International Standard 6460

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Road vehicles — Measurement method of gaseous pollutants emitted by motorcycles equipped with a controlled ignition engine

Véhicules routiers — Méthode de mesurage des émissions de gaz polluants par les motocycles équipés de moteurs à allumage commandé

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6460 was developed by Technical Committee ISO/TC 22, *Road vehicles,* and was circulated to the member bodies in June 1979.

It has been approved by the member bodies of the following countries :

Austria	Japan	Spain
Belgium	Korea, Dem. P. Rep. of	Sweden
Chile	Korea, Rep. of	Switzerland
Czechoslovakia	Netherlands	United Kingdom
France	Poland	USSR
Germany, F.R.	Romania	
Italy	South Africa, Rep. of	

No member body expressed disapproval of the document.

This International Standard incorporates draft Addendum 1 to draft International Standard ISO/DIS 6460, which was circulated to the member bodies in January 1980 and which has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	South Africa, Rep. of
Austria	Italy	Spain
Belgium	Japan	Sweden
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Chile	Korea, Rep. of	United Kingdom
China	Mexico	USA
Czechoslovakia	Netherlands	USSR
Egypt, Arab Rep. of	Poland	
France	Romania	

The member body of the following country expressed disapproval of the document on technical grounds :

Brazil

Printed in Switzerland

Road vehicles — Measurement method of gaseous pollutants emitted by motorcycles equipped with a controlled ignition engine

1 Scope and field of application

This International Standard specifies methods of measurement for gaseous pollutants emitted by motorcycles as defined in ISO 3833, equipped with a 4-stroke, a 2-stroke or a rotary controlled ignition engine.

It defines a driving cycle in accordance with the requirements of different types of motorcycles and provides specifications of the collecting methods for gaseous pollutants, a measuring system and a test bench.

2 References

ISO 3833, *Road vehicles — Types — Terms and definitions.*

ISO/TR 6970, *Road vehicles — Pollution tests for motorcycles and mopeds — Chassis dynamometer (bench).* [1)]

CEC Specification RF-05-T-76.

CEC Specification RF-05-T-77.

3 Definitions

3.1 motorcycle kerb weight : Motorcycle total unladen weight, the motorcycle being filled with fuel in such a way that the normal container for fuel is filled to at least 90 % of the capacity specified by the manufacturer and being fitted with tool kit and spare wheel (if it is obligatory).

3.2 reference weight of the motorcycle : The weight corresponding to the motorcycle kerb weight (see 3.1), increased by a uniform figure corresponding to a mass of 75 kg.

NOTE — The terms "weight" and "load" have been retained in this International Standard in place of the correct term "mass" as a concession to the continued current use of these terms by certain legislative bodies.

3.3 equivalent inertia : The total inertia of the rotating masses of the test bench determined with respect to the reference weight of the motorcycle (see 3.2).

3.4 gaseous pollutants : Carbon monoxide, hydrocarbons and nitrogen oxides.

4 Tests

The motorcycle shall be subjected, according to its category, to tests of three types :

4.1 Type 1 test

Measurement of the average exhaust gas pollutants emitted by a motorcycle fitted with a controlled ignition engine during a conventional driving cycle.

4.1.1 The motorcycle shall be placed on a roller bench equipped with a brake and an inertia simulation system. A test shall include four cycles as described in 5.1 carried out without a break.

During the test, the exhaust emissions are diluted with air to a constant volumetric flow rate of the mixture. Part of the mixture shall be collected continuously and stored in a bag and then analysed for the determination of the average concentration of carbon monoxide, hydrocarbons and nitrogen oxides.

4.1.2 The test shall be carried out in accordance with the method described in clause 5.

4.2 Type 2 test

Measurement of the emissions of the exhaust gases at idling speed.

The test shall be carried out in accordance with the method described in clause 6.

4.3 Type 3 test [2)]

Verifying emissions of crank-case gases.

Existing knowledge does not permit definition of a method of measurement of the mass of the hydrocarbons contained in the crank-case gases not re-cycled by the engine.

1) At present at the stage of draft.

2) This method will be the subject of a later addendum.

