Light-duty Exhaust Emission Regulations
< UN Regulation R83 >

The 58th Asia Expert Meeting in Indonesia

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JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

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Environmental Regulations

JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

Vehicle Emissions

Tailpipe Emissions

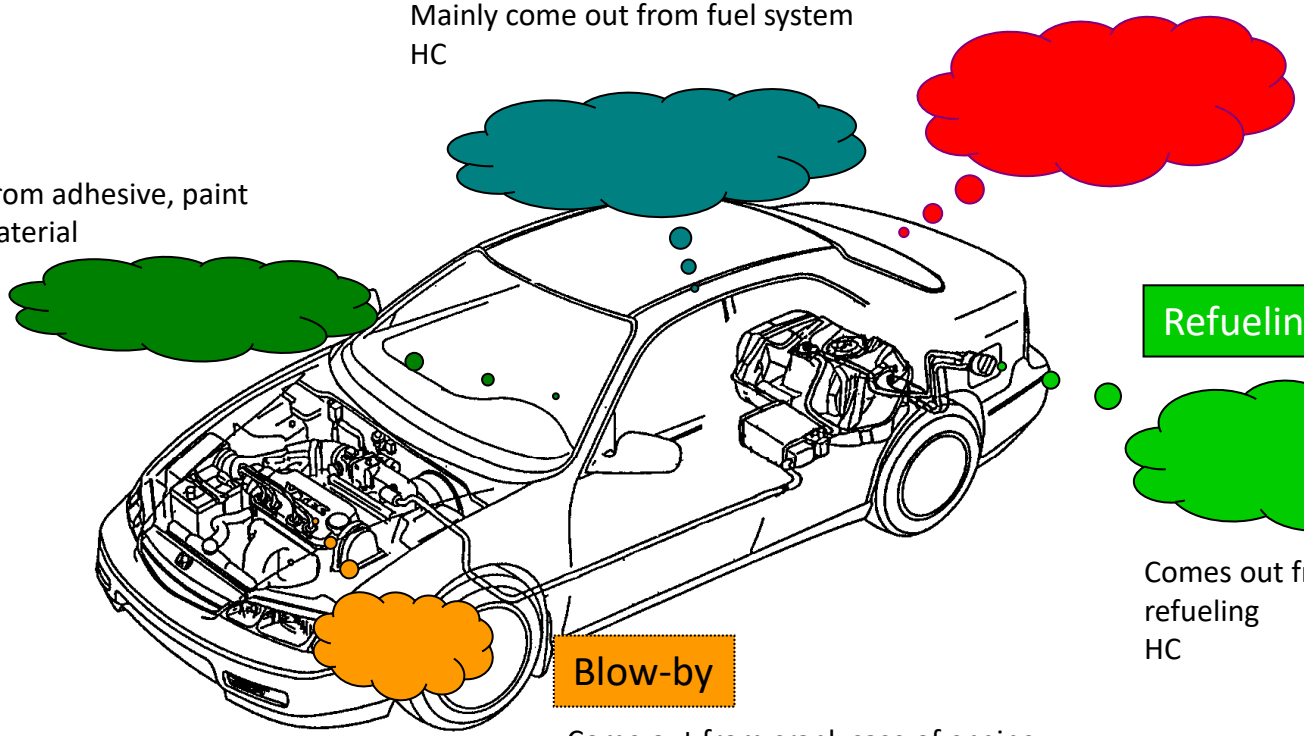
come from engine combustion
CO/HC/NO**x**

Evaporative Emissions

Mainly come out from fuel system
HC

VOC

Come out from adhesive, paint
Resinous material
HC…



Refueling Emissions

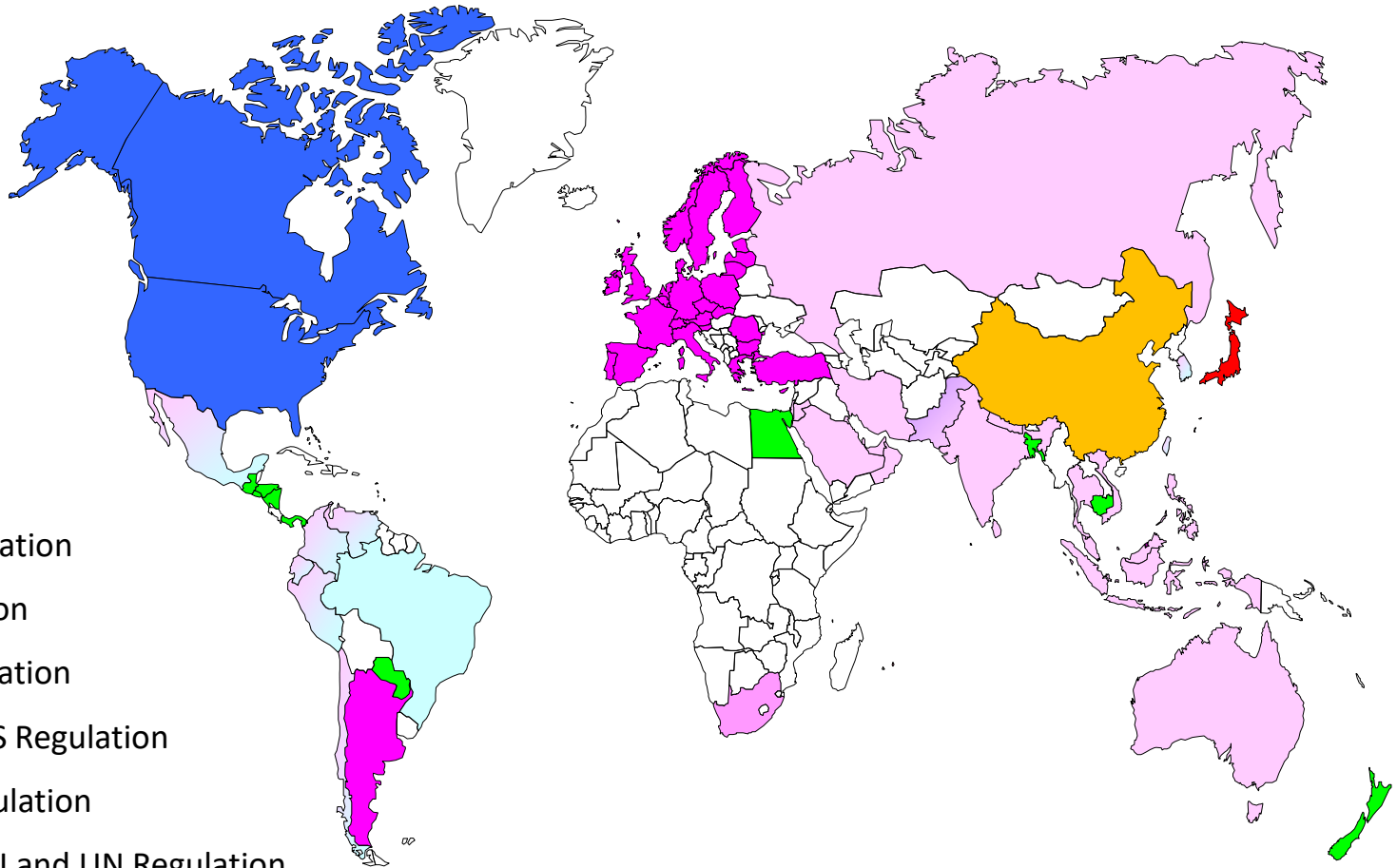
Comes out from fuel inlet when refueling
HC

Blow-by

Come out from crank case of engine

Several kind of gases are emitted from a vehicle

Environmental Regulations in The World



- Japan Regulation
- US Regulation
- China Regulation
- Based on US Regulation
- EU, UN Regulation
- Based on EU and UN Regulation
- Other

Environmental Regulations in The World

	EU	Malaysia	USA	China	Japan	Australia	Indonesia	Thailand	Singapore	Philippines	Vietnam
Idle Emission	●	●	●	(●)	●	●	(●)	●	●	●	●
Tailpipe Emission	●	●	●	●	●	●	●	●	●	●	●
Low Temp. Emission	●		●	●		●					
Crankcase Emission	●	●	●	●	●	●		●	●	●	●
Evaporative Emission	●		●	●	●	●		●	●	●	●
Durability	●		●	●	●	●		●	●	●	●
OBD	●		●	●	●	●		●	●		
RDE	●			●							

Emission regulation

G: Gasoline D: Diesel

Current

Country	Type	'16	'17	'18	'19	'20	'21	'22	'23	'24
Singapore	Gas	Euro4				Euro6b				
	Die	Euro5				Euro6b				
Vietnam	G&D	Euro2			Euro4			Euro5		
Thailand	G&D				Euro4				Euro5	
Indonesia	Gas	Euro2				Euro4				
	Die			Euro2			Euro4			
Philippine	G&D					Euro4				
Malaysia	Gas			Euro2			Euro4			
	Die			Euro2				Euro4		
Cambodia	G&D			Idle Emission			Euro2			
Brunei	G&D				Non legislated					
Laos	G&D				Non legislated					
Myanmar	G&D				Non legislated					
EU	G&D		Euro 6b		Euro 6c		Euro6d			

