Industrial Product Standard
Motorcycles: Safety Requirements:
Engine emissions, Level 6

1. Scope

1.1 This standard specifies the requirements for the marking, labelling, sampling and criteria for the conformity and testing of motorcycles.

1.2 This standard covers only two-wheel motorcycles with an unladen mass of less than 400kg, maximum designed speed exceeding 50 km/h, and cylinder capacity exceeding 50 cm^3, hereinafter referred to as "motorcycles."

1.3 This standard covers only the safety requirements related to the limitation of emissions of pollutants and durability of pollution control device.

2. Definition

For the purpose of this standard, the following definitions apply:

2.1 "Gaseous pollutants" refers to carbon monoxides, nitrogen oxides (expressed in terms of NO_2 equivalence), and hydrocarbons (expressed in $CH_{1.85}$) emitted by motorcycles.

2.2 "Evaporative emission" refers to hydrocarbon vapour loss from the fuel system of a motorcycle, with the exception of exhaust emissions.

2.2.1 "Tank breathing losses" refers to evaporative emission loss caused by temperature changes in the fuel tank.

2.2.2 "Hot soak losses" refers to evaporative emission loss of a stationary motorcycle after a period of driving.

2.3 "Unladen mass" refers to the total mass of a motorcycle with full fuel tank and tool kit.

2.4 "Reference mass" refers to the total unladen mass of a motorcycle, increased by a uniform mass of 75 kg.

2.5 "Crankcase" refers to the spaces inside or external to the engine that are connected to the oil sump by internal or external ducts through which gases and vapours can escape.

2.6 "Pollution control device" refers to a component or control of a motorcycle which controls and limits pollutants in the form of exhaust and/or evaporative emission.

2.7 “Defeat device” refers to a device that measures, senses or responds to operating variables (e.g. vehicle speed, engine speed, gear used, temperature, intake pressure or any other parameter) for the purpose of activating, modulating, delaying or deactivating the operation of any component of the emission control system so that the effectiveness of the emission control system is reduced under conditions encountered during normal motorcycle use unless the use of such a device is included by the manufacturer in the applied emission certification test procedures.

2.8 “Irrational emission control strategy” refers to any strategy or measure that reduces the effectiveness of the emission control system when the motorcycle is operating under normal conditions of use to a level below that which is expected on the applicable emission test procedures.

2.9 “Vehicle type” refers to motorcycles of any type/model that do not differ in such essential respects as the following:

2.9.1 the equivalent inertia determined in relation to the reference mass, as laid down in Clause B.5.1 of Annex B;

2.9.2 the characteristics of the engine and the motorcycle as defined in Annex A;

2.9.3 defeat device.

2.10 “Type approval test” refers to the test conducted on a prototype motorcycle to check its compliance on the emission of pollutions and the durability of pollution control device as set out for type approval.

2.11 “Conformity of production test” refers to the test conducted on a sample motorcycle taken at random from mass production to check its compliance on the emission of pollutions as required for conformity of production.

3. Requirements

3.1 General

3.1.1 The components liable to affect the emission of gaseous pollutants must be designed, constructed, assembled and installed so as to enable the motorcycle, in normal use, to comply with the requirements set out in this standard.

3.1.2 The use of a defeat device and/or an irrational emission control strategy is forbidden.

3.1.2.1 An auxiliary control device may be installed to the control engine, operation, system or measurement, provided that it:

(1) is used for protection against engine damage or accident, cold start or warming-up;

(2) is used for safe or emergency operation of the motorcycle.

3.1.2.2 In the test to determine emission value, an engine control device, system or measure that operates during the conditions specified in the test, or its modifications, will be permitted if proven as not reducing the effectiveness of the emission control system and complying

with the requirements set out in Clause 3.1.2.3. Such devices shall not be considered a defeat device.

3.1.2.3 The manufacturer shall provide documentation showing the basic design of the system and the means by which it controls its output variables, whether that control is direct or indirect.

(1) The documentation, which shall be supplied to the testing unit at the time of submission of the type-approval application, shall include a full description of the system. This documentation may be brief, provided that it provides evidence that all outputs permitted by a matrix obtained from the range of control of the individual unit inputs have been identified.

The material shall contain a justification for the use of any engine control device and include test data to demonstrate the effect on the exhaust emissions of any engine control device. It shall be submitted with the documentation set out in Clause 5.1.1 of this standard.

(2) Additional material that shows the parameters that are modified by any engine control device, system or measure, and the boundary conditions under which the device operates. The additional material shall include a description of the fuel system control logic, timing strategies and switch points during all modes of operation.

This additional material shall remain strictly confidential and be retained by the manufacturer, but made available for inspection during the validity of the type-approval.

3.2 Carbon monoxide, hydrocarbon and nitrogen oxides

After testing in accordance with the stipulations of Clause 6.1, the average mass of carbon monoxide, the average combined mass of hydrocarbon and nitrogen oxides from 3 tests multiplied by a deterioration factor (See Clause 3.5) shall not exceed the limits provided in Table 1. For each of the pollutants, one of the 3 results obtained may exceed by not more than 10% of the limits set out in Table 1. For cases in which the limits are exceeded not over 10% for more than one pollutant, it shall be immaterial whether this occurs in the same test or not.

Table 1: Limits for carbon monoxide, hydrocarbon and oxides of nitrogen for type approval test and conformity of production test

(Clause 3.2)

Unit in g/km

Cylinder capacity	Carbon monoxide	Hydrocarbon	Oxides of nitrogen
Less than 150 cm^3	2.0	0.8	0.15
From 150 cm^3 up	2.0	0.3	0.15

3.3 Emission at idling

3.3.1 After testing at idling speed in accordance with Clause 6.2:

3.3.1.1 the concentration of carbon monoxide shall not exceed 2.5% by volume;

3.3.1.2 the concentration of hydrocarbon shall not exceed 1,000 ppm.

3.3.2 At high idling speeds such as 2,000 rpm, the carbon monoxide content shall be recorded by volume, engine speed, and any other deviations. The lubricant temperature shall also be measured and recorded.

3.4 Evaporative emission

After testing in accordance with Clause 6.3:

3.4.1 evaporative emission shall not exceed 2.0 g/test; or

3.4.2 if the cylinder capacity of the motorcycle is less than 150 cm^3, if the hydrocarbon content from Clause 3.2 does not exceed 0.6 g/km, the evaporative emission can exceed 2.0 g/test, but not exceeding 6.0 g/test.

3.5 Durability of pollution control device

3.5.1 After the type approval test in accordance with Clause 6.4, the interpolated values of carbon monoxide, hydrocarbon and oxides of nitrogen shall be used for calculating deterioration factor provided that they are less than the limits given in Table 1.

3.5.2 The manufacturer may choose to use the deterioration factor 1.1 as an alternative to the durability of pollution control device test.

At the request of the manufacturer, the testing unit may carry out the test to verify carbon monoxide, hydrocarbon and nitrogen oxides before the durability of the pollution control device test; the testing unit may then amend the type approval results by replacing the deterioration factor 1.1 with that measured from the test.

3.5.3 The deterioration factor obtained from Clause 3.5.1 or Clause 3.5.2 shall be used in Clause 3.2 for the type approval test and Clause 5.2 for the production conformity test.

4. Marking and labelling

4.1 A number, letter or mark shall be affixed legibly, clearly and permanently to any part of the engine of every motorcycle representing the model of the engine corresponding to the motorcycle. If a foreign language is used, the meaning expressed shall correspond to the abovementioned meaning expressed in Thai.

5. Sampling and criteria for conformity

5.1 Sampling and criteria for type approval test

5.1.1 The manufacturer shall provide 1 motorcycle for type approval test, including details as of Annex A.

5.1.2 Provided that the motorcycle complies with all requirements specified in Clause 3, that type of motorcycles shall be deemed to be in compliance with this standard.

5.2 Sampling and criteria for conformity of production test

5.2.1 Lot refers to motorcycles of the same type as those previously deemed to be in compliance with this standard which are manufactured or delivered or purchased at the same time, and not exceeding 5,000 in number.

5.2.2 Sampling

1 sample shall be drawn at random from the lot set out in Clause 5.2.1.