5 Measurement of the average exhaust gas pollutants emitted by a motorcycle equipped with a controlled ignition engine during a conventional driving cycle (Type 1 test)

5.1 Operating cycle on the roller bench

5.1.1 Description of the cycle

The operating cycle on the roller bench shall be that indicated in table 1 and depicted in the graph in figure 1.[1)]

5.1.2 General conditions under which the cycle is carried out

Preliminary testing cycles should be carried out, if necessary, to determine how best to actuate the throttle, gear box, clutch and brake controls so as to achieve a cycle approximating to the theoretical cycle within the prescribed limits.

5.1.2.1 If the acceleration of the motorcycle is sufficient, the theoretical cycle described in 5.1.1 shall be carried out.

5.1.2.2 If the acceleration of the motorcycle is not sufficient to carry out the acceleration phases within the prescribed limits of tolerances, the motorcycle shall be driven with the throttle fully open until the speed prescribed for the cycle is reached and the cycle shall then be carried out normally.

5.1.3 Use of the gear box

The use of the gear box shall be as specified by the manufacturer; however, in the absence of such instructions, the following points shall be taken into account.

5.1.3.1 Manual change gear box

During each phase at constant speed, the rotating speed of the engine shall be, if possible, between 50 and 90 % of the speed corresponding to the maximum power of the engine. When this speed can be reached in two or more gears, the motorcycle shall be tested with the higher gear engaged.

During acceleration, the motorcycle shall be tested in whichever gear is appropriate to the acceleration imposed by the cycle. A higher gear shall be engaged at the latest when the rotating speed is equal to 110 % of the speed corresponding to the maximum power of the engine.

During deceleration, a lower gear shall be engaged before the engine starts to idle roughly, at the latest when the engine revolutions are equal to 30 % of the speed corresponding to the maximum power of the engine. No change down to first gear shall be effected during deceleration.

Table 1 — Operating cycle on the roller bench

No. of operation	Operation	Phase	Acceleration m/s²	Speed km/h	Duration of each operation s	Duration of each phase s	Cumulative time s	Gear to be used in the case of a manual shift	Distance covered m
1	Idling	1			11	11	11	6 s PM 5 s K*	0
2	Acceleration	2	1,04	0 to 15	4	4	15	prescribed by the manufacturer	8
3	Constant speed	3		15	8	8	23		34
4	Deceleration	4	0,69	15 to 10	2	5	25		7
5	Deceleration, clutch disengaged		– 0,92	10 to 0	3		28	K	4
6	Idling	5			21	21	49	16 s PM 5 s K	0
7	Acceleration	6	0,74	0 to 32	12	12	61	prescribed by the manufacturer	54
8	Constant speed	7		32	24	24	85		214
9	Deceleration	8	– 0,75	32 to 10	8	11	93		48
10	Deceleration, clutch disengaged		– 0,92	10 to 0	3		96	K	4
11	Idling	9			21	21	117	16 s PM 5 s K	0
12	Acceleration	10	0,53	0 to 50	26	26	143	prescribed by the manufacturer	183
13	Constant speed	11		50	12	12	155		167
14	Deceleration	12	– 0,52	50 to 35	8	8	163	prescribed by the manufacturer	95
15	Constant speed	13		35	13	13	176		127
16	Deceleration	14	– 0,68	35 to 10	9	12	185		64
17	Deceleration, clutch disengaged		– 0,92	10 to 0	3		188	K	4
18	Idling	15			7	7	195	7 s PM	0
								TOTAL	1 013

* PM = gear in neutral, clutch engaged

K = clutch disengaged

1) If another operating cycle is used, this fact must be stated in the results.