Advanced European regulation is being introduced to ASEAN

UN Regulation R83-Series

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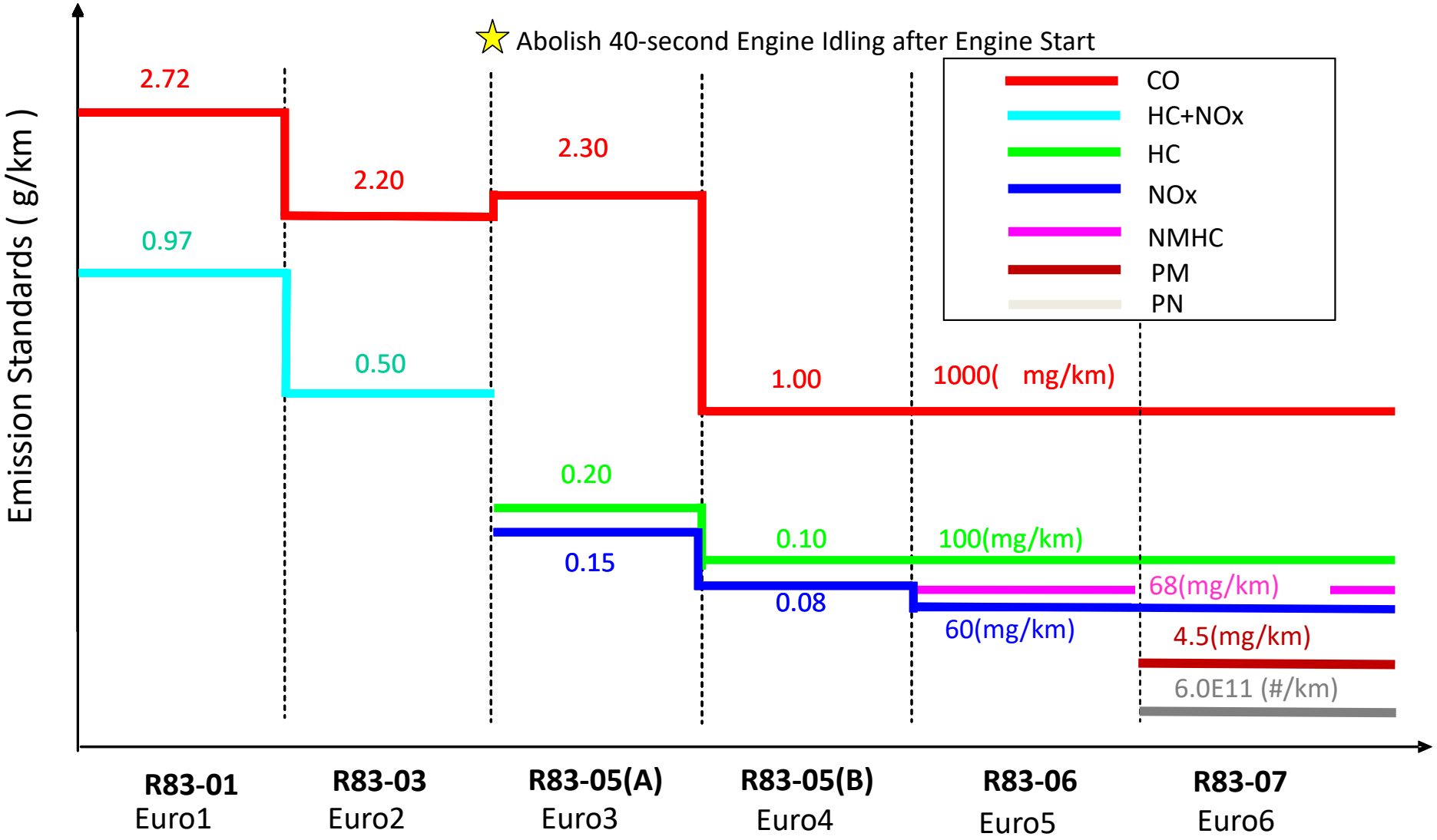
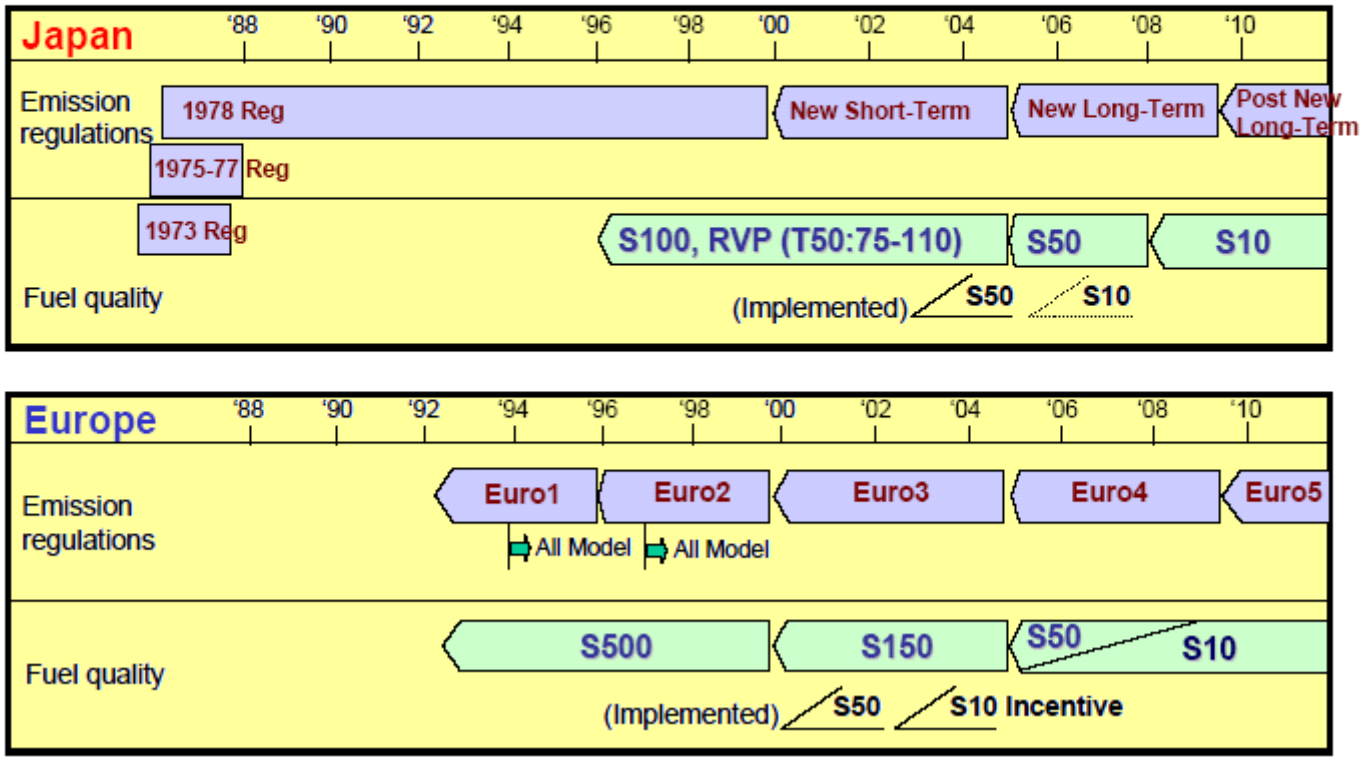
History of UN Regulation R83 Series

Series	Date of Entry into Force	Note
00	1989/11/05	Urban driving cycle only
01	1992/12/30	Addition of extra urban driving cycle Euro-1
02	1995/07/02	
03	1996/12/07	Euro-2
04	1999/11/13	
05	2001/03/29	Addition of OBD provisions A limit : Euro-3 B limit : Euro-4
06	2010/12/09	Euro-5
07	2014/04/15	Euro-6

History of Emission Standards

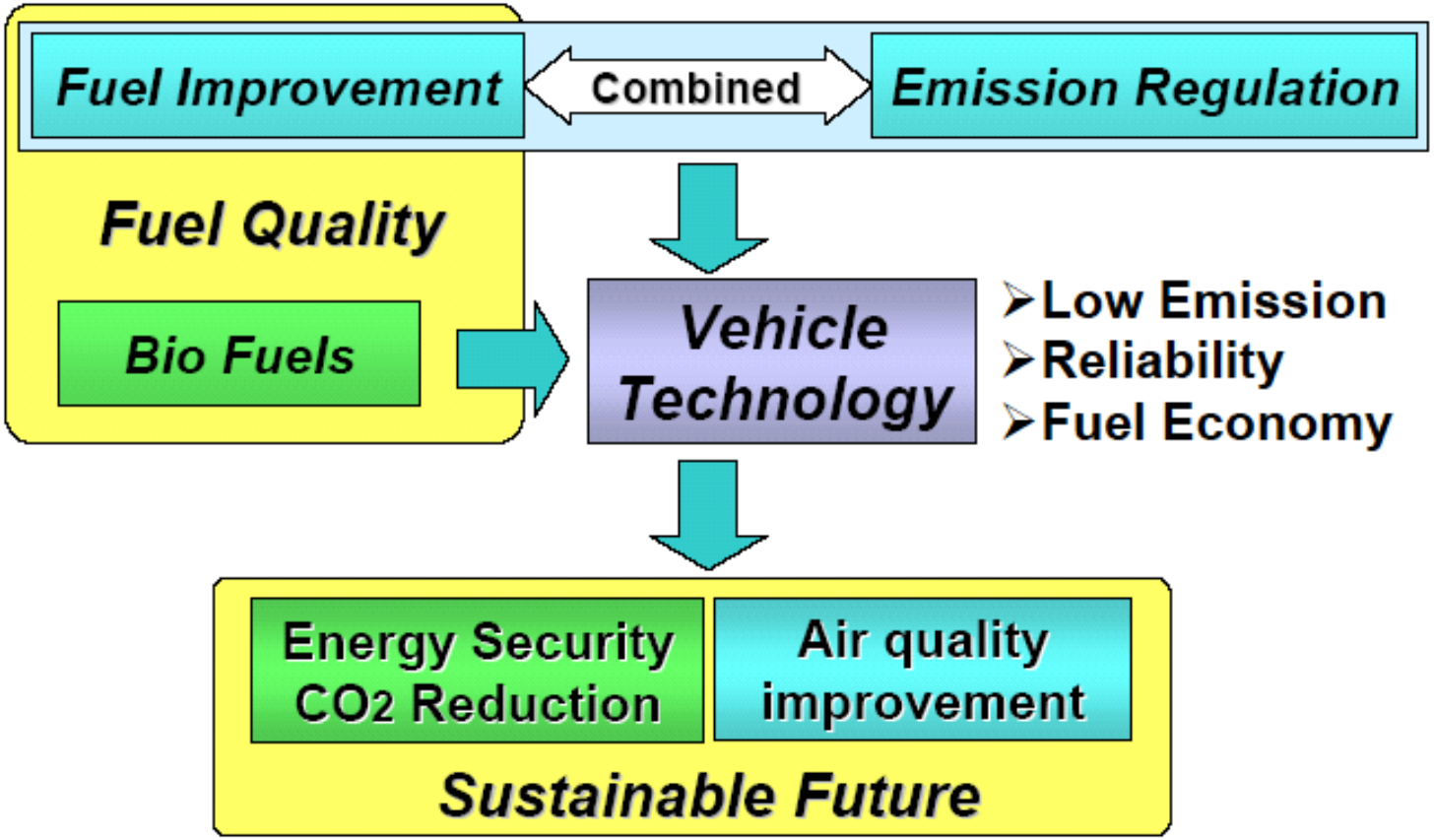


Emission and Fuel Regulations in JP & EU (Gasoline)



Emission regulations have to be enforced under fuel improvement.

Relations between Fuel Improvement and Vehicle Technology



Gasoline Quality for Low Emissions

Fuel quality to maximize the catalyst performance;

- **For air fuel ratio control**
  - **Distillation properties (and RVP)**
  - **Detergent (preventing deposits)**
- **For quicker warm up of catalyst**
  - **Lowering sulfur**
- **For keeping higher conversion efficiency**
  - **Lowering sulfur**
  - **Metal Free**

Market fuel quality recommendations

In order to ensure proper functioning of in-use vehicles, link the vehicle technology levels associated with the **various emission levels with the corresponding market fuel quality is very important**,. A certain number of parameters were agreed upon in UN/ECE discussion including oil industries, as a recommendation in R.E.3 and S.R. 1.

Diesel fuel parameters	Euro 2 emissions enabling fuel	Euro 3 emissions enabling fuel	Euro 4 emissions enabling fuel	Test method
Sulphur (mg/kg)	≤ 500	≤ 350	≤ 50	EN ISO 20846 EN ISO 20884
Ash % (m/m)	≤ 0,01	≤ 0,01	≤ 0,01	EN/ISO 6245
Total Contamination (mg/kg)	≤ 24	≤ 24	≤ 24	EN 12662

<from Annex 4 of R.E.3 (ECE/TRANS/WP.29/78/Rev.2/Amend.1)>

Contents of UN Regulation R83-05

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2. Definitions
3. Application for approval
4. Approval
5. Specifications and tests
6. Modifications of the vehicle type
7. Extension of approval
8. Conformity of production (COP)
9. Penalties for non-conformity of production
10. Production definitely discontinued
11. Transitional provisions
12. Names and addresses of technical services responsible for conducting approval tests ,and of administrative departments

Appendix 1: Procedure for verifying the conformity of production requirements if the production standard deviation given by the manufacturer is satisfactory

Appendix 2: Procedure for verifying the conformity of production requirements if the production standard deviation given by the manufacturer is either not satisfactory or not available

Appendix 3: In-service conformity check

Appendix 4: Statistical procedure for in-service conformity testing

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Annex 6:	TYPE III TEST	(Emissions of crankcase gases)
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Annex 14:	EMISSIONS TEST PROCEDURE FOR HYBRID ELECTRIC VEHICLES	

Scope

- This Regulation applies to vehicles of categories M and N 1/ as shown by Table A, with regard to the tests foreseen for these vehicles in Table B.

Table A

Vehicle category	Max. mass	Positive-ignition engined vehicles including hybrid vehicles			Compression-ignition engined vehicles including hybrid vehicles
		Petrol	NG	LPG	Diesel
M_1	< 3.5 t	R83	R83	R83	R83
	> 3.5 t	R83	-	-	-
M_2	-	R83	-	-	R49 or R83
M_3	-	R83	-	-	-
N_1	-	R83	R49 or R83	R49 or R83	R49 or R83
N_2	-	R83	-	-	R49 or R83
N_3	-	R83	-	-	-

Scope

Table B

Different routes for type-approval and extensions

Type-approval test	Positive-ignition engined vehicles of categories M and N			Compression-ignition engined vehicles of categories M_1 and N_1
	Petrol-fuelled vehicle	Bi-fuel vehicle	Mono-fuel vehicle	
Type I	Yes (maximum mass ≤ 3,5 t)	Yes (test with both fuel types) (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t)
Type II	Yes	Yes (test with both fuel types)	Yes	-
Type III	Yes	Yes (test only with petrol)	Yes	-
Type IV	Yes (maximum mass ≤ 3,5 t)	Yes (test only with petrol) (maximum mass ≤ 3,5 t)	-	-
Type V	Yes (maximum mass ≤ 3,5 t)	Yes (test only with petrol) (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t)
Type VI	Yes (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t) (test only with petrol)	-	-
Extension	Section 6	Section 6	Section 6	Section 6; M_2 and N_2 with a reference mass ≤ 2 840 kg (1)
On-board diag nostics	Yes, in accordance with section 8.1.1 or 8.4	Yes, in accordance with section 8.1.2 or 8.4	Yes, in accordance with section 8.1.2 or 8.4	Yes, in accordance with sections 8.2, 8.3 or 8.4

"Bi-fuel vehicle" means a vehicle that can run part-time on petrol and also part-time on either LPG or NG.