5.2.3 Criteria for conformity

After tests in accordance with Clauses 6.1, 6.2 and 6.3,

5.2.3.1 Provided that all samples set out in Clause 5.2.2 meet the requirements of Clauses 3.2, 3.3 and 3.4, the lot of motorcycles shall be deemed as in compliance with this standard.

5.2.3.2 If the sample set out in Clause 5.2.2 fails to comply only with the requirement of Clause 3.1, as many additional samples as required by the manufacturer shall be drawn from the same lot and subjected once again to testing as stipulated in Clause 6.1. The average of carbon monoxide, hydrocarbon and nitrogen oxides calculated from Annex F (multiplied by the deterioration factor in Clause 3.5) on all samples (1 original sample plus additional samples, totally n samples) shall be less than the limits given in Table 1.

6. Testing

6.1 Carbon monoxide, hydrocarbon and nitrogen oxides

The test shall be carried out in accordance with Annex B.

6.2 Emission at idling

The test shall be carried out in accordance with Annex C.

6.3 Evaporative emission

The test shall be carried out in accordance with Annex D.

6.4 Durability of pollution control device

The test shall be carried out in accordance with Annex E.

Annex A

Description of motorcycles

(Clause 2.9.2)

A.1 For the type approval test, the following details of motorcycle shall be given.

(1) Name of the motorcycles

(2) Engine

(2.1) Make: _____

(2.2) Model: _____

(2.3) Engine type (two or four-stroke): _____

(2.4) Cylinder diameter: _____ mm.

(2.5) Stroke: _____ mm.

(2.6) Number, arrangement and firing order of cylinder: _____

(2.7) Cylinder capacity: _____ cm^3

(2.8) Compression ratio: _____

(2.9) Cooling system: _____

(2.10) Crankcase vapour recirculating device: _____

(2.11) Lubricating system (for two-stroke engines), separate or combined: _____

(3) Transmission type: _____

(4) Other emission treatment device (if any): _____

(5) Intake system and fuel feed system: _____

(5.1) Description and pattern of intake feed and related equipment:_____

(5.2) Fuel feed: _____

(5.2.1) Carburettor

(5.2.1.1) Make: _____

(5.2.1.2) Type: _____

(5.2.2) Injector and pump

(5.2.2.1) Make: _____

(5.2.2.2) Type: _____

(5.2.2.3) Fuel feed rate: _____ mm^3/time

At pump speed: _____ rpm

(6) Angle of opening and closing of valves

(6.1) Angle of opening and closing of valves in relation to piston: _____

(6.2) Feed through port cavity (two-stroke engine): _____

(6.2.1) Description of intake valve (with illustration): _____

(6.2.2) Description with illustration showing intake and exhaust flow in relation to piston operation: _____

(7) Ignition system

(7.1) Distributor

(7.1.1) Make: _____

(7.1.2) Type: _____

(7.1.3) Ignition angle: _____

(7.1.4) Contact gap: _____

(7.2) Electronic system

(7.2.1) Make: _____

(7.2.2) Type: _____

(7.2.3) Ignition angle: _____

(8) Exhaust system

(9) Additional information on testing condition

(9.1) Lubricating oil

(9.1.1) Make: _____

(9.1.2) Type: _____

(9.2) Sparking plugs

(9.2.1) Make: _____

(9.2.2) Type: _____

(9.2.3) Contact gap: _____

(9.3) Ignition coil

(9.3.1) Make: _____

(9.3.2) Type: _____

(10) Engine performance

(10.1) Idling speed

(10.1.1) Idling speed _____ rpm

(10.1.2) High idling speed _____ rpm

(10.2) Percentage by volume of carbon monoxide concentration while idling: _____

(10.3) Engine speed at maximum power: _____ rpm

(10.4) Maximum power: _____ kW

Annex B

Testing to determine the mass of carbon monoxide, hydrocarbon and oxides of nitrogen

(Clause 6.1)

B.1 General requirements

B.1.1 The sample motorcycle shall be placed on a chassis dynamometer and subjected to Part 1 and Part 2 tests as follows:

B.1.1.1 Part 1

The test shall consist of 6 continuously conducted basic cycles, each of which has the format shown in Figure B.1 and the testing details according to Table B.1.

B.1.1.2 Part 2

The test shall be conducted in compliance with the type as shown in Figure B.2 and the testing details according to Table B.2.

B.1.2 Use of the gearbox

B.1.2.1 At a steady speed, the engine speed must remain between 50-90 % of the maximum speed. If this speed can be achieved using more than one gear, the motorcycle should be tested using the highest gear.

B.1.2.2 During acceleration under the basic test cycle, the motorcycle should be tested using the gear that allows maximum acceleration. The next highest gear must be engaged when the engine speed has reached 110 % of the rated maximum output, at the latest.

If the motorcycle reaches a speed of 20 km/h in first gear or 35 km/h in second gear, the next higher gear must be engaged at these speeds. In these cases, no other change into higher gears is permitted. If, during the acceleration phase, the gears are changed at fixed motorcycle speeds, the steady speed phase which follows must be performed with the gear that is engaged when the motorcycle begins the steady speed phase, irrespective of the engine speed.

B.1.2.3 During deceleration, the next lowest gear must be engaged before the engine begins to vibrate or, at the latest, when the engine speed has fallen to 30 % of the rated maximum output, whichever come first. First gear must not be engaged during deceleration.

B.1.2.4 Motorcycles equipped with automatic gearboxes shall be tested with the highest gear engaged. The accelerator must be operated in such a way as to obtain as steady acceleration as possible so that the transmission engages the different gears in the normal order.

B.1.2.5 Under Part 2, the test shall be conducted in accordance with the manufacturer's instructions.

Gears shall not be shifted at the speeds set out in the test. The acceleration rate shall be maintained during the period illustrated by straight line between the idling phase and the next steady speed.

B.1.3 Tolerances

B.1.3.1 A tolerance of ± 2 km/h above or below the theoretical speed is allowed during all phases. Speed tolerances greater than those prescribed are permitted during phase changes provided that the tolerances are never exceeded for more than 0.5 seconds on any one occasion, in all cases subject to the provisions of B.6.4.2 and B.6.5.3.

B.1.3.2 A tolerance of ± 0.5 seconds above or below the theoretical times must be allowed.

B.1.3.3 The speed and time tolerances are shown in Figures B.1 and B.2.

B.1.3.4 The distance travelled during the cycle shall not exceed a tolerance of ± 2 %.

K refers to disengaged clutch.

PM refers to neutral gear.

R refers to idling.

refers to tolerances (± 1 km/h for speed and +1s for time).

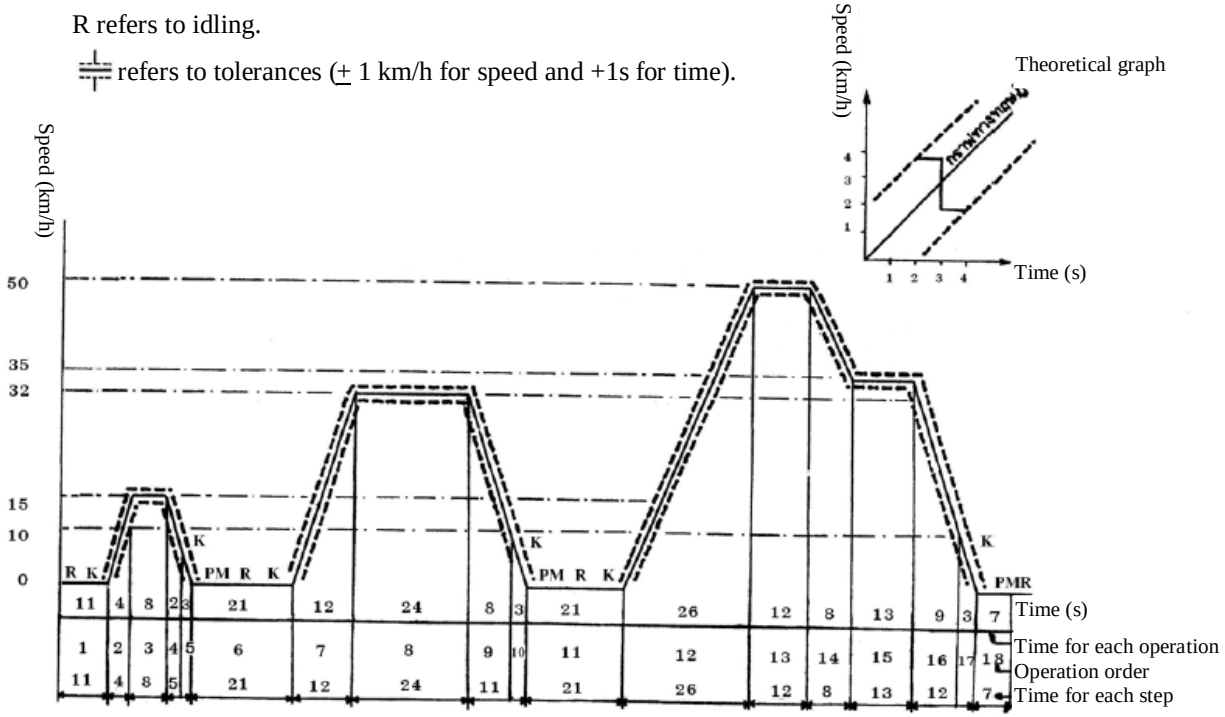


Figure B.1: Type 1 test – Basic cycle of Part 1

Table B.1 Type 1 test - Basic cycle of Part 1

(Clause B.1.1)