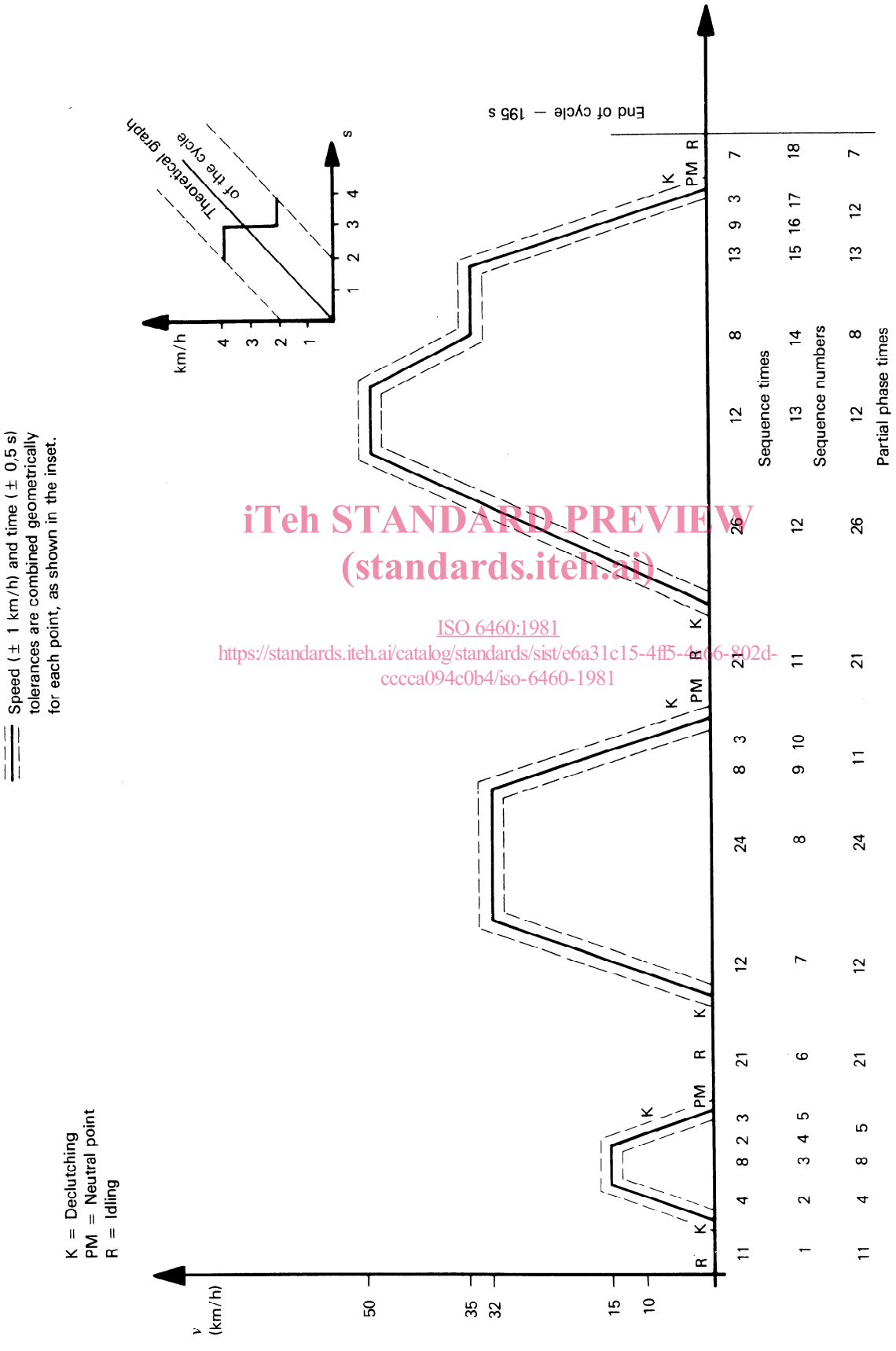

Figure 1 — Operating cycle on the roller bench
(Type 1 test)

5.1.3.2 Automatic gear box and torque converter

The position "drive" shall be used.

5.1.4 Tolerances

5.1.4.1 A tolerance of ± 1 km/h on the theoretical speed shall be allowed during acceleration, during steady speed, and during deceleration. If the motorcycle decelerates more rapidly without the use of the brakes, the specifications of 5.5.5.3 shall apply.

Speed tolerances greater than those prescribed shall be accepted during phase changes provided that the tolerances are never exceeded for more than 0,5 s on any one occasion.