"Mono-fuel vehicle" means a vehicle that is designed primarily for permanent running on LPG or NG, but may also have a petrol system for emergency purposes for starting only, where the petrol tank does not contain more than 15 litres of petrol;

Type Approval Tests for R83-05

JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

Type Approval Tests

Requirement \ Std.	R83-01 (Euro 1)	R83-03 (Euro 2)	R83-05(A) (Euro 3)	R83-05(B) (Euro 4)	R83-06 (Euro 5)	R83-07 (Euro6)
Type I Test (Tailpipe Emissions) Driving Cycle: NEDC	○	○	○ (No 40-sec. Idle)	○ (No 40-sec. Idle)	○ (No 40-sec. Idle)	○ (No 40-sec. Idle)
Type II Test (Idle Emissions) *	○	○	○	○	○	○
Type III Test (Crank Case Emissions)*	○	○	○	○	○	○
Type IV Test (Evaporative Emissions) *	○ (2g/test)	○ (2g/test)	○VT-SHED (2g/test)	○VT-SHED (2g/test)	○VT-SHED (2g/test)	○VT-SHED (2g/test)
Type V Test (Durability)	○ (80,000km)	○ (80,000km)	○ (80,000km)	○ (80,000km)	○ (160,000km)	○ (160,000km)
Type VI Test (Cold CO/HC Emissions) *	-	-	○	○	○	○
Test Fuel	E0	E0	E0	E0	E5,B5	E10,B7
OBD	-	-	○	○	○	○
OBD IUPR	-	-	-	-	○	○
COP	○	○	○	○	○	○
In-use COP	-	-	○	○	○	○

* : No Requirement for Vehicle with Compression Ignition Engine

Type Approval Tests

Contents

Type I Tailpipe emission ▶ Current Indonesia Regulation

Type II Idling emission

Type III Crankcase gases emissions

Type IV Evaporative emissions

Type V Durability of anti-pollution devices

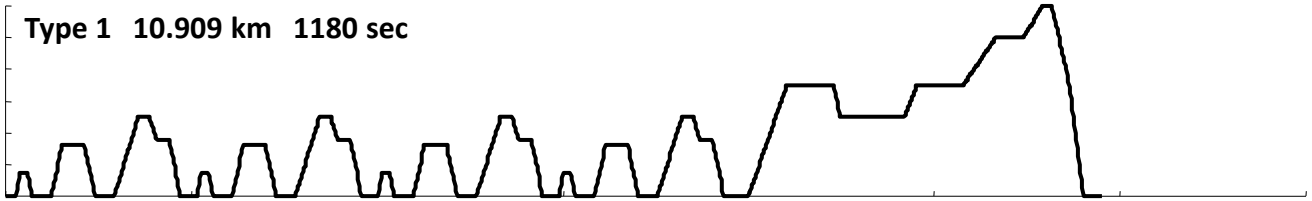
Type VI Low ambient temperature emissions

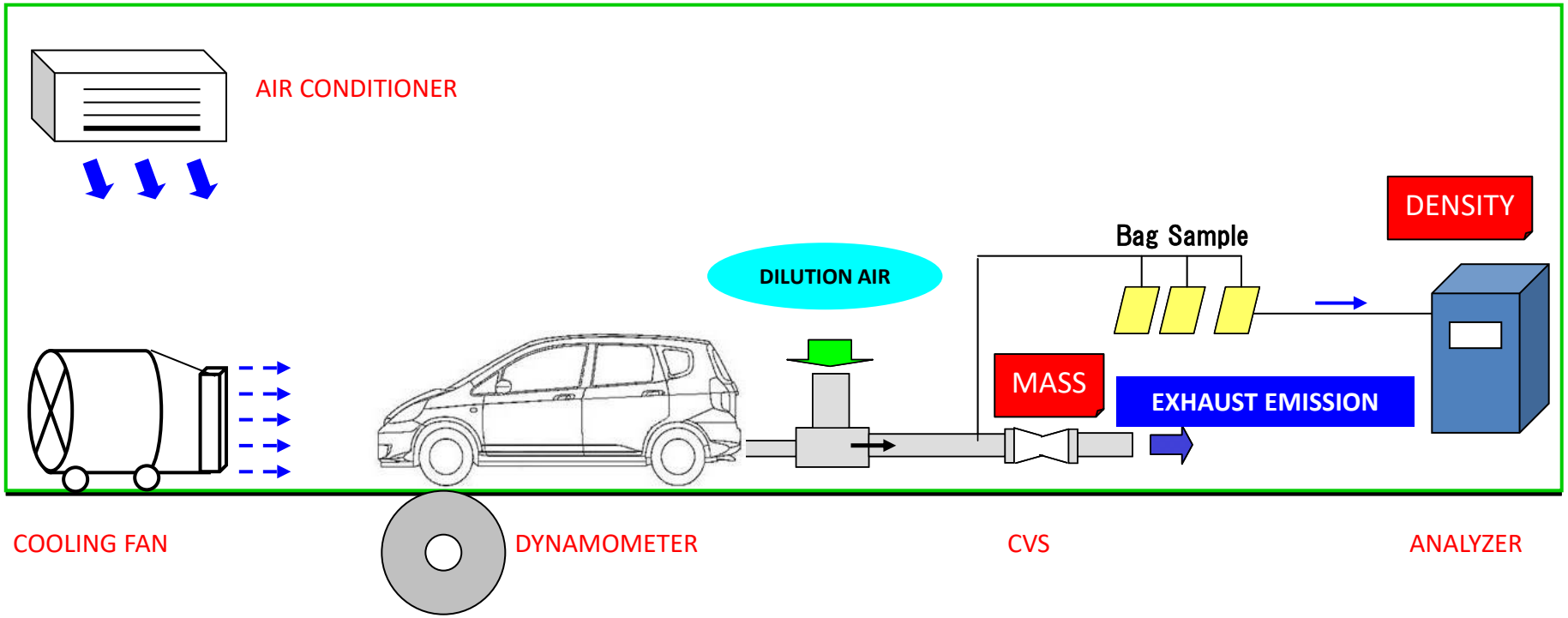
OBD On-board-diagnostic system

Type Approval Tests

Type I Test

Tailpipe emissions emitted from cold engine start to the end of driving cycle are measured. The emissions must not exceed applicable emission limits.

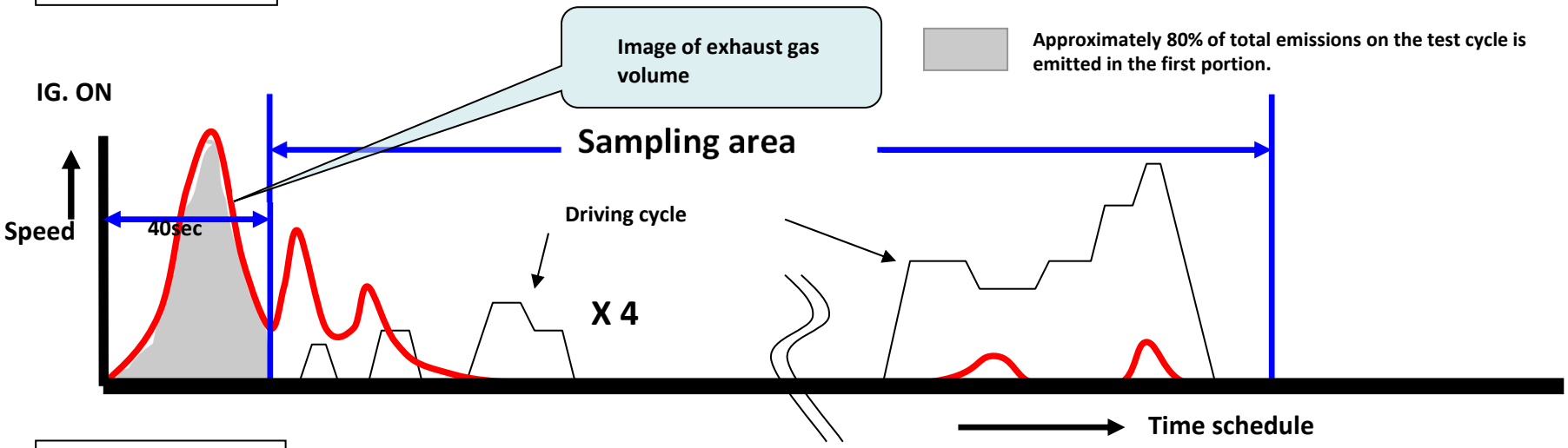




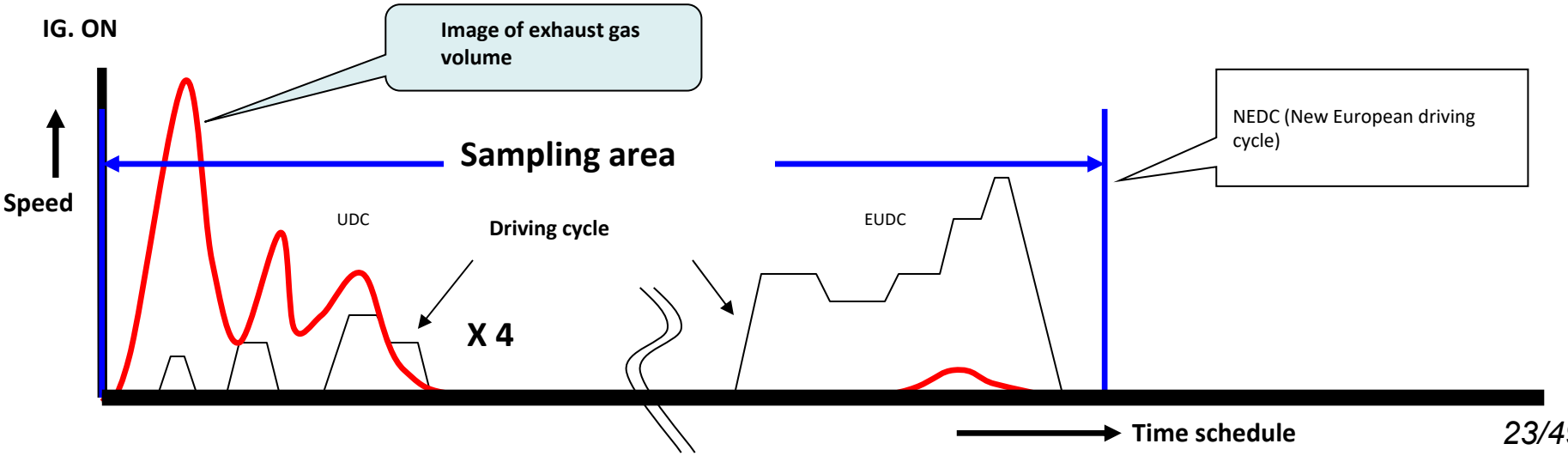
Type Approval Tests

Type I Test

~ R83-03



R83-04 ~



Type Approval Tests

Type I Test

For EURO5 & EURO6, CH4 Analyzer and PN measurement systems are necessary

Test Procedure

Day1

- Vehicle inspection
  - 【Annex4 5】 Vehicle weight
  - Tire pressure
  - Vehicle specification
- Dynamometer setting
  - Road load setting
- Pre-conditioning
  - 【Annex4 5.3】 Type Ⅰ (part1＋part2)

Day2

- Soak
  - Soak condition
    - ・Temperature : 20～30℃
    - ・Period : 6～30hours
- Pre-check
  - Condition
    - ・soak temperature
    - ・Oil temperature
    - ・Coolant temperature
    - ・Tire pressure
    - ・Odometer
- Dynamometer check
  - Inertia weight
  - Road load power
- Type Ⅰ test
  - 【Annex4 6, 7】 Test result

Adjust tire pressure in soak temperature environment.