No	Operation	Step No	Acceleration (m/s^2)	Speed (km/h)	Duration (s)		Accu-mulated duration (s)	Gear used in case of manual gearbox
					Each operation	Each step		
1	Idling	1			11	11	11	PM 6s, K 5 s
2	Accelerating	2	1.04	0 to 15	4	4	15	
3	Steady speed	3		15	8	8	23	See Clause B.1.2
4	Decelerating		-0.69	15 to 10	2		25	
5	Decelerating Clutch disengaged	4	-0.92	10 to 0	3	5	28	K
6	Idling	5			21	21	49	PM 16 s, K 5 s
7	Accelerating	6	0.74	0 to 32	12	12	61	
8	Steady speed	7		32	24	24	85	See Clause B.1.2
9	Decelerating		-0.75	32 to 10	8		93	
10	Decelerating Clutch disengaged	8	-0.92	10 to 0	3	11	96	K
11	Idling	9			21	21	117	PM 16 s, K 5 s
12	Accelerating	10	0.53	0 to 50	26	26	143	
13	Steady speed	11		50	12	12	155	
14	Decelerating	12	-0.52	50 to 35	8	8	163	See Clause B.1.2
15	Steady speed	13		35	13	13	176	
16	Decelerating		-0.68	35 to 10	9		185	
17	Decelerating Clutch disengaged	14	-0.92	10 to 0	3	12	188	K
18	Idling	15			7	7	195	PM 7 s

Remark: *1. PM means neutral gear.*

2. K means disengaged clutch.

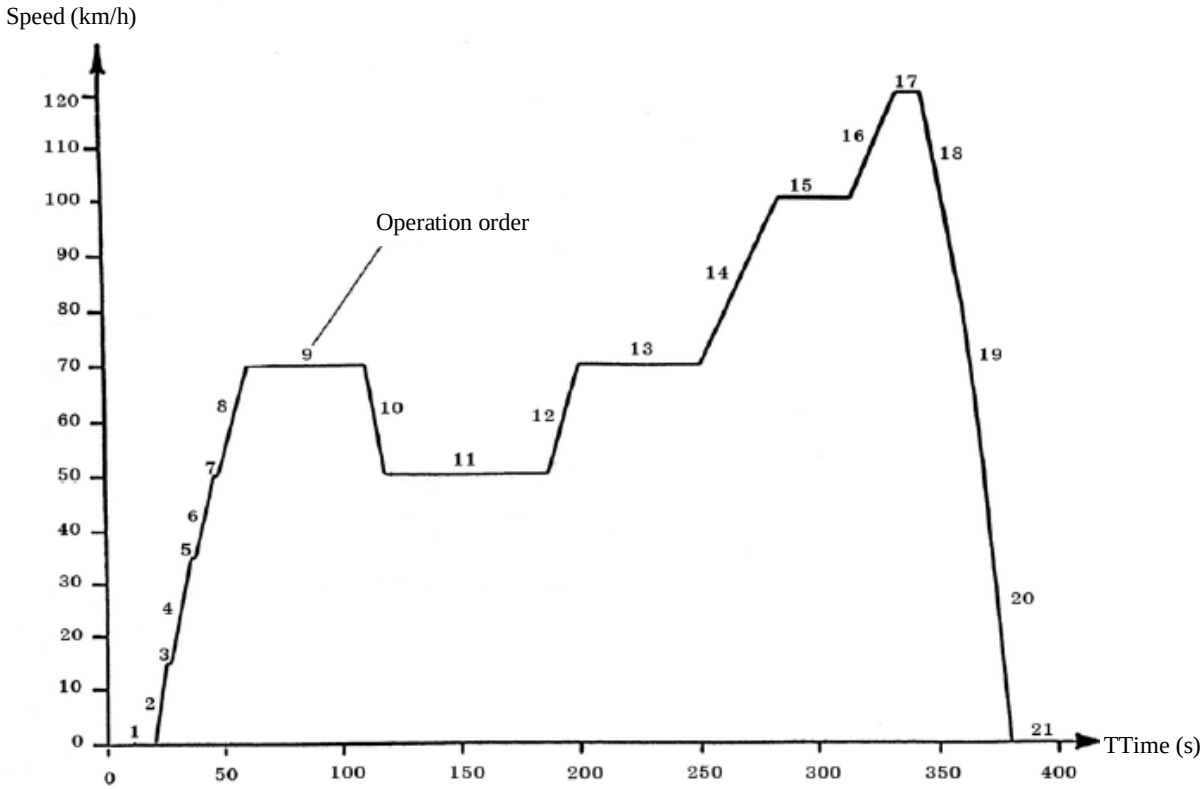


Figure B.2 Type of test for Part 2

(Clause B.1.1)

Table B.2 Testing details on Part 2

(Clause B.1.1)

No	Operation	Step No	Acceleration (m/s^2)	Speed (km/h)	Duration (s)		Accumulated duration (s)	Gear used in case of manual gearbox
					Each operation	Each step		
1	Idling	1			20	20	20	Tested using gear according to the manufacturer's instructions
2	Accelerating		0.83	0 to 15	5		25	
3	Gear shifted				2		27	
4	Accelerating		0.62	15 to 35	9		36	
5	Gear shifted	2			2	41	38	
6	Accelerating		0.52	35 to 50	8		46	
7	Gear shifted				2		48	
8	Accelerating		0.43	50 to 70	13		61	
9	Steady speed	3		70	50	50	111	
10	Decelerating	4	-0.69	70 to 50	8	8	119	
11	Steady speed	5		50	69	69	188	
12	Accelerating	6	0.43	50 to 70	13	13	201	
13	Steady speed	7		70	50	50	251	
14	Accelerating	8	0.24	70 to 100	35	35	286	
15	Steady speed	9		100	30	30	316	
16	Accelerating	10	0.28	100 to 120	20	20	336	
17	Steady speed	11		120	10	20	346	
18	Decelerating		-0.69	120 to 80	16		362	
19	Decelerating	12	-1.04	80 to 50	8	34	370	
20	Decelerating Clutch disengaged		-1.39	50 to 0	10		380	
21	Idling	13			20	20	400	

B.1.4 Upon calibration, deviation of all analysers shall not exceed 3% of the values measured by using calibration gas. The flame-ionisation analyser that measures the concentration of hydrocarbons must be capable of reaching 90 % of the full scale in less than one second.

B.1.5 The content of the gases used in testing and calibration must not differ by more than 2 % of the reference value of each gas. The diluent must be nitrogen.

B.1.6 The test fuel must be either benzene according to the notification of the Energy Business Department, or reference fuel.

B.2 Test conditions

B.2.1 Testing shall be conducted in a chamber with a controlled temperature of between 20°C and 30°C throughout the test.

B.2.2 Motorcycles under testing must be horizontal during the test to ensure the normal distribution of fuel.

B.2.3 A cooling blower shall be fitted with a dynamometer, so as to direct a variable speed of airflow corresponding to roller speed. The linear velocity of the air at the blower outlet is within ±5 km/h of the corresponding roller speed within the operating range of 10 to 50 km/h. The linear velocity of the air shall be within ± 10 % at the range of over 50 km/h. At roller speeds of less than 10 km/h, linear air velocity may be zero.

