GTRs that are expected to be adopted at UN WP.29 in June 2017 are the ones that will be used.

Test procedures currently in use in Japan



①Test for number of days parked: Extended from 1 day to 2 days → Increase size of canister to enhance adsorption capacity

② Purge running cycle:
With running up to HSL from canister loading, changes take place from JC08 × 4 to WLTC (Low, Medium, High, Medium)

	Time [s]	Travel [km]
Current domestic regulation JC08 × 4	4816	32.7
UN GTR proposal WLTC (LMHM) × 1	1910	19.8

→ Change engine control to enhance purge capability

③ Limit value: Improved by changing from 2g of emissions per day to 2g of emissions per 2 days
A 2g regulation value to deal with emissions for HSL + DBL_1stday + DBL_2ndday + PF (48hr)*
*PF is the fixed deterioration factor for the fuel tank, with PF (48hr) = 0.24g PF(24hr)= 0.12g
(This is just limited to multilayer tanks. Monolayer tanks are to be measured based on the deterioration procedure.)

→ Change the rubber material used for fueling pipe, to control permeating

④ Application start time: Commence application by the end of 2020 (New type: October 2020, All vehicles: Date envisaged as October 2022)

II PM Measures for Gasoline Direct Injection Vehicles ① Background to PM Regulations

- In Japan, with the short-term control of 1994, PM regulations were introduced for diesel vehicles.
- After that, in the case of lean-burn direct injection vehicles (those equipped with cylinder direct-injection internal combustion engines with occlusion type NOx reduction catalysts on board), considering the fact that there were vehicles emitting particulate matter above the level for diesel vehicles equipped with diesel particulate filters (DPF), in the post-2009 new long-term regulations, the same control as those for diesel vehicles were introduced for lean-burn vehicles.

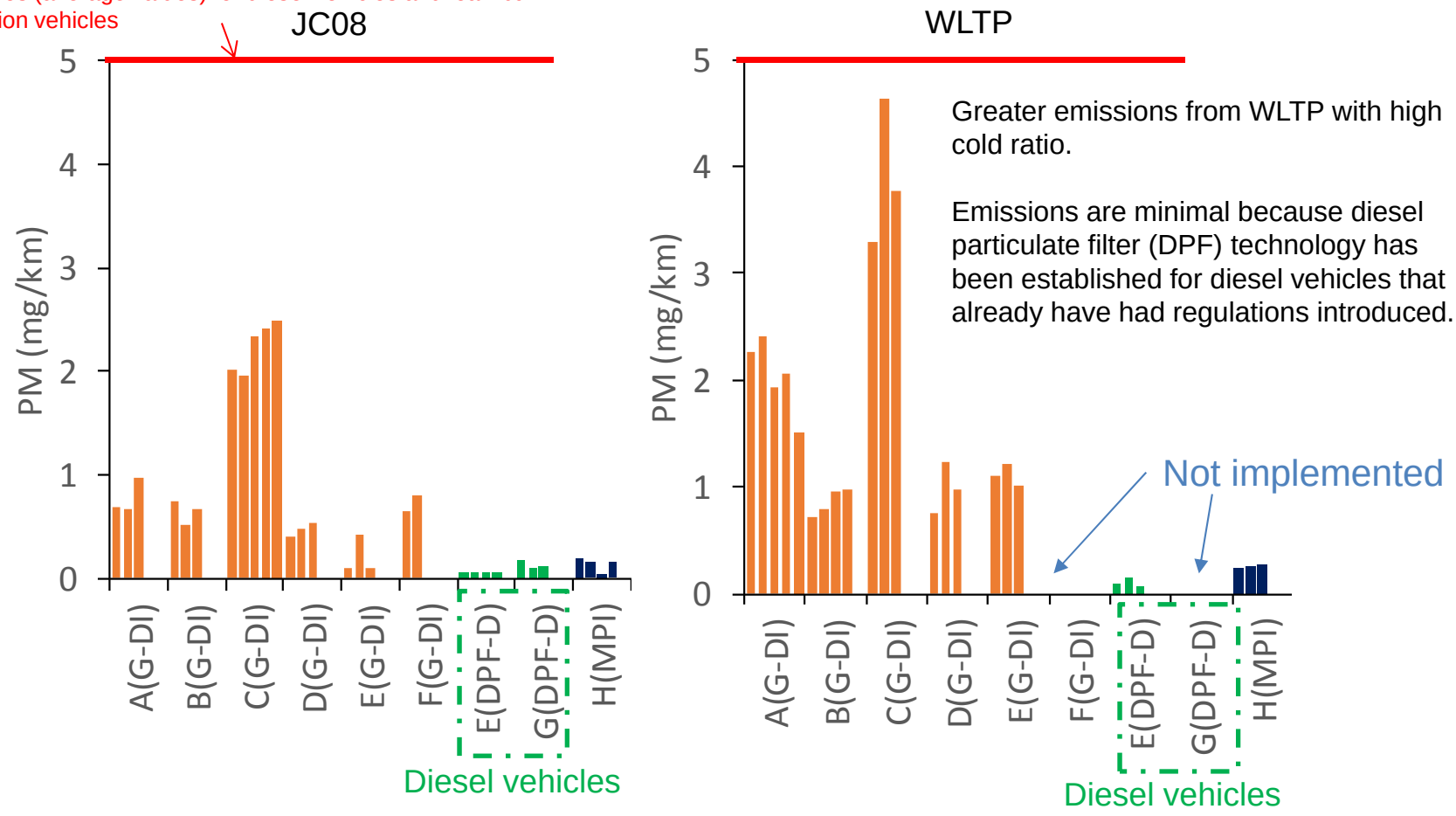
Passenger vehicle (g/km)	Short-term regulations (1994)	Long-term regulations (1997)	New short-term regulations (2003)	New long-term regulations (2005)	Post new long-term regulations (2009)
Diesel	0.34	0.08	0.052	0.013	0.005
Lean-burn direct injection	-	-	-	-	0.005