A/C system, Seat Heating Device ⇒Turn off

Check power train to determind pre-conditioning cycle

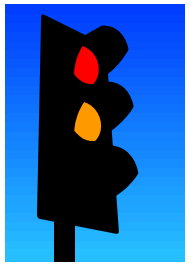
・Check the measuring equipment is normal.
・Verify mode trace error.
・Time from the end of sampling to analyze completion.
・Temp. in the test room duraing EM test.
・Absolute humidity in the test room duraing EM test.
・Verify compliance of EM pollutants with the standard.
・There was any abnormality in the measuring equipment.

Type Approval Tests

Type II Test

Carbon monoxide emissions (CO) are measured at normal and high engine idling speeds.

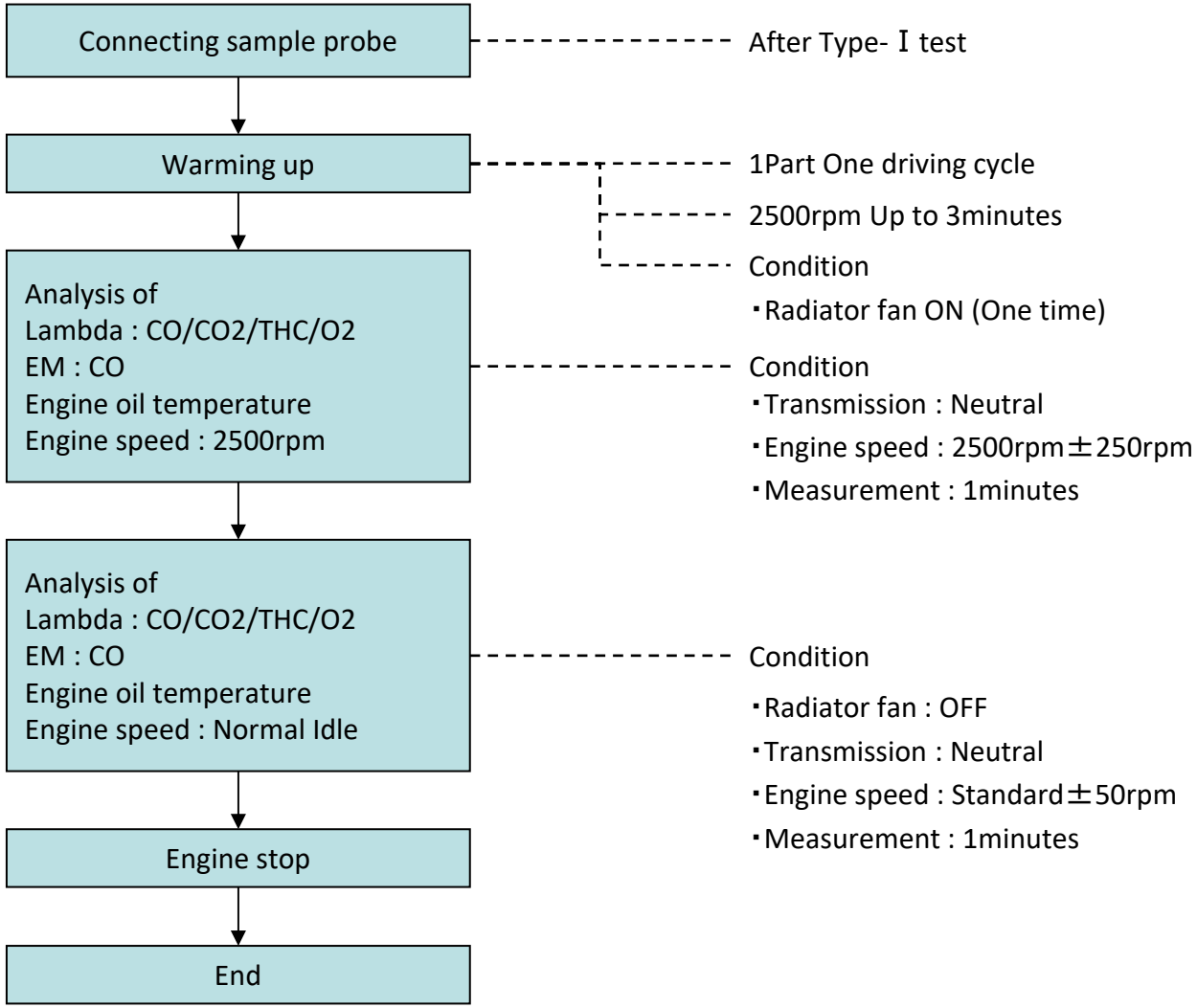
The CO content by volume of the exhaust gases emitted at the engine idling must not exceed 3.5%.



Type Approval Tests

Type II Test

Test Procedure

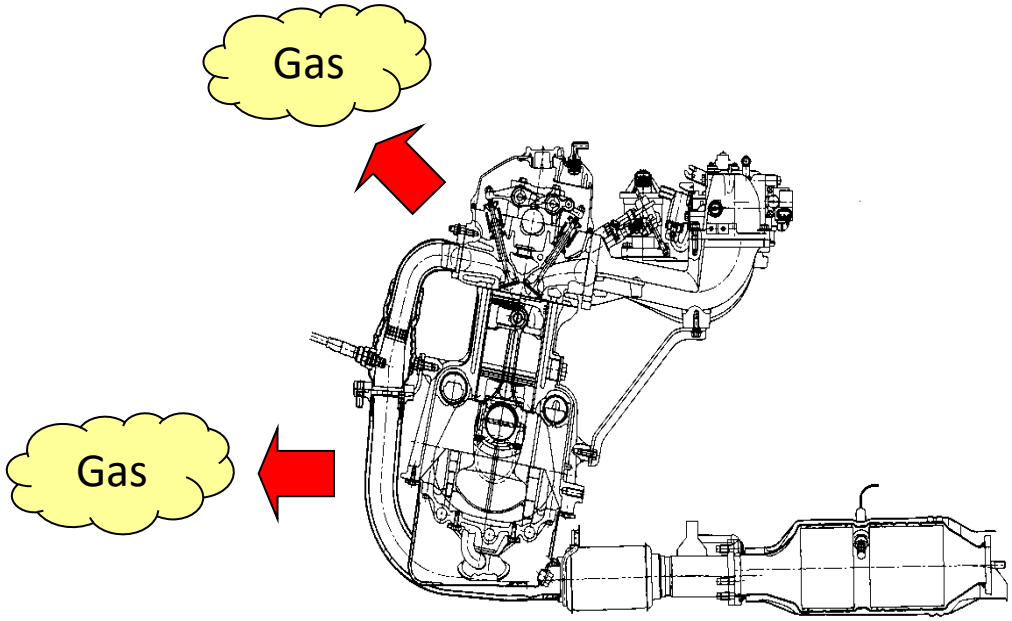


Type Approval Tests

Type III Test

Any crankcase gas must not be released into atmosphere.

The crankcase pressure is measured at a cruse driving. The crankcase pressure must not exceed atmospheric pressure.



Type Approval Tests

Type III Test

Test Procedure

- Connecting inclination manometer — After Type-Ⅱ test
- Warming up — 1Part One driving cycle
- Idling
  Measurement of crankcase pressure — Condition
  - Radiator fan : OFF
  - Transmission : Neutral
- Constant speed at 50km/h
  Measurement of Crankcase pressure — Road Load : Type-Ⅰ load
- Adjustment of
  Dynamometer Road Load — Road Load : Type-Ⅰ load × 1.7
- Constant speed at 50km/h
  Measurement of Crankcase pressure
- Engine stop
- End

Type Approval Tests

Type IV Test

Hydrocarbon emissions (HC) are measured during a short vehicle parking after the vehicle operates (hot soak), and during a diurnal vehicle parking.

The evaporative emission tests consist of the following phases:

- Urban (Part One) and extra-urban (Part Two) driving
- Hot soak loss measurement (HSL) : 1 hour
- Diurnal breathing loss measurement (DBL) : 24 hours

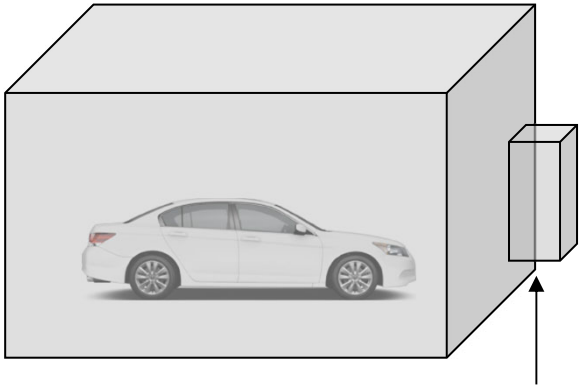
Total emissions of HSL and DBL must not exceed emission limit of 2g.

Type Approval Tests

Type IV Test

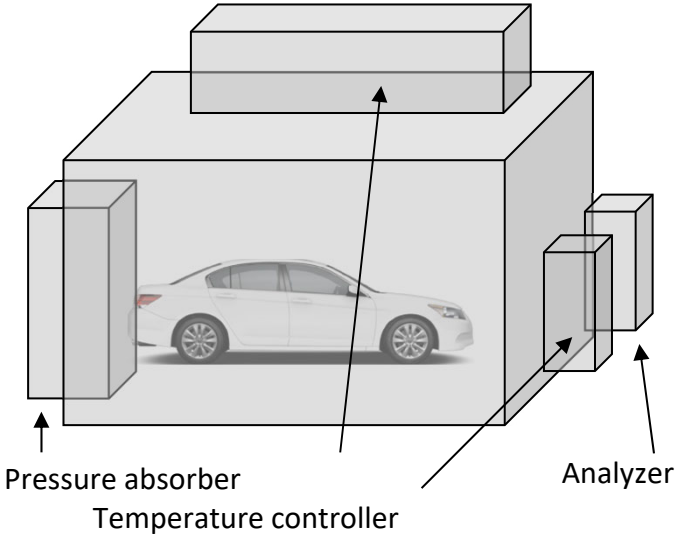
Test Equipments

Normal SHED(91/441/EC)

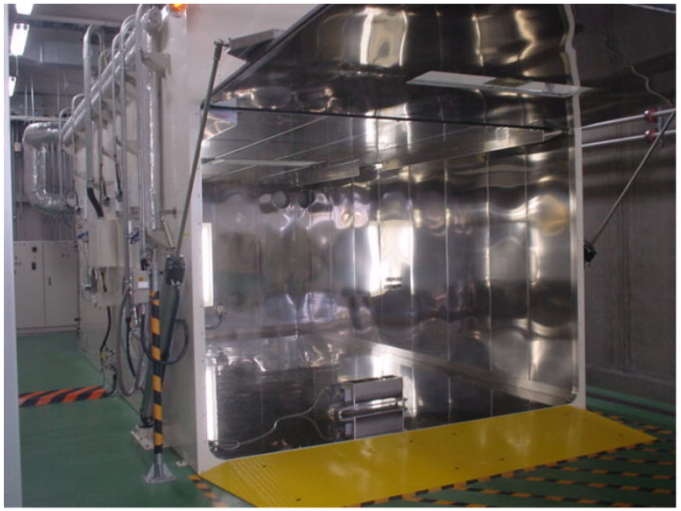


Variable Temperature

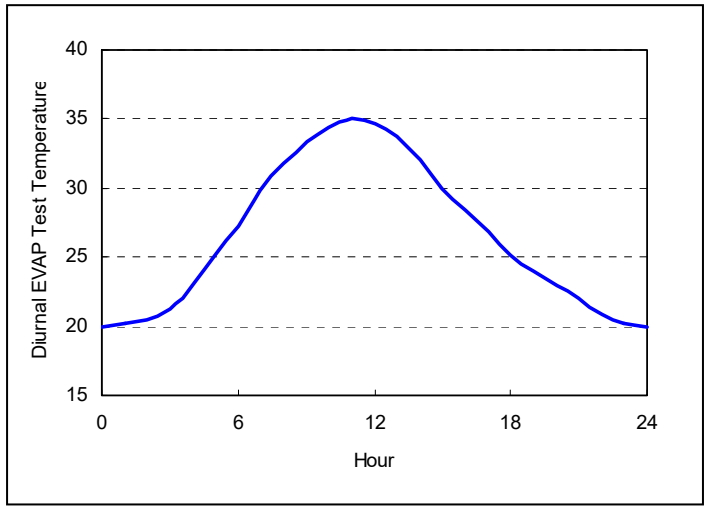
VT-SHED(98/69/EC~)