The air blower must have the following characteristics:

cross-sectional area of at least	0.4	m^2
lower edge above ground level between	0.05 – 0.20	m
distance from the leading edge of the motorcycle between	0.30 – 0.45	m
distance from the outlet to the linear velocity measuring device	0.00 – 0.20	m

B.2.4 During the test, speed is plotted against time in order to check that the cycles have been performed correctly. The temperatures of the cooling water and the crankcase oil may be recorded.

B.3 Test equipment and devices

B.3.1 Chassis dynamometer

B.3.2 Analysers for pollutant emissions

B.3.2.1 Fame-ionisation analyser for hydrocarbons

B.3.2.2 Non-dispersive analyser with infrared absorption for carbon monoxide

B.3.2.3 Chemiluminescent analyser for nitrogen oxides

B.3.2.4 Constant volume sampling device

B.3.2.5 Temperature sensor with deviation not exceeding ± 1 °C for measuring the temperature of sample gases and temperature sensor with deviation not exceeding ± 2 °C for measuring the temperature in test chamber.

B.3.2.6 Pressure sensor for measuring atmospheric pressure with deviation not exceeding 0.133 kPa.

B.4 Preparation for sample

B.4.1 The sample motorcycle must have been driven at least 1,000 km unless the manufacturer requests the sample be a motorcycle that has been driven less than 1,000 km.

B.4.2 The exhaust system must not have any leaks so as to collect the exhaust sample correctly.

B.4.3 The intake system must not have any leaks so as to avoid any impact on the mixture resulting from air leakage.

B.4.4 The settings of the engine must be as indicated by the manufacturer.

B.4.5 The testing unit may verify that the motorcycle delivers the performance stated by the manufacturer, that it could be used for normal driving, and capable of starting when cold or when hot.

B.5 Test preparation

B.5.1 Chassis dynamometer shall be set so that the total equivalent inertia is proportional to the reference mass of the motorcycle in accordance with Table B.3.

B.5.2 The sample motorcycle must be kept at the test temperature until the coolant and engine oil temperatures are within ± 2 K of the temperature of the room.

B.5.3 The tire pressure must be that stated by the manufacturer. In case the diameter of the dynamometer rollers is less than 500 mm, the pressure in the tires will be increased by 30-50%.

B.5.4 The load on the driving wheel shall be on a motorcycle in normal road use, with a driver weighing 75 kg.

Table B.3 Relation between reference mass and equivalent inertia

(Clause B.5.1)

Reference mass kg	Equivalent inertia kg
Over 95 but not exceeding 105	100
Over 105 but not exceeding 115	110
Over 115 but not exceeding 125	120
Over 125 but not exceeding 135	130
Over 135 but not exceeding 145	140
Over 145 but not exceeding 155	150
Over 155 but not exceeding 165	160
Over 165 but not exceeding 175	170
Over 175 but not exceeding 185	180
Over 185 but not exceeding 195	190
Over 195 but not exceeding 205	200
Over 205 but not exceeding 215	210
Over 215 but not exceeding 225	220
Over 225 but not exceeding 235	230
Over 235 but not exceeding 245	240
Over 245 but not exceeding 255	250
Over 255 but not exceeding 265	260
Over 265 but not exceeding 275	270
Over 275 but not exceeding 285	280
Over 285 but not exceeding 295	290
Over 295 but not exceeding 305	300
Over 305 but not exceeding 315	310
Over 315 but not exceeding 325	320
Over 325 but not exceeding 335	330
Over 335 but not exceeding 345	340

Table B.3 Relation between reference mass and equivalent inertia (Cont.)

Reference mass kg	Equivalent inertia kg
Over 345 but not exceeding 355	350
Over 355 but not exceeding 365	360
Over 365 but not exceeding 375	370
Over 375 but not exceeding 385	380
Over 385 but not exceeding 395	390
Over 395 but not exceeding 405	400
Over 405 but not exceeding 415	410
Over 415 but not exceeding 425	420
Over 425 but not exceeding 435	430
Over 435 but not exceeding 445	440
Over 445 but not exceeding 455	450
Over 455 but not exceeding 465	460
Over 465 but not exceeding 475	470
Over 475 but not exceeding 485	480
Over 485 but not exceeding 495	490
Over 495 but not exceeding 505	500

B.6 Test method

B.6.1 Starting up the engine

Once the preliminary operations on the equipment for collecting, diluting, and analysing the gases have been carried out, the engine is started up by means of the devices provided for that purpose, such as the choke, the starter valve, etc., according to the manufacturer's instructions.

B.6.2 Use of the manual choke

The choke must not be used in the test and before acceleration from 0 to 50 km/h. If this requirement cannot be met, the moment of manual choke must be indicated and its use must be in accordance with the manufacturer's instructions.

B.6.3 Idling

B.6.3.1 Manual-shift gearbox:

(1) During periods of idling the clutch must be engaged and the gears in neutral;

(2) The clutch must be disengaged within 5 seconds in first gear before commencement of the acceleration following the idling period;

(3) The first idling period at the beginning of the cycle consists of 6 seconds of idling in neutral with the clutch engaged and 5 seconds in first gear with the clutch disengaged;

(4) For the idling periods during each cycle the corresponding times are 16 seconds in neutral and 5 seconds in first gear with the clutch disengaged;

(5) The last idling period in the cycle consists of 7 seconds in neutral with the clutch engaged.

B.6.3.2 Semi-automatic gearboxes:

The manufacturer's instructions for driving, or in their absence the instructions applicable to manual gearboxes, must be followed.

B.6.3.3 Automatic gearboxes:

The selector must not be operated at any time during the test unless the manufacturer specifies otherwise. In the latter case the procedure for manual gearboxes applies.

B.6.4 Accelerations

B.6.4.1 Accelerations must be effected so as to ensure that the rate of acceleration is as constant as possible throughout the operation.

B.6.4.2 If the acceleration capacities of the motorcycle are not sufficient to perform the acceleration cycles within the prescribed time, the motorcycle must be driven with the throttle completely open until the speed prescribed for the cycle has been reached; the cycle may then continue normally.

B.6.5 Decelerations

B.6.5.1 All decelerations must be effected by completely closing the throttle, the clutch remaining engaged. The clutch must be disengaged at a speed of 10 km/h.

B.6.5.2 If the period of deceleration is longer than that prescribed for the corresponding phase, the motorcycle’s brakes are used to keep to the cycle.

B.6.5.3 If the period of deceleration is shorter than that prescribed for the corresponding phase, the timing of the theoretical cycle is restored by a steady state or an idling period merging into the following steady state or idling operation. In this case, Clause B.1.3 is not applicable.

B.6.5.4 At the end of the deceleration period (stopping motorcycle on the rollers) the gear is put into neutral and the clutch engaged.

B.6.6 Steady speeds

B.6.6.1 Actuation of the accelerator must be avoided when passing from acceleration to the following steady speed.

B.6.6.2 Periods of constant speed must be achieved by keeping the accelerator position fixed.

B.6.7 The motorcycle shall be driven on a chassis dynamometer in accordance with the following cycle:

B.6.7.1 If the cylinder capacity of the motorcycle is over or equivalent to 150 cm^3, it shall be driven in accordance with the test cycle under Part 1.

B.6.7.2 If the cylinder capacity of the motorcycle is over or equivalent to 150 cm^3, it shall be driven in accordance with the test cycle under Part 1 and Part 2 continuously.

B.7 Sampling

Exhaust gases shall be collected for sampling throughout the driving operation on chassis dynamometer.

B.8 Pollutant emission

The exhaust gases must be analysed within a period no later than 20 minutes after the end of the sampling cycle and the mass of each pollutant shall be reported.

B.9 Test shall be carried out in accordance with Clauses B.5 to B.8 for 3 cycles.

- If, in the first cycle, $A1 \leq 0.7La$, $B1 \leq 0.7Lb$, and $C1 \leq 0.7Lc$,

the test shall be carried out only once and the motorcycle shall be deemed as meeting the requirements set out in Clause 3.2.