Heavy vehicle (g/kWh)	Short-term regulations (1994)	Long-term regulations (1997)	New short-term regulations (2003)	New long-term regulations (2005)	Post new long-term regulations (2009)
Diesel	0.7	0.25	0.18	0.027	0.01
Lean-burn direct injection	-	-	-	-	0.01

II PM Measures for Gasoline Direct Injection Vehicles ② Emissions from Stoichiometric Direct Injection Vehicles

2015 Ministry of the Environment Study (Implementing body: National Traffic Safety and Environment Laboratory (IAA) [currently: National Agency for Automobiles and Land Transport Technology (IAA)])

Control values (average values) for diesel vehicles and lean-burn direct injection vehicles



Reference: Basic approach to selecting vehicles

① Put to use the PM emission data for stoichiometric direct injection vehicles implemented by the Ministry of the Environment up to now.

② Regarding vehicles from automakers producing stoichiometric direct injection vehicles, tests are being implemented on at least one vehicle of each model in popular demand from each maker.

③ In addition to the tests in item ② above, the number of vehicles studied is being expanded in accordance with market sales ratios of each maker, including emission data provided by the Association of the Automotive Industry.

II PM Measures for Gasoline Direct Injection Vehicles ③ Details of Measures

- The PM emissions of stoichiometric direct injection vehicles are already exceeding the emissions from diesel passenger vehicles that have been regulated.
- Emissions for WLTP are affected by issues such as cold start, so when the conventional JC08 mode is used, emissions become even greater.
- Conversely, stoichiometric direct injection vehicles targeted in studies up to now have control values below those for diesel passenger vehicles and lean-burn direct injection vehicles, so regulating stoichiometric direct injection vehicles to the same level should be technologically possible.

- From the perspectives of air environment protection and regulatory fairness, PM regulations will be introduced to stoichiometric direct injection vehicles at the same level as the diesel passenger vehicle ones, so that PM emissions from automobiles can be reduced further.
- As there are vehicle types where these regulations apply already, the lead time will be shortened to approximately three years, which is less than the industry hearing results showed (four to five years).

○ Lead time required for introducing PM regulations for gasoline direct injection vehicles

Commence application of regulations by the end of 2020
(New type: October 2020, Continuation: Date envisaged as October 2022)

*To apply to all gasoline direct injection vehicles
*Control values to be the same as diesel vehicles and lean-burn direct injection vehicles

(1) Application Start Time

- Application of Euro 5 scheduled to commence from January 2020.
- Taking into consideration the development periods of automobile manufacturers, and from the perspective of the world-wide harmonization of technical standards, the application year has been aligned with that for Euro 5.

⇒ Application year set as 2020. (New model vehicles: October 2020, Continued production vehicles: Date envisaged as October 2022)

(2) Prescribed Allowable Maximum Desired Value for Emissions involving Mode of Travel

- The emission regulation values for mode travel in Euro 5 will provide stronger regulations for any of the regulated substances when it comes to the current Japanese regulations.
- It has been confirmed that automobile manufacturers can handle the technical aspects, even including the regulation values of NMHC, which will broadly strengthen regulations.