VT SHED

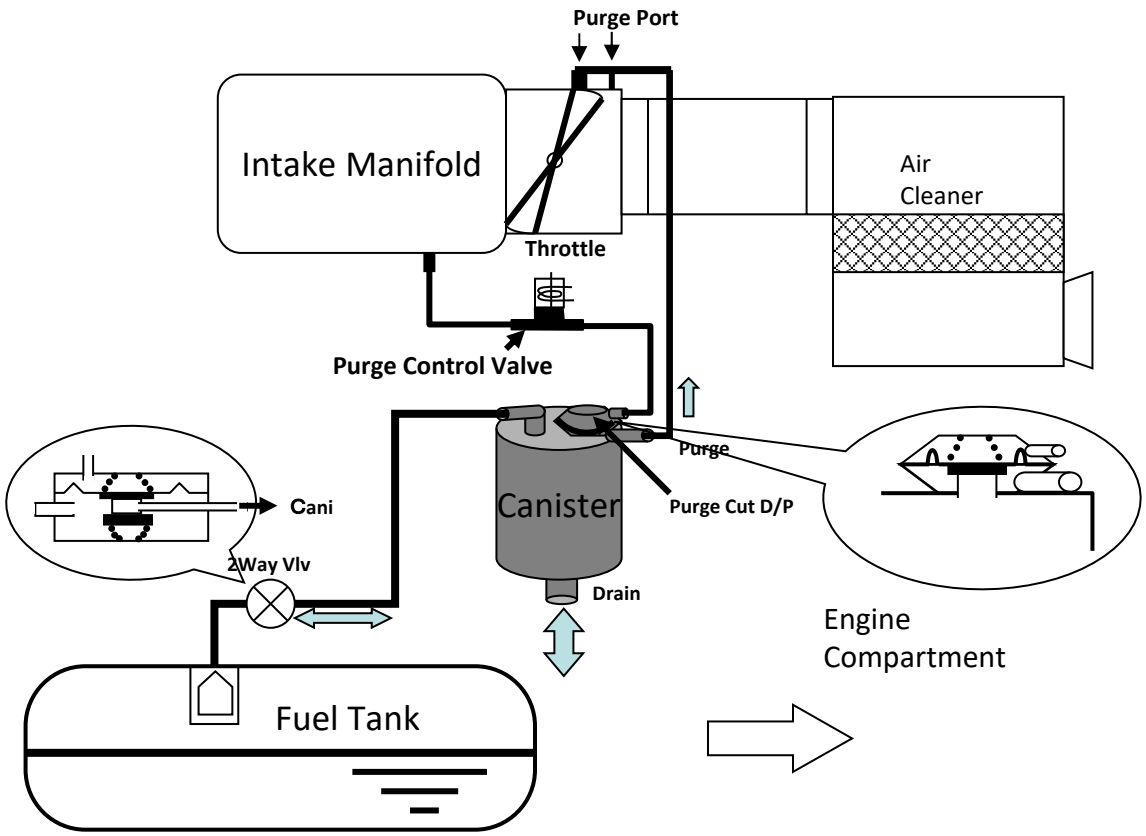


DBL Test Temperature Profile



Type Approval Tests

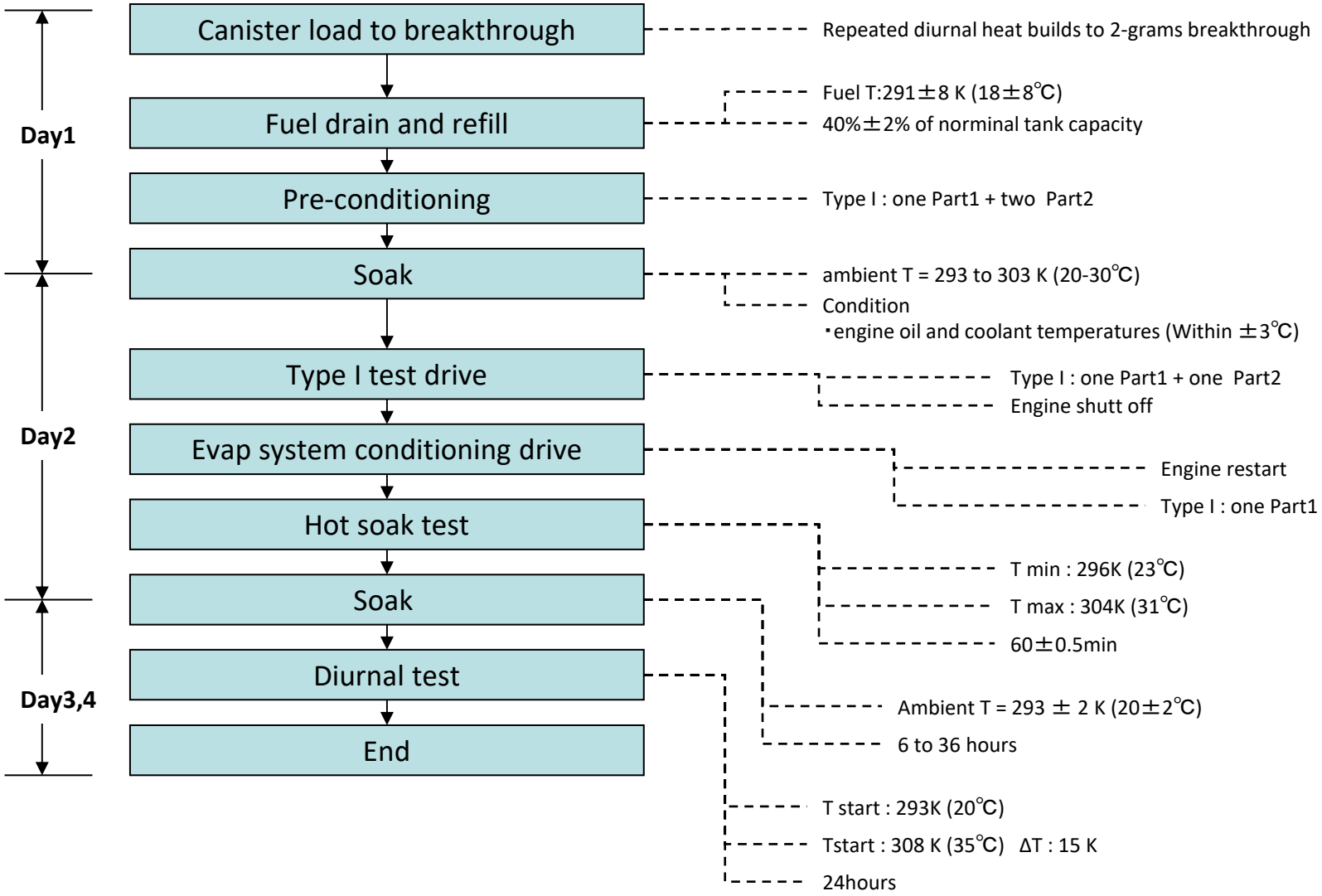
Evaporative Emission Control System



Type Approval Tests

Type IV Test

Test Procedure



Type Approval Tests

Type V Test

The following deterioration factors are applied to emission results of certification test vehicle to estimate the useful life emission level.

		Deterioration factors				
	Pollutant	CO	HC	NO_x	HC + NO_x (1)	Particulates
Engine Category	Positive-ignition Engine	1.2	1.2	1.2	-	-
	Compression-ignition engine	1.1	-	1	1	1.2

(1) For compression ignition engined vehicles

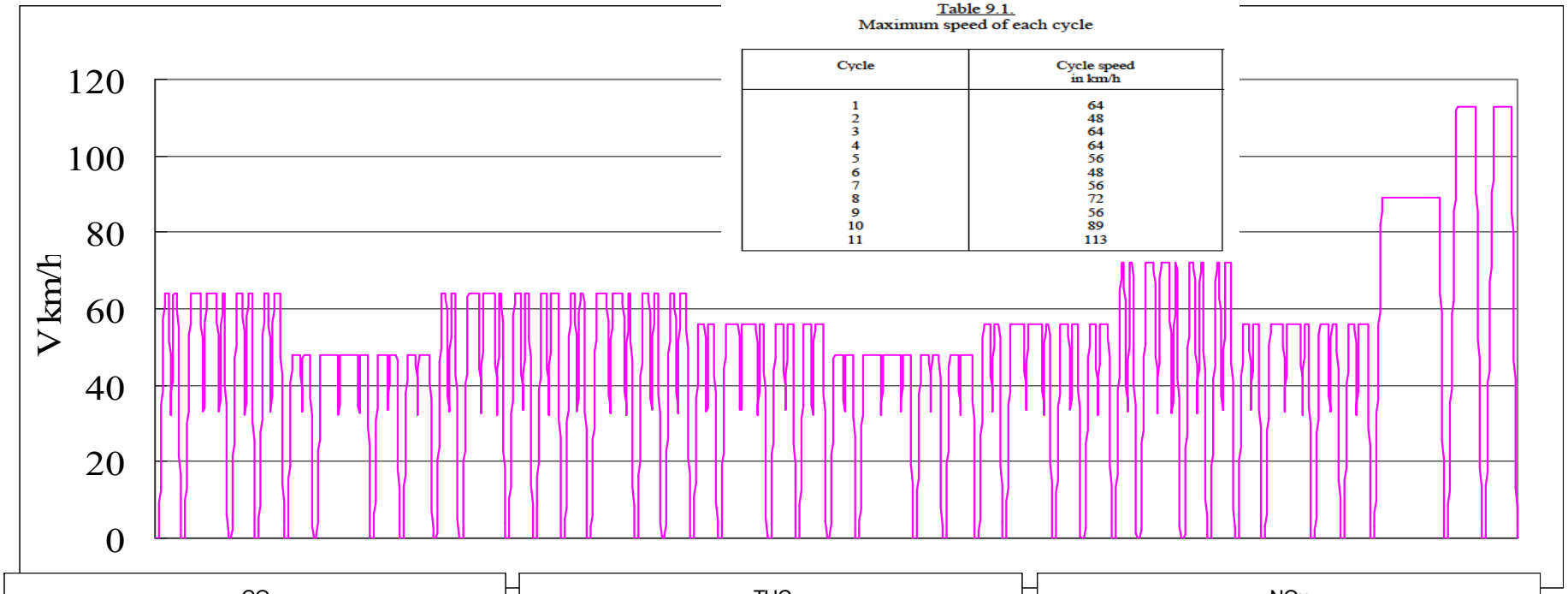
In stead of using the above deterioration factors, a manufacturer can choose to conduct durability tests.