- If, in the first cycle, $A1 \leq 0.85La$, $B1 \leq 0.85Lb$, and $C1 \leq 0.85Lc$, and

$A1 > 0.7La$ or $B1 > 0.7Lb$ or $C1 > 0.7Lc$,

the second cycle shall be performed, and if $A1+A2 < 1.70La$, $B1+B2 < 1.70Lb$, and $C1+C2 < 1.70Lc$, and $A2 < La$, $B2 < Lb$, and $C2 < Lc$,

the motorcycle shall be deemed as meeting the requirements set out in Clause 3.2.

- If in the first cycle, $A1 > 0.85La$, $B1 > 0.85Lb$, and $C1 > 0.85Lc$,

the test shall be carried out for 3 cycles and

$$\frac{A1 + A2 + A3}{3} < La,$$

$$\frac{B1 + B2 + B3}{3} < Lb,$$

$$\frac{C1 + C2 + C3}{3} < Lc,$$

the motorcycle shall be deemed as meeting the requirements set out in Clause 3.2.

Where A1 A2 A3 is the mass of carbon monoxide emitted in the first, second, and third cycle respectively, multiplied by a deterioration factor.

La is the mass of carbon monoxide as set out in Table 1.

B1 B2 B3 is the mass of hydrocarbon emitted in the first, second, and third cycle respectively, multiplied by deterioration factor.

Lb is the mass of hydrocarbon as set out in Table 1.

C1 C2 C3 is the mass of nitrogen oxides emitted in the first, second, and third cycle respectively, multiplied by deterioration factor.

Lc is the mass of nitrogen oxides as set out in Table 1.

Annex C
Testing for pollutant emissions while idling
(Clause 6.2)

C.1 General requirements

C.1.1 The test fuel must be either benzene according to the notification of the Energy Business Department, or reference fuel.

C.1.2 Type 2 test shall be performed immediately after Type 1 test with the engine at idling speed.

C.1.3 In the case of motorcycles with semi-automatic or manual gearboxes, the test should be carried out with the gear lever in the neutral position and with the clutch engaged.

C.1.4 In the case of motorcycles with automatic transmissions, the test should be carried out with the gear lever in the neutral or parking position.

C.2 Test conditions

The test conditions shall be as set out in Clause B.2 of Annex B.

C.3 Testing

C.3.1 The exhaust outlet must be fitted with a sufficiently leak-tight extension piece so that the exhaust-gas sampling probe can be inserted to at least 60 cm without increasing backpressure by more than 1.25 kPa and without affecting operation of the motorcycle. Nevertheless, the shape of the extension piece must be such as to avoid appreciable dilution of exhaust gases by air at the point of the sampling probe. If the motorcycle is equipped with more than one exhaust outlet, either these outlets must be connected to a common pipe or pollutant concentrations must be measured at each outlet, with the results of the measurements calculated for mean value.

C.3.2 The engine shall run at idling speed until the temperatures of the lubricating oil and coolant are stable, after which the mass of the pollutants under Clause 3.3 should be measured immediately.

C.3.3 During the test, while the engine is running at idling speed the mass of carbon monoxide by volume, concentration of hydrocarbon, engine speed, and tolerances shall be recorded. The temperature of the lubricating oil should be measured and recorded.

C.3.4 The concentrations of carbon monoxide and carbon dioxide are determined by reading the results shown by the instruments and recording devices calibrated in accordance with appropriate intervals.

C.3.5 The concentration of carbon monoxide shall be corrected by using the following formula.

C.3.5.1 Motorcycles with two-stroke engines:

$$C_{CO\ corr} = C_{CO} \frac{10}{C_{CO} + C_{CO_2}} \quad (\%\ vol)$$

C.3.5.2 Motorcycles with four-stroke engines:

$$C_{CO\ corr} = C_{CO} \frac{15}{C_{CO+}\ C_{CO_2}} \quad (\%\ vol)$$

Where C_{CO} is the concentration of carbon monoxide read in %.

C_{CO2} is the concentration of carbon dioxide read in %.

C.3.6 It is not necessary to correct the concentration of carbon monoxide measured according to the formulae given in Clause C.3.5.1 or Clause C.3.5.2 if the sum of the concentrations measured (C_{CO} + C_{CO^2}) is 10 or more for two-stroke engines or 15 or more for four-stroke engines.

Annex D

Evaporative emission test

(Clause 6.3)

D.1 General

Evaporative emission may be determined in accordance with this standard by using either one of the following methods:

D.1.1 Sealed-Housing Evaporative Determination (SHED) Method;

D.1.2 Carbon Canister Trap Method.

D.2 Sealed-Housing Evaporative Determination (SHED) Method

D.2.1 General requirements

As specified in Annex B.

D.2.2 Test chamber

D.2.2.1 The chamber for the evaporative emission test shall be a gas-tight rectangular shape with sufficient area for parking a motorcycle and shall have adequate space for personnel to handle the test. The inner surface of the chamber shall not be permeated by hydrocarbons. At least one of the surfaces shall be built with a flexible and impermeable material to allow the change of reducing its volume by the change in temperature. The wall of the chamber shall be designed to rapidly exhale heat. During the test, the internal surface temperature shall not be lower than 20 °C.

D.2.2.2 At least one or more blowers with 0.1-0.5 m^3/second blowing capacity shall be provided in order to mix the air inside the chamber. During the test, temperature and concentration of evaporative hydrocarbon inside the chamber shall be so maintained to ensure uniformity. No airflow shall be directly blown against the motorcycle.

D.2.2.3 The mass of hydrocarbon inside the chamber shall be monitored by using a flame ionisation type hydrocarbon analyser. The gas flow passing through the analyser shall be recirculated back to the chamber.

D.2.3 Test equipment and devices

D.2.3.1 Chassis dynamometer as specified in Clause B.3.1 of Annex B.

D.2.3.2 Hydrocarbon analyser of the flame ionisation type shall have the following characteristics.

(1) A response time up to 90% of the final reading shall be less than 1.5 seconds and shall satisfy the requirements that are expressed by the function of Cstd. The Cstd is a particular HC level inside a chamber conforming to evaporated gas standards and is expressed by ppm. (Example of Cstd calculation as specified in Annex G)

(2) The stability of the analyser shall be better than zero and 0.01 Cstd.ppm in 15 minutes over its entire service range.

(3) The reproducibility of the analyser, expressed by a standard deviation, shall be better than 0.005 Cstd.ppm over its entire service range.

D.2.3.3 Electronic signal output data recorder shall make a record in strip chart or other data processing system at a frequency of at least once per minute. The operation characteristics of the recording system shall be equal to the signal to be recorded and shall provide a permanent result. The elapsed time between the beginning and the end of test shall be recorded.

D.2.3.4 Temperature measuring system shall have the accuracy of 1°C and readable to 0.42°C.

D.2.3.5 Pressure sensor shall have a resolution of $\pm$ 0.1 kPa.

D.2.3.6 Humidity sensor shall have a resolution of $\pm$ 5%.

D.2.3.7 Fuel and evaporated gas heating system

The heating system with temperature controller shall be of 2 heating sources for heating fuel and evaporated gas in the fuel tank. Such system shall not cause any local heating of fuel and evaporated gas.

D.2.4 Preparation for sample

D.2.4.1 The test motorcycle shall have been tested in accordance with Clauses 6.1 and 6.2.

D.2.4.2 The evaporative emission control system shall be set so as to function correctly throughout the test.

D.2.4.3 The exhaust system must not leak.

D.2.4.4 The fuel tank shall be equipped with a temperature sensor to measure fuel temperature at the midpoint when filled to the level 50 $\pm$5% of its capacity and measure the evaporated gas temperature at the middle of its volume. The sensor shall be set away from the installation point of heating pieces for at least 25.4 mm.

D.2.4.5 Additional devices shall be equipped to allow a complete draining of fuel from tank.

D.2.5 Preparation for test

D.2.5.1 The temperature of the chamber shall be controlled in the range of 20-30°C.

D.2.5.2 Fuel shall be drained out of the tank and let it dry. Test oil shall be poured into the tank to the level of 50 $\pm$5% of its capacity.

D.2.5.3 After Clause D 2.5 not later than 1 hour, the motorcycle shall be warmed up by running it on chassis dynamometer at the speed of 50 km/h for at least 10 km for preliminary adjustments.

D.2.5.4 Within 5 minutes after preliminary adjustments in accordance with Clause B.2.5.3, the motorcycle shall be parked for at least 6 hours but not exceeding 36 hours.