⇒ Allowable maximum desired value for emissions involving mode of travel will be strengthened to values that are the same as Euro 5 control values.

(3) Weighting Factor for Cold Start and Hot Start (continued)

- In Europe, Class 1 and Class 2 are for the same vehicle classification, therefore the same regulation value is necessary. With Euro 5, the weighting factor for cold start and hot start for Class 2 is 5:5.
- In the present WMTC-gtr (GTR2), based on the actual travel data of each country, the weighting factor for Class 2 cold start and hot start is 3:7; whereas, in Japan, a difficulty arises because the weighting factor used differs to the international standard.

For the meantime, the weighting factor based on WMTC-gtr (GTR2) will be maintained. From here on, in WP.29/GRPE/EPPR, based on the approach to the weighting factor when being established for WMTC and the study results for Euro 5, there should be discussions about the appropriate weighting factor.

(4) Idling Regulations

- Regarding idling regulations, under the current Japanese regulations, carbon monoxide (CO) and hydrocarbon (HC) are the regulated substances, while in Europe the substance regulated is just CO.
- As the aim of the idling regulations is to confirm whether performance is being maintained in devices that reduce emissions on vehicles in current usage, then in regard to abolishing the HC regulation from the perspective of international harmonization of technical standards, we need to carefully consider the current usage emission levels of vehicles that conform to the latest regulations in Japan.

For the meantime, the current HC regulation will be maintained. (In the future, consideration will be given to this issue based on knowledge gained about idling emission levels in accordance with the year of the regulation.)

Current Japanese Regulations
- CO: 3.0%
- HC: 1000ppm (mopeds, small motorcycles)
- HC: 1600ppm (motorcycles, less than or equal to 50cc or less than or equal to 125cc)

EURO 5 (Same as EURO 4)
- CO: 0.5% or less or manufacturer's claimed value
- HC: None

(4) Idling Regulations (continued)

- On the one hand, regarding the carbon monoxide (CO) regulation values, although the EURO 5 regulation values are tougher than the current Japanese regulations, it has been confirmed that auto manufacturers are able to respond to this issue on the technical front.
- Even with the system adopted by automakers in Europe, where they declare values (automakers declare the CO emission values for their vehicles, in an easing measure that confirms that vehicles in current usage fulfill the regulations), this kind of declaration has been found to be unnecessary.
- Specifically, with notable regard to vehicles that use secondary air, the precondition is that oxidation treatment will be performed by a catalyst, and, in many cases, power output is assured by the air-fuel ratio at time of combustion being at the rich side, so that there were worries about whether there were vehicles that caused increases in HC emissions because the catalyst struggled to warm up during idling; however, results from auto industry studies show that all vehicles – even those using secondary air – were well below the 0.5% CO emission level. Thus, it was confirmed that there is no need for an easing measure.
- Indeed, even regarding the CO measuring accuracy of idling emission analyzers used in the new tests and continuing tests by bodies (National Agency for Automobile and Land Transport Technology [independent] and designated vehicle maintenance operators), it has been confirmed that there will be no problems with measuring even if regulations are strengthened.

⇒ Regarding the allowable maximum desired value for emissions of CO, we will move to strengthen regulations to a uniform 0.5%* (without using automakers declared values).

*With regulation values for idling, the preconception is that the engine will be in a warm state, so warming is necessary prior to measuring of emissions.

(5) Fuel Evaporative Emission Regulations

- Although the regulation values for fuel evaporative emissions in EURO 5 are tougher than the current Japanese regulation values, it has been confirmed that automakers are able to respond to this issue on the technical front.

⇒ Regarding the allowable maximum desired value for fuel evaporative emissions, we will strengthen the value to the same level as that of EURO 5 (2g/test → 1.5g/test).

(6) Durability Mileage

- If a durability mileage was to be introduced in EURO 5, it would be tougher than the current Japanese regulation, yet it has been confirmed that automakers are able to respond to this issue on the technical front.
- Note, for some of the vehicle categories (two-wheelers with maximum speeds of less than 130km/h among small motorcycles and mopeds), the EURO 5 durability mileage is shorter than the current Japanese regulation; however, taking into consideration the emission deterioration factor and the next allowable maximum desired value for emissions for the vehicle categories concerned, we will strengthen regulations because the emission regulation value for durability mileage will get stricter.

⇒ Regarding durability mileage, we will strengthen the value to the same level as that of EURO 5.