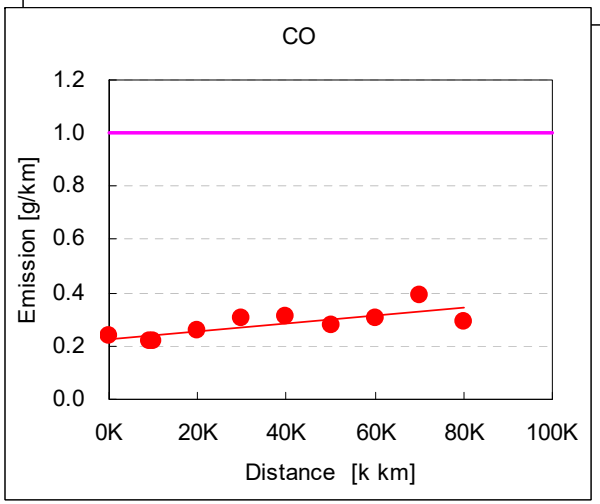
Type Approval Tests

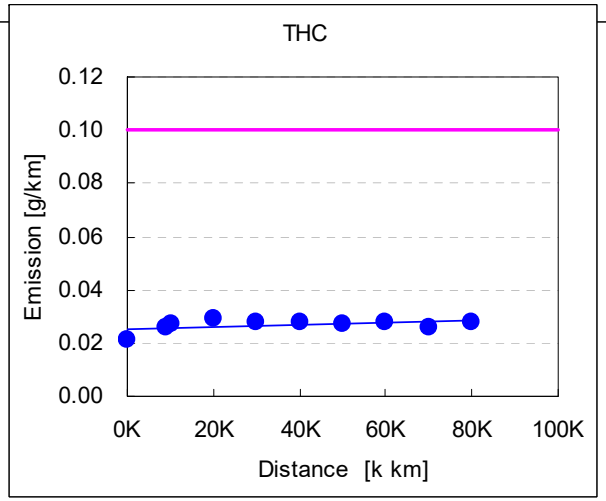
Type V Test

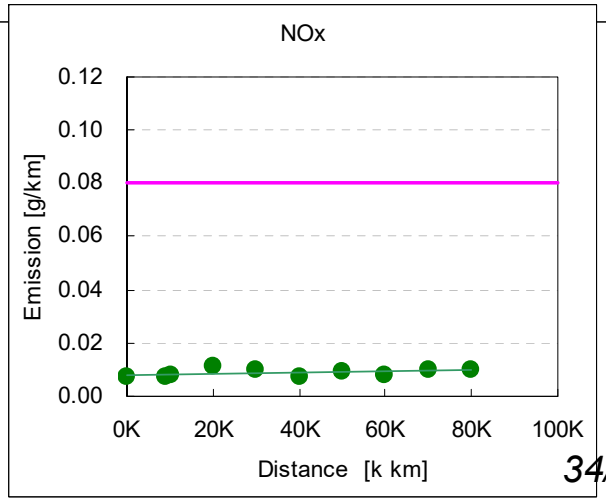
Table 9.1.
Maximum speed of each cycle

Cycle	Cycle speed in km/h
1	64
2	48
3	64
4	64
5	56
6	48
7	56
8	72
9	56
10	89
11	113









Type Approval Tests

Type VI Test

Carbon monoxide (CO) and hydrocarbon (HC) tailpipe emissions emitted from cold engine start to the end of driving cycle are measured at low atmospheric temperature of 266 degrees K ± 3 degrees K (-6.7 degrees C).

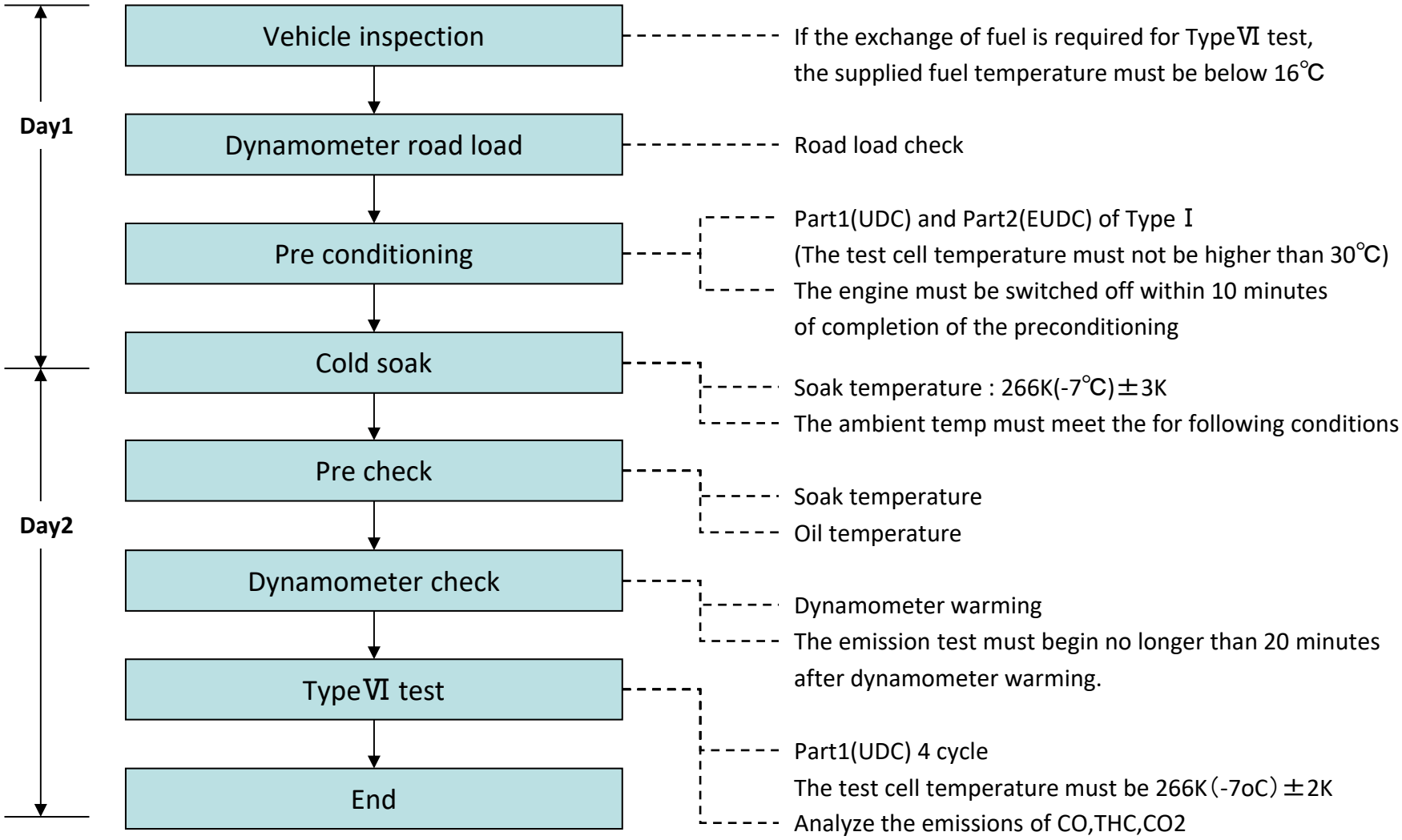
The CO and HC emissions must not exceed emission limits of 15g/km and 1.8g/km, respectively.

Type VI test should be only required in countries with vehicle driving under cold weather conditions.