5.1.4.2 The time tolerance shall be ± 0,5 s.

5.1.4.3 The speed and time tolerances shall be combined as indicated in figure 1.

5.2 Engine fuel and lubricants

For the test, either the reference fuel CEC RF-05-T-77 or the reference fuel CEC RF-05-T-76 shall be used. The lubrication of the engine, including engines lubricated by mixture, shall comply, as to grade and quantity of oil, with the manufacturer's recommendation.

5.3 Test equipment

5.3.1 Roller bench

The main characteristics of the roller bench are as follows[1] :

— Number of points of contact between tyre(s) and roller(s) : one to each driven wheel

— Roller diameter : ⩾ 400 mm

— Roller surface : polished metallic

— Equation of the power absorption curve :

The power absorbed by the brake and the internal frictions of the bench should be:

— $0 < P_a < kv^3_{12} + 0{,}05\ kv^3_{12} + 0{,}05\ P_{v50}$ for speeds inferior to 12 km/h;

— $P_a = kv^3 \pm 0{,}05\ kv^3 \pm 0{,}05\ P_{v50}$ (without being negative) for speeds superior to 12 km/h.

The method of verification shall be in accordance with the method described in annex B.

NOTE — It can be assumed that the power lost between the tyre(s) and the roller(s) equals the loss between the tyre(s) and the road.

1) A detailed description is given in ISO/TR 6970.

5.3.2 Gas-collection equipment

The gas-collection device is described below (see example in figure 2).

5.3.2.1 A device to collect all the exhaust gases produced during the test. This device is generally an open type device, maintaining the atmospheric pressure at the motorcycle exhaust outlet(s). Nevertheless, if the back pressure conditions are complied with at ± 125 mm H_2O, a closed system may be used. The gas collection shall be such that there is no condensation which could appreciably modify the nature of exhaust gases at the test temperature.

5.3.2.2 A connecting tube between the device and the exhaust gas sampling system.

This tube, and the device, shall be made of stainless steel, or of some other material which does not affect the composition of the gases collected and which withstands the temperature of these gases.

5.3.2.3 A heat exchanger capable of limiting the temperature variation of the diluted gases in the pump intake to ± 5 °C throughout the test. This exchanger shall be equipped with a preheating system able to bring the exchanger to its operating temperature (with the tolerance of ± 5 °C) before the test begins.

5.3.2.4 A positive displacement pump to draw in the dilute exhaust mixture. This pump is equipped with a motor having several strictly controlled uniform speeds. The pump capacity shall be large enough to ensure the intake of all the exhaust gases. A device using a critical flow Venturi may also be used.

5.3.2.5 A device to allow continuous recording of the diluted exhaust mixture entering the pump.

5.3.2.6 Two gauges : the first to ensure the pressure depression of the dilute exhaust mixture entering the pump, relative to atmospheric pressure, the other to measure the dynamic pressure variation of the positive displacement pump.

5.3.2.7 A probe, located near to, but outside the gas collecting device, to collect, through a pump, a filter and a flowmeter, samples of the dilution air stream, at constant flow rates, throughout the test.

5.3.2.8 A sample probe, pointed upstream into the dilute exhaust mixture flow, upstream of the positive displacement pump, to collect, through a pump, a filter and a flowmeter, samples from the dilute exhaust mixture, at constant flow rates, throughout the test.

The minimum sample flow rate in the two sampling devices described above and in 5.3.2.7 shall be at least 150 l/h.