D.2.6 Test method

The measurement of the tank breathing and the hot soak evaporative emission shall be as follows:

D.2.6.1 Tank breathing loss

(1) 5 minutes before the test, the air inside the chamber shall be cleaned and removed by using the blower until the hydrocarbon concentration is equal to the atmosphere.

(2) Immediately before the test, the analyser shall be reset to zero and all graduations shall be calibrated.

(3) Drain out the fuel and refill it with test fuel to 50 $\pm$2.5% of its capacity. The temperature of test fuel shall be lower than 15.5°C. The lid of tank is kept removed. The motorcycle shall be pushed into the chamber.

(4) The temperature sensors shall be connected to the temperature recorder and the temperature controller.

(5) The heating pieces shall be installed to as low as possible point of the fuel tank and shall cover more than 10% of the tank area contacted with the fuel. The centreline of the heating pieces shall be in parallel with the surface level of the fuel as far as possible. The centreline of evaporated gas heating pieces shall be drawn as close as possible to the centre of the height of the evaporated gas volume.

(6) Start recording the temperature of fuel, the temperature of evaporated gas and the temperature of ambient air in the chamber.

(7) Start heating the fuel; when the fuel temperature reaches 13.5°C, place the lid on the fuel tank immediately and switch off the blower.

(8) Close the chamber and seal it hermetically.

(9) When the fuel temperature reaches 15.5 $\pm$0.5°C for exposed-type fuel tank or 16 $\pm$0.5°C for non-exposed fuel tank, the hydrocarbon concentration ($C_{HC,I}$), barometric pressure (P_i) and temperature (T_i) in the chamber shall be recorded as the initial values.

(10) Continue to heat the fuel so that the temperature rises by 20°C for exposed-type fuel tank and 13.3°C for non-exposed fuel tank within 60 $\pm$2 minutes. The temperature of the fuel during heating shall conform to the following equation and shall be within a tolerance of $\pm$1.7°C.

For exposed-type fuel tank: $T_f = (1/3)t + 15.5$

$T_v = (1/3)t + 21$

For non-exposed fuel tank: $T_f = (2/9)t + 16$

Where: T_f is the required temperature of fuel, °C

T_v is the required temperature of evaporated gas, °C

t is elapsed time, min

The final temperature shall be 35.5 $\pm$0.5°C for exposed-type fuel tank and 29.3 $\pm$0.5°C for non-exposed fuel tank.

(11) The temperature of the evaporated gas at the beginning of the test shall not exceed 26°C. In such conditions, it is not necessary to heat the evaporated gas. However, if

the fuel temperature of the exposed-type fuel tank reaches T_f and the rising temperature of evaporated gas becomes lower than 5.5°C, then heating shall be carried out in accordance with the above equation.

(12) The analyser shall be returned to zero and all graduations shall be calibrated immediately before the completion of test.

(13) The hydrocarbon concentration ($C_{HC,f}$), barometric pressure (P_f) and temperature (T_f) in the chamber shall be recorded as the final values.

(14) Turn off the heating source, open the door of the chamber and push the motorcycle out of the chamber.

D.2.6.2 Hot soak loss

(1) The test shall be continued from the test set out in Clause D.2.6.1 by driving the motorcycle on the chassis dynamometer at the speed of 50 km/h for at least 10 km.

(2) Within 7 minutes after the completion of operation of Clause (1), the motorcycle shall be pushed into the chamber.

(3) Before the test, the air inside the chamber shall be cleaned and removed until the hydrocarbon concentration is equal to the atmosphere by using a blower.

(4) The analyser shall be returned to zero and all graduations shall be calibrated immediately before testing.

(5) Push the motorcycle into the chamber, close the chamber and seal it hermetically.

(6) The hydrocarbon concentration ($C_{HC,i}$), barometric pressure (P_i) and temperature (T_i) in the chamber shall be recorded as the initial values.

(7) The motorcycle shall be kept in the chamber for 60 $\pm$0.5 minutes. The hydrocarbon concentration ($C_{HC,f}$), barometric pressure (P_f) and temperature (T_f) in the chamber shall be recorded as the final values. The analyser shall be returned to zero and all graduations shall be calibrated immediately before the completion of the test.

(8) Open the chamber and push the motorcycle out.

D.2.6.3 Calculation

(1) The tank breathing and hot soak evaporative emission losses shall be calculated by using the following formula.

$$M_{HC} = K \times V \times 10^{-4} \left[\frac{C_{HC,f} \times P_f}{T_f} - \frac{C_{HC,i} \times P_i}{T_i} \right]$$

Where M_{HC} is the mass of hydrocarbon measured over the test phase, g.

C_{HC} is the concentration of evaporated hydrocarbon in the chamber, ppm.

V is the volume of chamber, m^3 (deleted by the volume of motorcycle. If the volume of motorcycle is not determined, a volume of 0.135 m^3 shall be used.)

T is the ambient temperature in the chamber, °C.

P is the barometric pressure in the chamber, kPa.

H/C is the hydrocarbon to carbon ratio.

K is 1.2 (12+H/C).

When i is the initial value.

f is the final value.

H/C is taken to be 2.33 for tank breathing loss and 2.20 for hot soak loss.

(2) The total evaporative emission is the sum of tank breathing evaporative emission loss and hot soak evaporative emission loss.

D.3 Carbon Canister Trap Method

D.3.1 General requirements

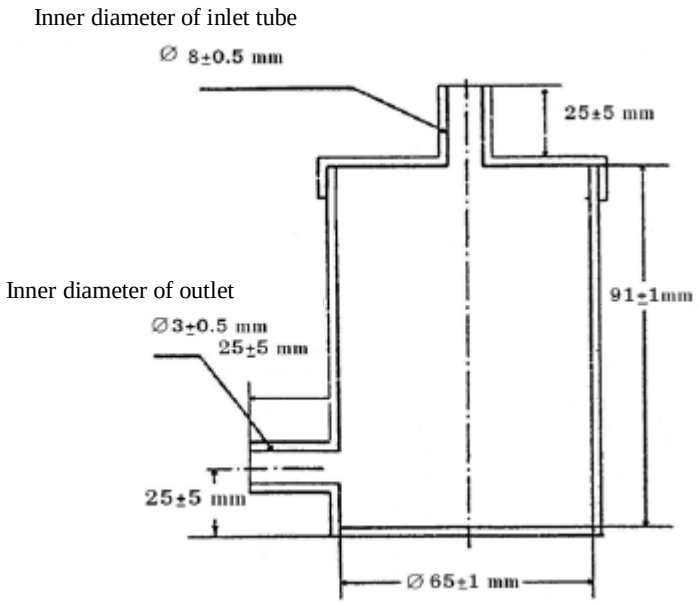
The test shall be conducted in a room with a temperature of 20 - 30°C.

D.3.2 Test equipment and devices

D.3.2.1 Chassis dynamometer as specified in Clause B.3.1 of Annex B.

D.3.2.2 Carbon canister

(1) The canister shall be of cylindrical shape with the ratio of length to inner diameter at 1.4:1. The dimension is as shown in Figure D.1.



Unit in millimetre

Figure D.1 Carbon canister

(Clause D.3.2.2 (1))

(2) The collecting medium shall be activated carbon of which the capacity to absorb carbon tetrachloride exceeds 60% of the weight.

(3) All particles of activated carbon shall be within the range from 1.4 to 3.0 mm in diameter. More than 90% of the activated carbon shall be within the range from 1.7 to 2.4 mm. in diameter.

D.3.2.3 The furnace shall control the temperature at 150 ±10°C.

D.3.2.4 A balance device shall make the resolution up to 0.01 g.

D.3.2.5 The temperature measuring system shall have an accuracy of 1°C and shall be readable to 0.42°C.

D.3.2.6 Fuel and evaporated gas heating system

The heating system with temperature controller shall have 2 heating sources for heating fuel and evaporated gas in the fuel tank. Such system shall not cause any local heating of the fuel or evaporated gas.

D.3.3 Preparation for sample

See Clause D.2.4.

D.3.4 Preparation for test

D.3.4.1 See Clause D.2.5.