Type Approval Tests

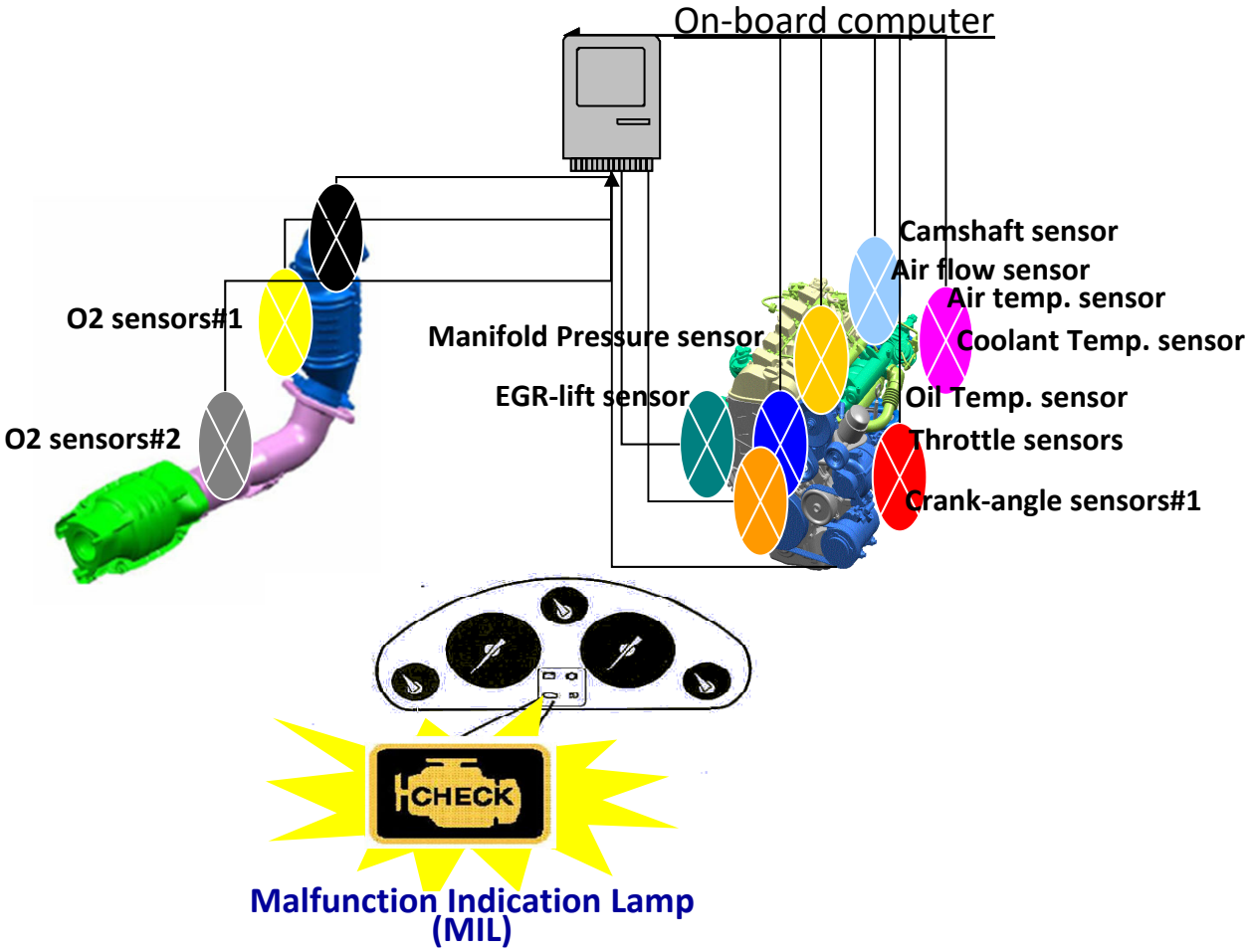
Type VI Test

Test Procedure



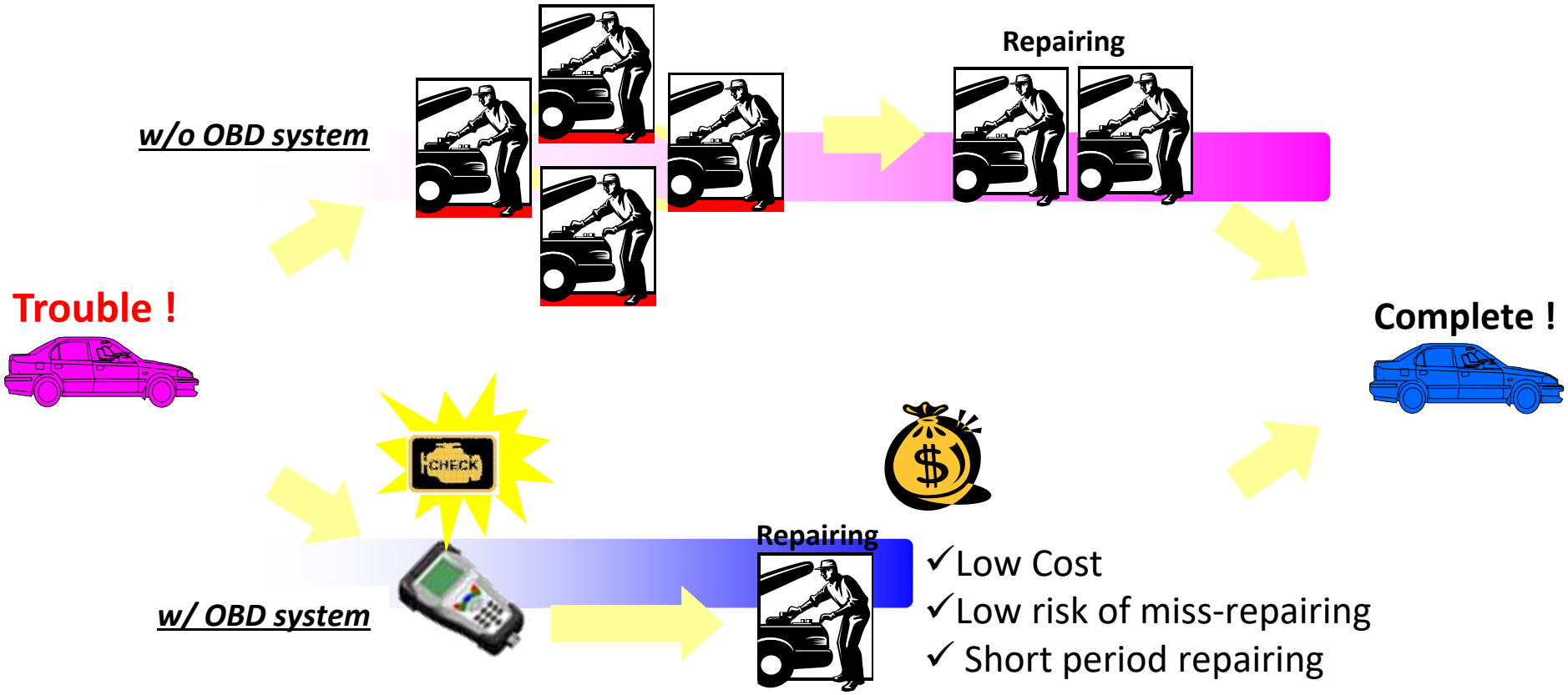
On-board Diagnostic System (OBD)

On-board computer watches whether or not emission related components or systems correctly work. If the computer detects malfunction or deterioration of the component, malfunction indicator light (MIL) in the instrument panel will be illuminated to make a driver realize some problem occurs.



Type Approval Tests

OBD



- ✓Low Cost
- ✓Low risk of miss-repairing
- ✓ Short period repairing

What's wrong ?

A repair technician can use a scan tool to diagnose emission related components

Type Approval Tests

OBD

In according to Appendix1 in Annex 11, demonstration tests are defined as follows. (minimum request)

	Monitor Devices	*Malfunctions*	*Emission Measure*[*1]	*OBD Test Tools*[*2]
1. Catalyst Diagnosis	Catalytic converter	Catalyst Deterioration	Available	Deteriorated catalyst
2. Misfiring Diagnosis	Misfiring	Unique/multi-cylinder misfiring	Available	Simulator
3. O2 sensor Diagnosis	O2 sensor	Sensor un-active Circuit check	Available	Simulator
4. Input/Out sensor Diagnosis	EGR system	Low Flow-rate	Available	Simulator
	Fuel system	Amount of over-rich & over-lean	Available	Simulator
	2nd Air Injection	Injector of function/circuit check	NA	NA
5. Evapo.Purge control valve Diagnosis	Evaporation system	Leak and/or purge defect	NA	NA
6. Other Diagnosis	Electronic device	Function and/or circuit check	NA	NA

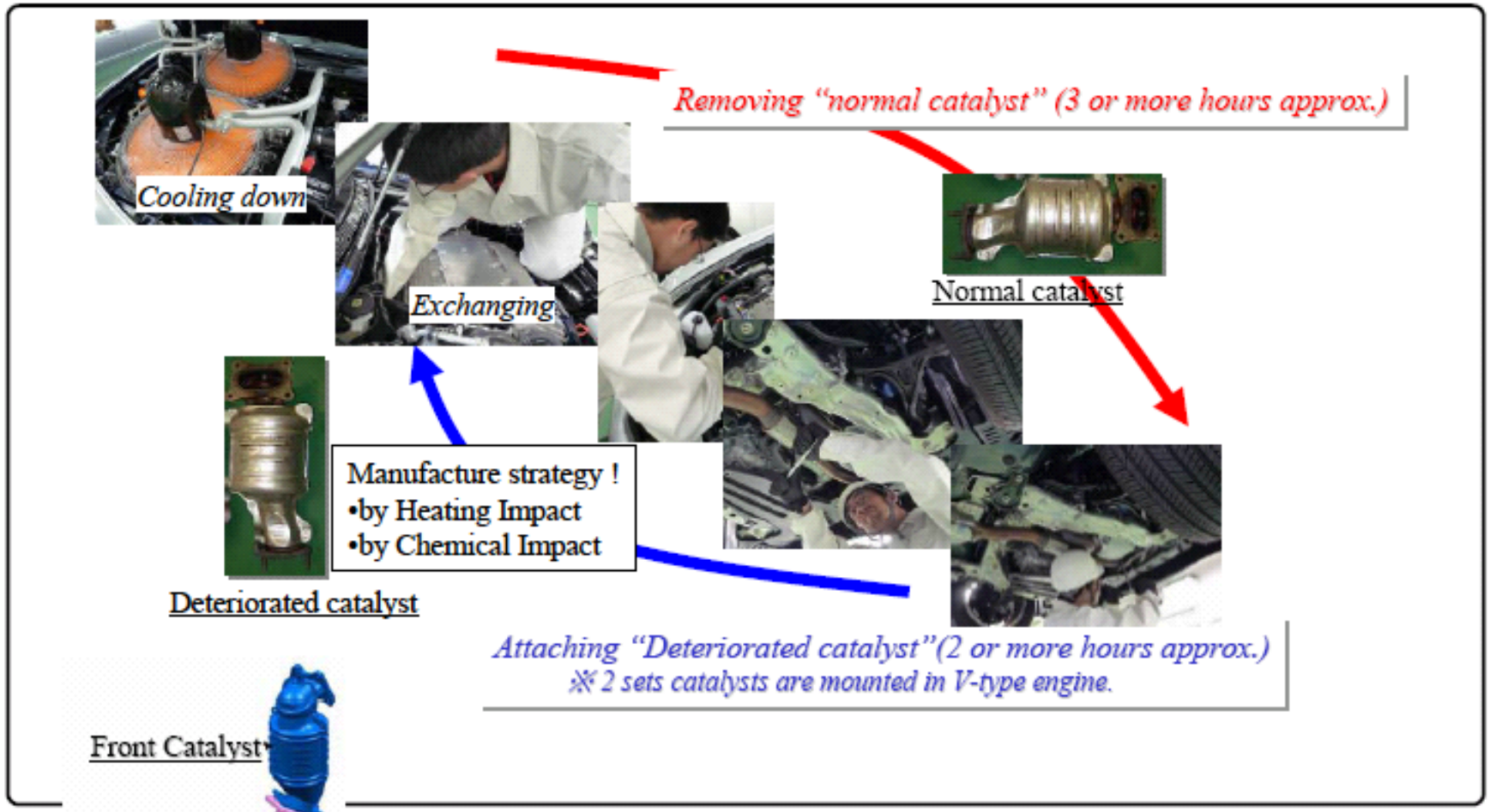
Note;

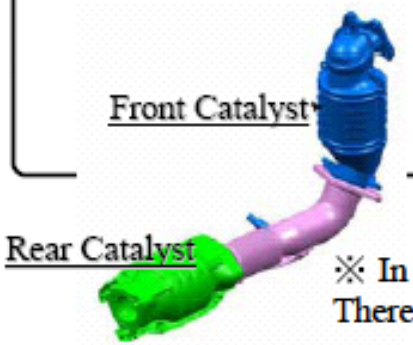
*1; not necessary when emission does NOT exceed OBD limit, and dependence of each manufacturer's strategy.
*2; methods and/or tools are dependence on manufacturers.

Type Approval Tests

OBD

Catalyst Test





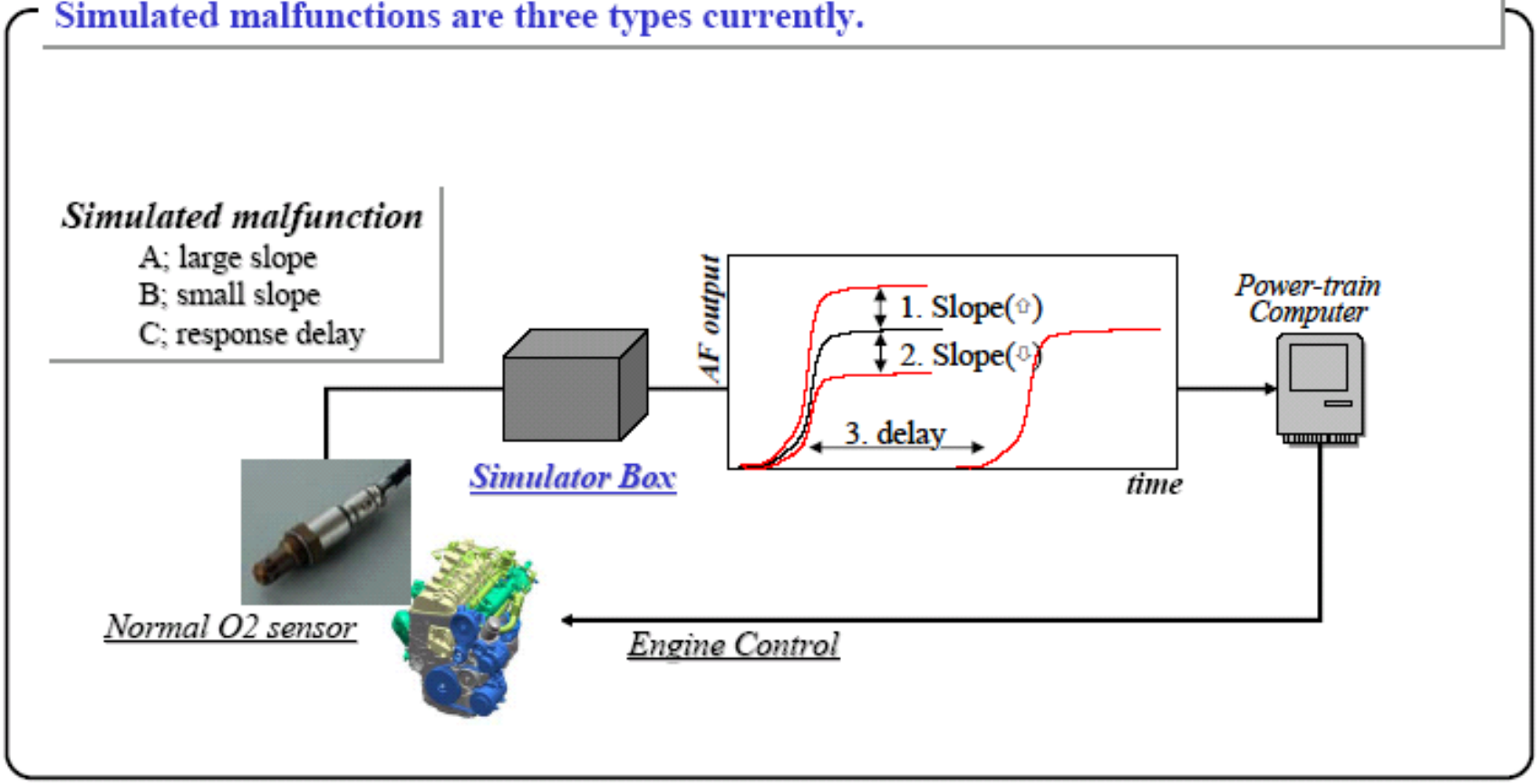
※ In case of combined catalyst, front catalyst must be deteriorated in prior to the rear catalyst. Therefore, the rear catalyst may be full-useful aged catalyst. It depends on manufacturer strategy.

Type Approval Tests

OBD

O2 Sensor Test

Regarding to "O2 sensor" demonstration,
"electrical simulator" is utilized to modify the sensor signal !
Simulated malfunctions are three types currently.