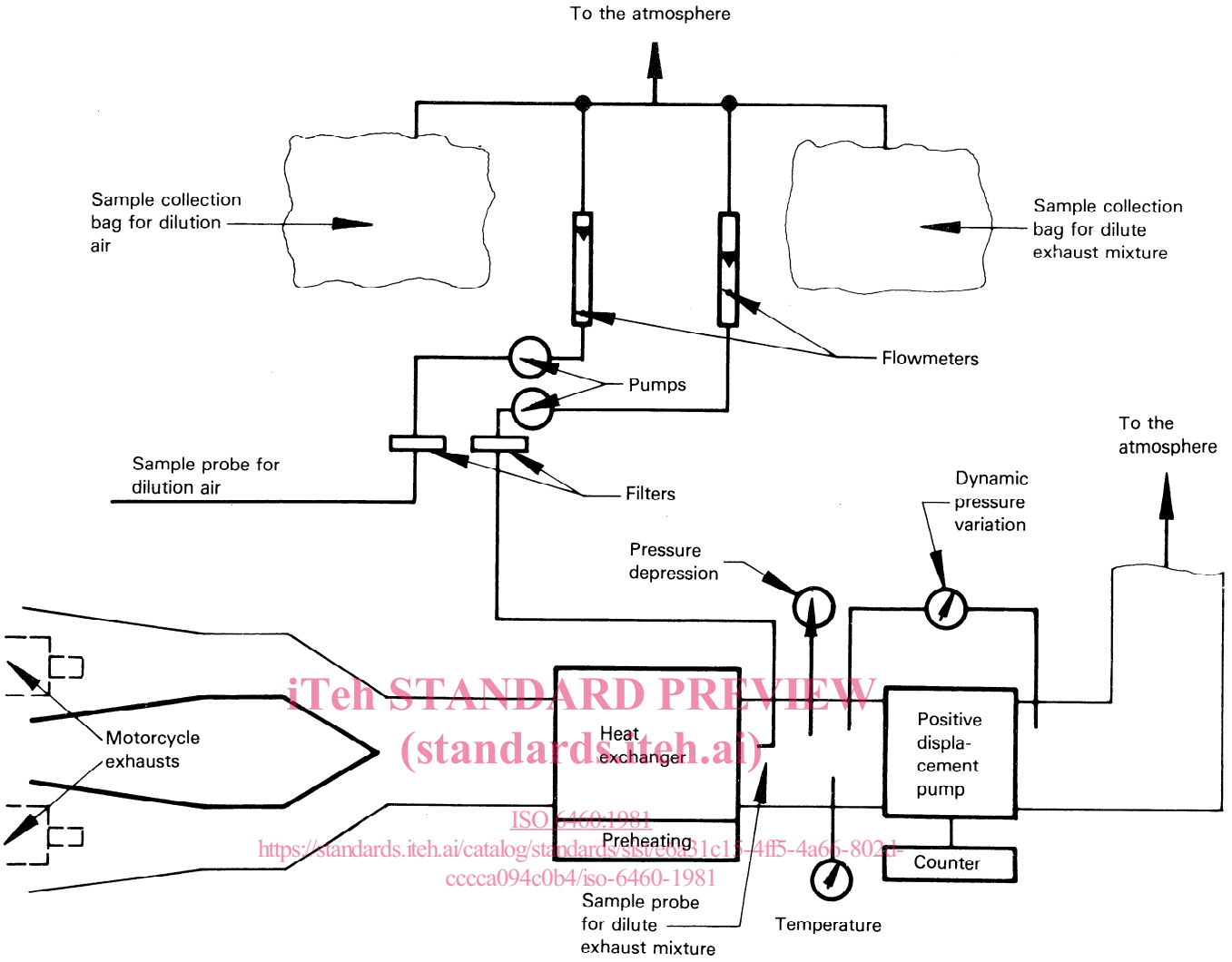

Figure 2 — Example of exhaust gas collection equipment

5.3.2.9 Three way valves on the sampling system, described in 5.3.2.7 and 5.3.2.8, to direct the samples either to their respective bags or to the outside throughout the test.

5.3.2.10 Gas-tight collection bags for dilution air and dilute exhaust mixture of sufficient capacity so as not to impede normal sample flow and which will not change the nature of the gas pollutants concerned.

The bags shall have an automatic self-locking device, and shall be easily and tightly fastened either to the sampling system or the analyzing system at the end of the test.

5.3.2.11 A revolution counter to count the revolutions of the positive displacement pump throughout the test.

5.3.3 Analytical equipment

5.3.3.1 The sample probe may consist of a sampling tube leading into the collecting bags or of a drainage tube. This sample probe shall be made of stainless steel or of some other material that will not adversely affect the composition of the gases to be analyzed. The sample probe as well as the tube taking the gases to the analyser shall be at ambient temperature.

5.3.3.2 Analysers shall be of the following types :

— non-dispersive type with absorption in the infra-red for carbon monoxide;

— flame ionization type for hydrocarbons;

— chemiluminescence type for nitrogen oxides.