D.3.4.2 The canister shall be placed into a drying furnace before use for more than 3 hours at a temperature of 150 ±10°C. After drying it shall be removed and its inlet tube shall be firmly plugged. The outlet shall be connected to a dehumidifier tube filling with silica gel remaining on sieve No 8 or equivalent. The silica gel shall be changed if the colour of more than ¾ of it changes from blue to red.

D.3.4.3 As in Clause D3.4.2, the canister shall be placed in a desiccator, and allowed to cool down naturally for 24 hours.

D.3.5 Test method

The measurement of tank breathing and hot soak evaporative emission shall be as follows:

D.3.5.1 Tank breathing loss

(1) Drain out the fuel tank and fill it back up with test fuel at a temperature lower than 15.5°C to the level of 50 ±2.5% of its capacity.

(2) The canister shall be removed from the desiccator 1 hour before the test. After weighing, the canister shall be placed in the laboratory. Weighing shall be carried out once more before its installation. Its use shall be permitted only if the change in weight were within ±0.5 g.

(3) Evaporated gas shall be collected from several points e.g. vent of carburettor, tank overflow outlet, etc. The exhaust pipe shall be closed when collecting.

(4) Connect the temperature sensor to the temperature recorder and temperature controller.

(5) The heating pieces shall be installed as low as possible point of the fuel tank and they shall cover more than 10% of the tank area contacted with the fuel. The centreline of

the heating pieces shall be in parallel with the surface level of fuel as far as possible. The centreline of evaporated gas heating pieces shall be drawn as close as possible to the centre of the height of the evaporated gas volume.

(6) When the temperature in the fuel tank reaches 15.5 $\pm$0.5°C, start heating the fuel for 60 $\pm$2 minutes. The temperature shall rise by 20°C and 13.3°C for exposed-type fuel tank and non-exposed fuel tank respectively.

(7) The temperature of the fuel during heating shall conform to the following equation and shall be within a tolerance of $\pm$1.7°C.

For exposed-type fuel tank: $T_f = (1/3)t + 15.5$

$T_v = (1/3)t + 21$

For non-exposed fuel tank: $T_f = (2/9)t + 16$

Where: T_f is the required temperature of fuel, °C.

T_v is the required temperature of evaporated gas, °C.

t is elapsed time, min.

The final temperature shall be 35.5 $\pm$0.5°C for exposed-type fuel tanks and 29.3 $\pm$0.5°C for non-exposed fuel tanks.

(8) The temperature of the evaporated gas at the beginning of the test shall not exceed 26°C; it is not necessary to heat the evaporated gas. However, when the fuel temperature of the exposed-type fuel tank reaches T_f and the rising temperature of evaporated gas is lower than 5.5°C, heating shall be carried out in accordance with the above equation.

(9) The heating source shall be turned off and the canister shall be weighed.

D.3.5.2 Hot soak loss

(1) The test shall be continued from the test set out in Clause D.3.5.1 by driving the motorcycle on the chassis dynamometer at a speed of 50 km/h for at least 10 km.

(2) The canister shall be prepared in accordance with Clause D.3.5.1 (2).

(3) Within 7 minutes after the completion of operation of Clause D.3.5.2 (1), the canister shall be installed to the motorcycle in order to collect the evaporated gas from several points e.g. vent of carburettor, tank overflow outlet, etc. The collecting time shall be within 60 $\pm$0.5 minutes.

(4) The canister shall be weighed.

D.3.6 Test report

The test results shall be reported in terms of the sum of evaporated gas from tank breathing loss and from hot soak loss.

Annex E

Testing for durability of pollution control device

(Clause 6.4)

E.1 General requirements

E.1.1 The test shall be carried out either on a chassis dynamometer or on an actual road.

E.1.2 The test fuel must be either benzene according to the notification of the Energy Business Department, or reference fuel.

E.1.3 Inspection, maintenance, adjustments, and the use of control devices during distance accumulation running shall conform to the user instructions provided by the manufacturer upon delivery.

E.2 Test equipment and devices

Chassis dynamometer as specified in Clause B.3.1 of Annex B.

E.3 Preparation for sample

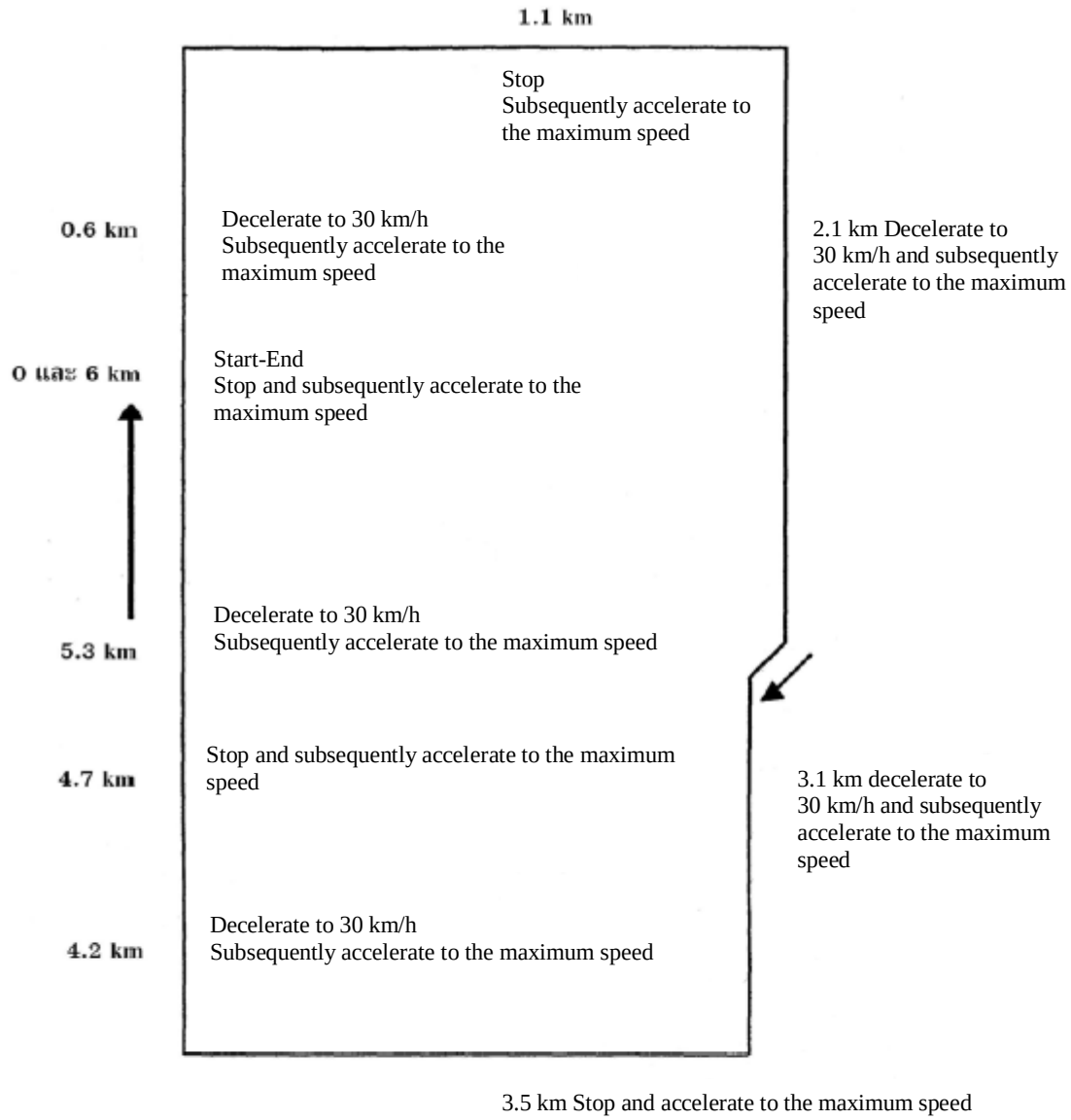
The motorcycle must be in good condition and the pollution control device in new condition.

E.4 Test method

E.4.1 The motorcycle shall be driven according to the driving program as follows:

E.4.1.1 The test shall consist of 11 cycles, each of which covers 6 km.

E.4.1.2 The first 1-9 cycles shall conform to the following program:



1 cycle of driving program from 1-9 cycles

E.4.1.3 The maximum running speed of each cycle is shown below.