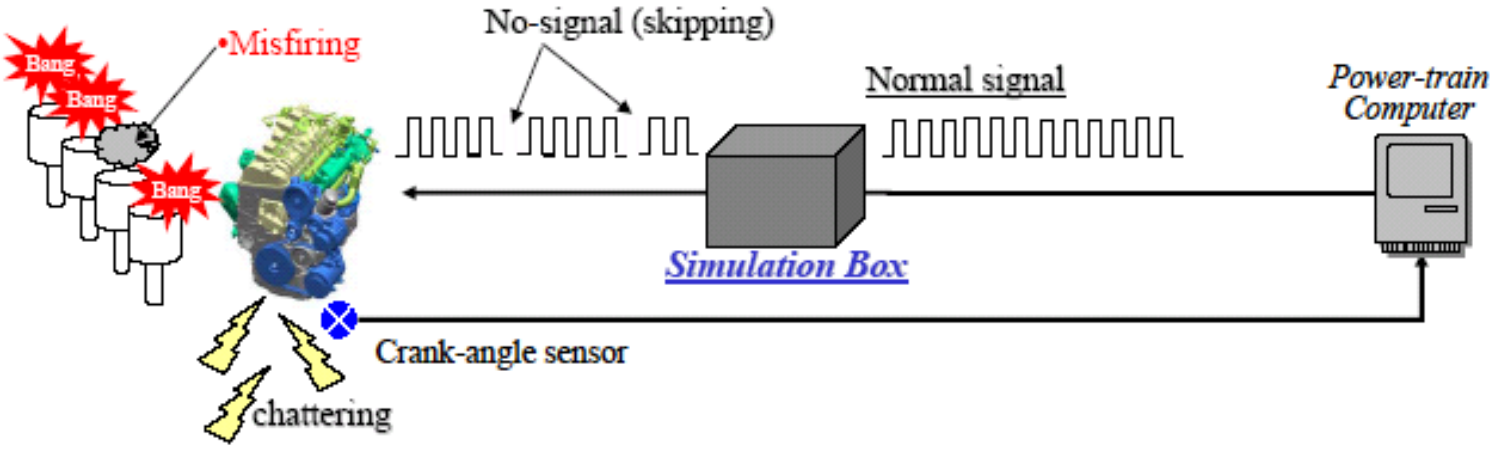
※ "The method" depends on Manufacture. It is required to confirm the principle and procedure before the test.

Type Approval Tests

OBD

Engine Misfire Test

Regarding to "Misfiring" demonstration,
"electrical simulator" is utilized to generate no-igniting condition !
Simulated malfunctions are "single-order misfiring".



※ "Misfiring method" depends on Manufacture. It is required to confirm the principle and procedure before the test.

Type Approval Tests

OBD

Installation of the malfunction threshold item

Test Procedure

- Vehicle inspection
  - Vehicle weight
  - Tire pressure
  - Vehicle specification
- Dynamometer setting
  - Road load setting
- Pre-conditioning
  - Type Ⅰ (part1＋part2)
- Cold soak
  - Soak condition
    - ・Temperature : 20～30℃
    - ・Period : 630hours
- Pre-check
  - Condition
    - ・soak temperature
    - ・Oil temperature
    - ・Coolant temperature
    - ・Tire pressure
    - ・Odometer
- Dynamometer check
  - Inertia weight
  - Road load power
- Type Ⅰ test

Type Approval Tests

Extensions to Type Approvals

Under "Extensions to Type Approvals" provisions, manufacturer is allowed to conduct emission tests on a representative vehicle, and to apply the emission test data to other vehicles with similar engine and similar emission control system if they meet a specific criteria, to obtain the vehicles' approval certificate.

This is an essential provision to accomplish both the streamlining of certification process and the assurance of certificate.

Annex14

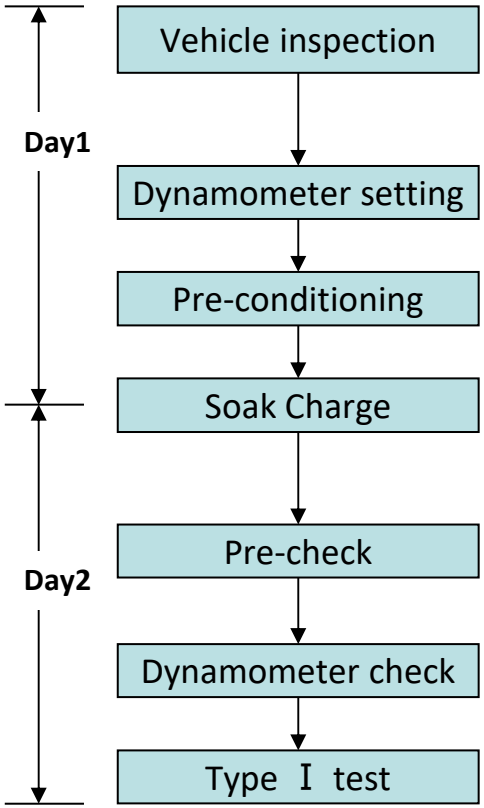
JAPAN AUTOMOBILE STANDARDS INTERNATIONALIZATION CENTER

Annex14 Type Ⅰ

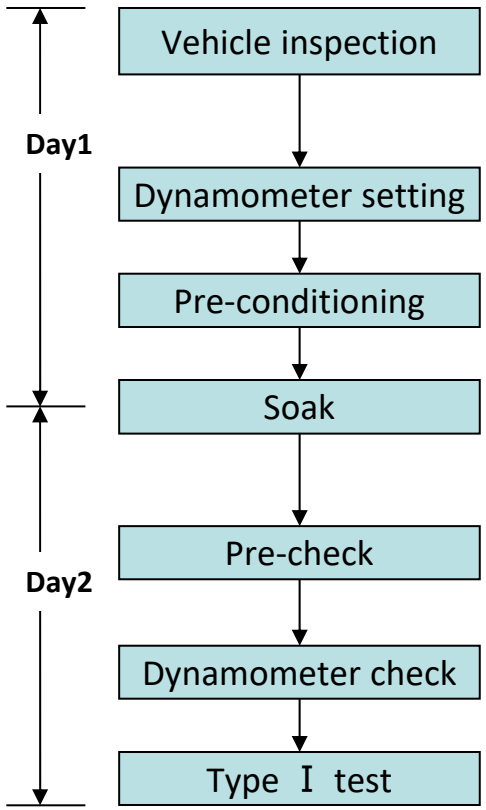
Categories of hybrid electric vehicles

Vehicle charging	Off-Vehicle Charging(OVC)		Not Off-Vehicle Charging(NOVC)	
Operating mode switch	Without	With	Without	With

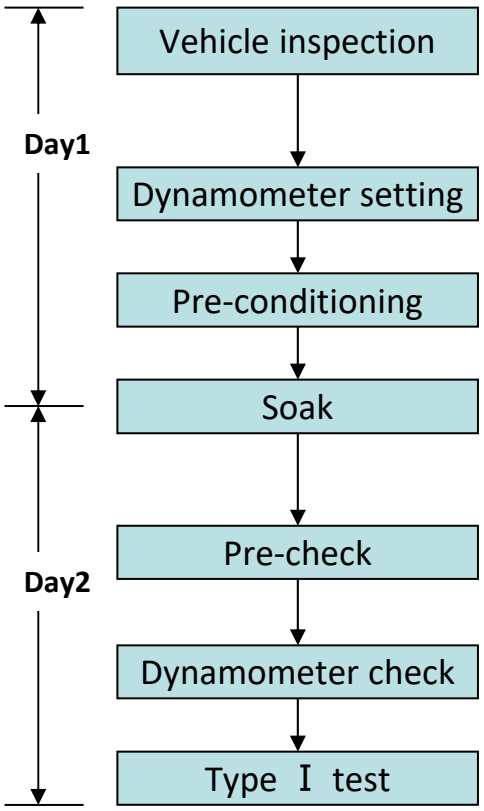
OVC Condition A



OVC Condition B



NOVC



Annex14 OVC HEV

Vehicle features

Equipped with a large-capacity battery and the ability to charge externally, the drive rate in EV state is improved compared to NOVC cars.

AER（All Electric Range)

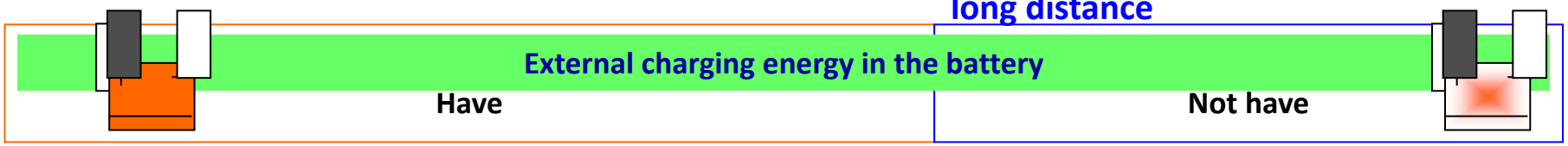
If vehicle start running from full charge, vehicle will run only with a motor using electric energy charged from external.

Hybrid driving

When the electricity charged from the outside is used up and the battery is in the minimum charge state, the vehicle runs in the same way as a NOVC car.

EV-based driving at close range

Driving in a hybrid state assuming a long distance

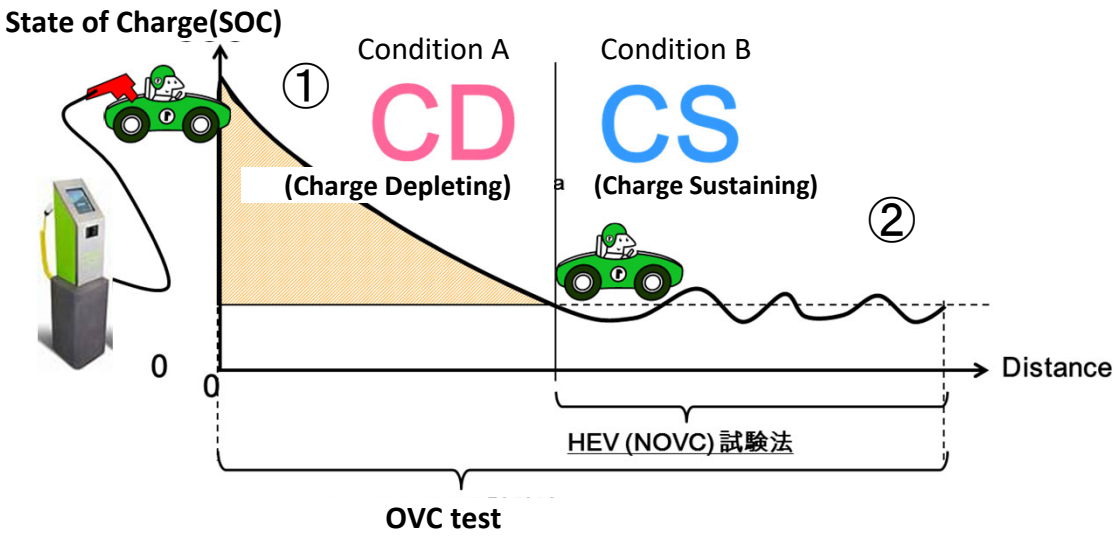


It is necessary to evaluate the exhaust gas with a value combined with each of these values. ⇒To study test method

Annex14 OVC HEV

On the OVC system
①Exhaust gas performance when running on charged power
②Exhaust gas performance after using up the charged power
Need to test separately

And it is necessary to evaluate the performance from ① + ②.



CD operation:

Travel while consuming electrical energy stored by external supply. (Depending on the system, the engine may be repeatedly started / stopped depending on the operating state during the CD.)

CS operation:

Electric energy in and out of the battery comes and goes due to regeneration, assistance, etc., but the battery SOC is controlled to run within a certain width. (Same driving condition as NOVC driving)

Exhaust gas emissions when using charged electricity (ConditionA)
Exhaust gas emissions when not charged electricity from external. (ConditionB)

Thank you for your attention.

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