5.3.4 Accuracy of instruments and measurements

5.3.4.1 If the brake is calibrated in a separate test (see 5.4.1), no indication of the accuracy of the roller bench is required. On the other hand, to use table 2, the roller bench must have a sensibility lower than 80 W. The total inertia of the rotating masses, including that of the roller and the rotating part of the brake (see 5.3.1), shall be measured to within ± 2 %.

5.3.4.2 The distance covered by the motorcycle shall be measured by the rotation of the roller; it shall be measured to within ± 10 m.

5.3.4.3 The speed of the motorcycle shall be measured by the speed of rotation of the roller; it shall be measured to within ± 1 km/h in the speed range above 10 km/h.

5.3.4.4 The ambient temperatures and the temperatures considered in 5.3.2.3 and 5.3.2.5 shall be measured to within ± 2 °C.

5.3.4.5 The atmospheric pressure shall be measured to within ± 2 mbar.

5.3.4.6 The relative humidity of the ambient air shall be measured to within ± 5 %.

5.3.4.7 The pressures considered in 5.3.2.6 shall be measured to within ± 4 mbar.

5.3.4.8 The analysers shall have a measuring range compatible with the accuracy required to measure the content of the various pollutants to within ± 3 %, disregarding the accuracy of the calibration gases. The overall response time of the analysing circuit shall be less than 1 min.

5.3.4.9 The content of the calibration gases shall not differ by more than ± 2 % from the reference value of each gas. The diluent shall be nitrogen for carbon monoxide and nitrogen oxides, and it shall be air for hydrocarbons (propane).

5.3.4.10 The speed of the cooling air speed shall be measured to within ± 5 km/h.

5.3.4.11 The duration of cycles and gas collection shall be conducted to within ± 1 s. These times shall be measured with an accuracy of 0,1 s.

5.3.4.12 The total volume of the diluted gases shall be measured with an accuracy of ± 2 %.

5.3.4.13 The total flow rate and the sampling flow rates shall be steady within ± 5 %.

5.4 Preparing the test

5.4.1 Setting of brake

The brake will be so adjusted as to absorb a power equivalent to that of the motorcycle on the level at 50 km/h (see method of setting in annex B).

In cases where it is not possible to carry out this power measurement, the brake will be adjusted in accordance with table 2.

5.4.2 Adjustment of equivalent inertias to the motorcycle's translatory inertias

The inertia simulation system shall be adjusted to obtain a total inertia of the rotating masses representing the motorcycle kerb weight, in accordance with the limits given in table 2.

Table 2 — Setting of brake

Motorcycle kerb weight m (kg)	Equivalent inertia M (kg)	Power absorbed by the brake $P_{V_{50}}$ (kW)
$m \leqslant 30$	100	0,88
$30 < m \leqslant 40$	110	0,90
$40 < m \leqslant 50$	120	0,91
$50 < m \leqslant 60$	130	0,93
$60 < m \leqslant 70$	140	0,94
$70 < m \leqslant 90$	150	0,96
$90 < m \leqslant 110$	170	0,99
$110 < m \leqslant 130$	190	1,02
$130 < m \leqslant 150$	210	1,05
$150 < m \leqslant 170$	230	1,09
$170 < m \leqslant 195$	260	1,14
$195 < m \leqslant 225$	280	1,17
$225 < m \leqslant 255$	310	1,21
$255 < m \leqslant 285$	340	1,26
$285 < m \leqslant 320$	380	1,33
$320 < m \leqslant 360$	410	1,37
$360 < m \leqslant 400$	450	1,44

Additional masses may be replaced by another device, provided that it is demonstrated that the results obtained are equivalent.

5.4.3 Conditioning of motorcycle

5.4.3.1 Adjustment of the tyre pressure

The tyre pressure shall be that recommended by the manufacturer for normal road use conditions.

5.4.3.2 Load on the driving wheel

The load on the driving wheel shall be within ± 3 % that of a motorcycle in normal road use with a rider of 75 ± 5 kg in the upright position (see note in 3.2).