(7) On-Board Diagnostics System

- With EURO 5, a high-level on-board diagnostics system (OBD II) will be introduced, bringing into action not only the disconnection detection of the conventional OBD but also detection of other faults, such as catalyst deterioration detection via emission threshold and misfire detection.
- It has been confirmed that automakers can respond on the technical front to diagnostic concepts involved in OBD II.
- Nevertheless, regarding the specific detection items, thresholds and evaluation methods, etc., from here on, they are scheduled to be discussed at the UN WP.29/GRPE/EPPR, based on the draft of EURO 5 (scheduled for presentation by January 2018).

We will introduce OBD II once the specific detection items, thresholds and evaluation methods, etc., have been established based on the direction that EURO 5 takes and the state of UN discussions.*

*Our OBD II application start time is 2020, which is the same as EURO 5. However, taking into consideration the time needed for technology development, there may be a delay in the application start time for some of the specific detection items.

III Measures to Reduce Two-Wheeled Vehicle Emissions ⑥ Summary of Details

Item	Current Japanese Regulations 2016 Regulations (Tier 3 Regulations)				Strengthen regulations	Next Generation Japanese Regulations 2020 Regulations (Tier 4 Regulations)				Harmonization of standards	Reference EURO 5		
Application start time	October 2016 onward					2020					January 1, 2020 onward		
Tailpipe emissions (mg/km)	Class	1	2	3		Class	1	2	3		Class	1,2 < 130km/h	3 ≥ 130km/h
	CO	1140	1140	1140		CO	**1000**				CO	1000	
	THC	300	200	170		THC	**100**				THC	100	
						NMHC	**68**				NMHC	68	
	NOx	70	70	90		NOx	**60**				NOx	60	
	PM	✘	✘	✘		PM	**4.5 (only DI)**				PM	4.5 (only DI)	
	WF	P1:0.5 P1:0.5	P1:0.3 P2:0.7	P1:0.25 P2:0.50 P3:0.25		WF	P1:0.5 P1:0.5	P1:0.3 P2:0.7	P1:0.25 P2:0.50 P3:0.25		WF	P1:0.5 P2:0.5	P1:0.25 P2:0.50 P3:0.25
Idling	CO: 3.0% HC: 1000ppm (mopeds, small motorcycles) HC: 1600ppm (motorcycles, less than or equal to 50cc or less than or equal to 125cc)					**CO: 0.5%** HC: 1000ppm (mopeds, small motorcycles) HC: 1600ppm (motorcycles, less than or equal to 50cc or less than or equal to 125cc)					CO: 0.5% or automaker declared value HC: None		
Evaporation	2g/Test					**1500mg/Test**					1500mg/Test		
Durability	Durability mileage: 6k/8k/24k (km)					**Durability mileage: 20k/35k (km)**					Durability mileage: 20k/35k (km)		
OBD	J-OBD Circuit diagnosis (disconnections, etc.), fuel system diagnosis					**OBDII** **Problems in emission reduction system, deterioration detection**					OBDII Problems in emission reduction system, deterioration detection		

■ Work Toward Domestic Introduction of Regulations for PM Particle Number (PN)

- In an effort to further reduce PM emissions, we are considering the introduction of the PM particle number (PN) measuring method and regulation value used in Europe, basing our decision on the status of achievement of the Japanese environment standard and the state of PM emissions.

■ Work to lower Conventional Detection Lower Limit of Particle Size

- In anticipation that we will have to lower the conventional detection limit for particle size (23 → 10nm), we will cooperate in round-robin testing for WP.29/GRPE/PMP-IWG.

■ Work to establish Testing Method for Brake Dust

- Noting that we should contribute to the establishment of a testing method for brake dust, we will conduct brake dust measuring tests (weight, particle number).

Measures to Reduce Fuel Evaporative Emissions

In considering cost-effectiveness that takes into account the parking realities in Japan, we found that rather than two days the parking test worked slightly better over three days – so, in the future, bolstering the parking test to three days to find ways of prolonging parking without fuel evaporation is desirable.

To strengthen our measures toward those of the future 3DBL in evaporation GTRs while taking into account the state of the latest technical developments, such as increased capacities of canisters and sealing of tanks, we will enthusiastically participate and contribute to activities that will review the issues in question.

Regarding puff losses when fuel caps are opened, vehicles equipped with sealed tanks are structured to control such puff loss emissions. Yet, while the testing method for puff loss from sealed tanks is being discussed, there has been no debate related to puff loss on vehicles with conventional tanks.

Having considered the cost involved in providing a countermeasure for puff loss emissions on vehicles with conventional tanks, we should discuss the establishment of a standard while keeping in mind the perspective of international harmonization of technical regulations in combination with the abovementioned bolstering of parking test length (number of days).

Thank you for your kind attention