Table E.1 Maximum speed

(Clause E.4.1.3)

Cycle	Maximum speed (km/h)		
	Cylinder capacity Less than 170 cm^3	**Cylinder capacity From 170 - 279 cm^3**	**Cylinder capacity From 280 cm^3 up**
1	65	65	65
2	45	45	65
3	65	65	55
4	65	65	45
5	55	55	55
6	45	45	55
7	55	55	70
8	70	70	55
9	55	55	46
10	70	90	90
11	70	90	110

(1) The motorcycle may be tested at the request of the manufacturer by using the maximum speed of the higher cylinder capacity. However, the decision shall be made in agreement with the testing unit.

(2) If the motorcycle cannot achieve maximum speed with the original cylinder capacity, the test may be carried out at the request of the manufacturer by using the maximum speed of the lower cylinder capacity. If the lowest cylinder capacity of the table is used and the motorcycle cannot achieve maximum speed, the maximum speed achieved by the motorcycle during the test shall then be used. However, the decision shall be made in agreement with the testing unit.

E.4.1.4 For the first 1-9 cycles, the motorcycle shall be run at idling during each stopping for 15 seconds.

E.4.1.5 Normal acceleration and deceleration shall be used.

E.4.1.6 The 10^{th} cycle shall be carried out at the steady speed throughout 6 km.

E.4.1.7 The 11^{th} cycle shall begin with the maximum acceleration from stop point up to the maximum speed. Breaking shall be employed normally at a distance of 3 km until the motorcycle comes to a stop followed by an idling period of 15 seconds, then perform the other maximum acceleration until covering a distance of 6 km.

E.4.1.8 Upon completing the first 11 cycles, the driving shall continue according to the 11-cycle program described above until it has covered half of the total distance as stipulated in Clause E.2 with the allowable tolerance of $\pm$250 km.

Table E.2 Distance specified for testing the durability of the pollution control device
(Clause E.4.1.8)

Cylinder capacity (cm^3)	Specified distance (km)
Less than 170 cm^3	12,000
From 170 – 279 cm^3	18,000
From 280 cm^3 up	30,000

E.4.2 Measuring the mass of pollutants

E.4.2.1 The mass of carbon monoxide, hydrocarbon, and nitrogen oxide shall be measured in accordance with the method set out in Annex B for at least 4 times within half of the total distance specified in Table E.2, where:

- the cylinder capacity is less than 170 cm^3, the measurement shall start at the distance of 2,500 km;
- the cylinder capacity is between 170-279 cm^3, the measurement shall start at the distance of 2,500 km;
- the cylinder capacity is from 280 cm^3 up, the measurement shall start at the distance of 3,500 km.

The final measurement shall be carried out at half of the total distance according to Table E.2. The tolerance between the starting point and the end point shall be $\pm$250 km.

E.4.2.2 The remaining distance where the emission must be measured shall be in accordance with the manufacturer's instructions regarding maintenance. Carry out the test by using the same distance both before and after maintenance However, the decision shall be made in agreement with the testing unit.

E.4.2.3 If within half of the total distance shown in Table E.2 the manufacturer requires more than 1 maintenance, the test shall be carried out at the shortest distance to the maintenance service and the middle point between the first and final measurements for the distance subjected to the 2^{nd} and 3^{rd} measurements of pollutants. However, the decision shall be made in agreement with the testing unit.

E.4.2.4 If, within half of the distance as shown in Table E.2, no maintenance is set by the manufacturer, the remaining distance subjected to the measurements of pollutants shall be set in intervals equally divided between the first and the final measurements.

E.4.2.5 At the request of the manufacturer, the test may be carried out at different distances for half of the total distance given in Table E.2. The values obtained shall be calculated for

deterioration factor. However, the decision shall be made in agreement with the testing unit.

E.4.2.6 The mass of carbon monoxide, hydrocarbon and nitrogen oxide as related to the distance up to a kilometre shall be plotted on the graph. A straight line shall be drawn by employing the least square method, regardless of the starting point. The graph shall show the relation between the mass of carbon monoxide, hydrocarbon and nitrogen oxide, and the running distance to the half of the total distance given in Table E.2.

E.4.2.7 The mass of carbon monoxide, hydrocarbon and nitrogen oxide shall be estimated from the total distance given in Table E.2.

E.4.3 Calculation

The deterioration factor of each pollutant shall be calculated by using the following formula.

$$D.F.= \frac{PE_{i2}}{PE_{i1}}$$

Where: D.F. is the deterioration factor.

PE_{i1} is the mass of each pollutant interpolated to half of the total distance specified in Table E.2.

PE_{i1} is the mass of each pollutant interpolated to the total distance specified in Table E.2.

The interpolated values shall be given to a minimum of 4 places to the right of the decimal point. The result shall be rounded to 3 places to the right of the decimal point. If a deterioration factor is less than 1, it shall be regarded as equal to 1.

Annex F

Calculation for average mass of pollutants

(Clause 5.2.3.2)

F.1 Average mass of carbon monoxide, hydrocarbon, and nitrogen oxide from the "n" samples shall be calculated by using the following formula.

$$X_A = \overline{X}_A + k \times S_A$$

$$X_B = \overline{X}_B + k \times S_B$$

$$X_C = \overline{X}_C + k \times S_C$$

$$S_A = \sqrt{\frac{(X_{A1} - \overline{X}_A)^2 + (X_{A2} - \overline{X}_A)^2 + \ldots + (X_{An} - \overline{X}_A)^2}{n - 1}}$$

$$S_B = \sqrt{\frac{(X_{B1} - \overline{X}_B)^2 + (X_{B2} - \overline{X}_B)^2 + \ldots + (X_{Bn} - \overline{X}_B)^2}{n - 1}}$$

$$S_C = \sqrt{\frac{(X_{C1} - \overline{X}_C)^2 + (X_{C2} - \overline{X}_C)^2 + \ldots + (X_{Cn} - \overline{X}_C)^2}{n - 1}}$$

Where: X_A is the average mass of carbon monoxide, g/km.

$\overline{X}_A$ is the arithmetical mean value of the mass of carbon monoxide from the n samples, g/km.

k is the constant value from Table F.1.

In case of $n \geq 20$, $k = \frac{0.860}{\sqrt{n}}$

S_A is the standard deviation of the mass of carbon monoxide.

X_B is the average mass of hydrocarbon, g/km.

$\overline{X}_B$ is the arithmetic mean value of the mass of hydrocarbon, g/km.

S_B is the standard deviation of the mass of hydrocarbon.

X_C is the average mass of nitrogen oxide, g/km.

$\overline{X}_C$ is the arithmetic mean value of the mass of nitrogen oxide, g/km.

S_C is the standard deviation of the mass of nitrogen oxide.

X_{A1} is the mass of carbon monoxide from original sample, g/km.

$X_{A2}…X_{An}$ is the mass of carbon monoxide from each of the additional sample, g/km.

X_{B1} is the mass of hydrocarbon from original sample, g/km.

$X_{B2}…X_{Bn}$ is the mass of hydrocarbon from each of the additional sample, g/km.

X_{C1} is the mass of nitrogen oxide from original sample, g/km.

$X_{C2}…X_{Cn}$ is the mass of nitrogen oxide from each of the additional sample, g/km.

n is the number of test motorcycles.

Table F.1 K Constant

(Clause F.1)

n	2	3	4	5	6	7	8	9	10
k	0.973	0.613	0.489	0.421	0.376	0.342	0.317	0.296	0.279

n	2	3	4	5	6	7	8	9	10
k	0.265	0.253	0.242	0.233	0.224	0.216	0.210	0.203	0.198

Annex G

Cstd calculation sample

(Clause D.2.3.2 (1))

G.1 Cstd shall be calculated from the following formula:

$$Cstd = \frac{M_{HC}}{K \times V \times 10^{-4} \times (P/T)}$$

Where: C_{std} is a particular hydrocarbon level inside the chamber, ppm.

M_{HC} is the standard mass of evaporated hydrocarbon emission, equal to 2.0 g/test.

K is 1.2 x (12 + H/C) when (H/C) = 2.2.

V is the net volume of test chamber, m^3.

P is the atmospheric pressure at the standard test condition, equal to 101.3 kPa.

T is the ambient temperature in the chamber at the standard test condition, equal to 298.15 K.