5.4.4 Check of back-pressure

During the preliminary tests, a check shall be made to ensure that the running of the motorcycle is not affected and that, in all cases, the back-pressure at the exhaust outlet(s) during gas collection is equal to the atmospheric pressure to within ± 12 mbar.

5.4.5 Adjustment of analytical apparatus

5.4.5.1 Calibration of analysers

The calibration gas at the indicated pressure, compatible with the correct functioning of the equipment, shall be passed through the analyser.

The curve of the analyser's deviations shall be drawn as a function of the contents of the various calibration gas cylinders used.

5.4.5.2 Adjustment of the analysers

The adjustment of the analysers can then be carried out with only one calibration gas having an established content.

5.4.5.3 Over-all response time of the apparatus

The gas from the maximum content cylinder shall be introduced into the end of the sampling probe. A check shall be made to ensure that the indicated value corresponding to the maximum deviation, is reached in less than 1 min. As long as this value is not reached, the analysing circuit shall be inspected from end to end for leaks.

5.5 Procedure for tests on the roller bench

5.5.1 Special conditions for carrying out the cycle

5.5.1.1 The temperature in the room housing the roller bench shall be between 20 and 30 °C throughout the test and approximate as closely as possible that of the room in which the motorcycle was conditioned for the test.

5.5.1.2 The motorcycle shall be as nearly level as possible when tested in order to prevent abnormal fuel distribution, and where appropriate, engine oil distribution.

5.5.1.3 Throughout the test, a variable speed cooling blower shall be positioned in front of the motorcycle, so as to direct cooling air to the engine in a manner which simulates actual operating conditions. The blower speed shall be such that, within the operating range of 10 to 50 km/h, the linear velocity of the air at the blower outlet is within ± 5 km/h of the corresponding roller speed. At roller speeds of less than 10 km/h, air velocity may be zero. With the manufacturer's agreement, engine cooling can be effected by a constant-speed blower giving a current of air delivered at a speed between 20 and 50 km/h. The blower outlet shall have a cross section area of at least 0,4 m^2 and the bottom of the blower outlet shall be between 15 and 20 cm above floor level. The blower outlet shall be perpendicular to the longitudinal axis of the motorcycle between 30 and 45 cm in front of its front wheel. The device used to measure the linear velocity of the air shall be located in the middle of the stream at 20 cm from the air outlet. This velocity shall be as nearly as possible steady across the whole of the blower outlet surface.

5.5.1.4 When the cycle is carried out, the speed considered shall be that of the rollers. During the test, the speed shall be plotted against time so that the validity of the cycles performed can be assessed.

5.5.2 Starting up the engine

5.5.2.1 The engine shall be started up by means of the devices provided for this purpose, such as the choke, the starter valve, etc. ... according to the manufacturer's instructions.

5.5.2.2 The collection of dilute exhaust mixture and dilution air into their respective collection bags shall begin :

— either after a period of 40 s at idling speed, and immediately before the beginning of the first cycle (cold cycle);

— or after running two cycles in order to warm up the engine (hot cycle).

5.5.3 Idling

5.5.3.1 Manual change gear box

5.5.3.1.1 During periods of idling, the clutch shall be engaged and the gears in neutral.

5.5.3.1.2 To enable acceleration to be performed according to the normal cycle, the motorcycle shall be placed in first gear, with the clutch disengaged, within 5 s before the acceleration following the idling period considered.

5.5.3.1.3 The first idling period at the beginning of the cycle shall consist of 6 s of idling in neutral, with the clutch engaged and 5 s in first gear, with the clutch disengaged.

5.5.3.1.4 For the idling periods in the middle of each cycle, the corresponding times shall be 16 s in neutral and 5 s in first gear with the clutch disengaged. These times may be modified if necessary when the motorcycle tested has not sufficient accelerative capacity to follow the theoretical driving cycle (see 5.1.2.2).

5.5.3.1.5 The idling period between two successive cycles shall comprise 13 s in neutral with the clutch engaged (except for the cases considered in 5.1.2.2).

5.5.3.2 Automatic gear box and torque converter

The gear selector shall be locked at the start of the test and must remain in the position defined in 5.1.3.2 throughout the whole of the test.