International Standard 6855

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Road vehicles — Measurement method for gaseous pollutants emitted by mopeds equipped with a controlled ignition engine

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

First edition — 1981-04-15

UDC 629.113.35 : 614.72 : 543.27 **Ref. No. ISO 6855-1981 (E)**

Descriptors : road vehicles, motor vehicles, mopeds, spark ignition engines, pollutant gases, measurement, tests, chemical tests, performance cycle, analyzing, test equipment.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

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 6855 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in July 1979.

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

Austria	Italy	Romania
Belgium	Japan	South Africa, Rep. of
Brazil	Korea, Dem. P. Rep. of	Spain
Chile	Korea, Rep. of	Sweden
China	Libyan Arab Jamahiriya	Switzerland
Czechoslovakia	Mexico	United Kingdom
France	Netherlands	USA
Germany, F. R.	Poland	

No member body expressed disapproval of the document.

This International Standard incorporates draft Addendum 1 to draft International Standard ISO/DIS 6855, which was circulated to the member bodies in February 1980 and which has been approved by the member bodies of the following countries :

Austria	Italy	Spain
Belgium	Japan	Sweden
Brazil	Korea, Dem. P. Rep. of	Switzerland
China	Korea, Rep. of	United Kingdom
Egypt, Arab Rep. of	Mexico	USA
France	Netherlands	USSR
Germany, F. R.	Poland	
Ireland	Romania	

No member body expressed disapproval of the document.

Printed in Switzerland

Road vehicles — Measurement method for gaseous pollutants emitted by mopeds equipped with a controlled ignition engine

1 Scope and field of application

This International Standard specifies the measurement methods for gaseous pollutants emitted by mopeds as defined in ISO 3833, equipped with a four stroke, a two stroke or a rotary controlled ignition engine.

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

2 References

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

ISO 6726, *Road vehicles — Mopeds — Weights — Vocabulary.*

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

ISO 7116, *Road vehicles — Method of measurement of maximum speed for mopeds.*

CEC specification RF-05-T-76.

CEC specification RF-05-T-77.

3 Definitions

3.1 moped kerb weight : Moped total unladen weight, the moped 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 moped : The weight corresponding to the moped 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 in relation to the reference weight of the moped (see 3.2).

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

4 Tests

The moped shall be subjected to tests of two types :

4.1 Type 1 test

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

4.1.1 The moped 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 shall be 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 analyzed 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 of this International Standard.

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.

1) At present at the stage of draft.

5 Measurement of the average exhaust gas pollutants emitted by a moped 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 specified in table 1 and depicted in figure 1. The cycle shall be adapted for each moped according to its performance (acceleration capacity, maximum design speed) as specified in 5.5.3 to 5.5.5.

Table 1 — Operating cycle on the roller bench

N° of operation	Operation	Acceleration m/s^2	Speed km/h	Duration of phase s	Total time s
1	Idling	—	—	8	8
2	Acceleration	Full throttle	0 to max.	57	—
3	Constant speed	Full throttle	max.		—
4	Deceleration	− 0,56	max. to 20		65
5	Constant speed	—	20	36	101
6	Deceleration	− 0,93	20 to 0	6	107
7	Idling	—	—	5	112

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 accelerator, brake controls, the gear box and clutch, where necessary.

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

At the constant speed of 20 km/h, the speed of rotation of the engine shall be, if possible, within 50 to 90 % of the speed corresponding to the maximum power of the engine. When this speed can be reached in two or more gears, the moped shall be tested with the highest such gear engaged.

During acceleration, the moped shall be tested with the gear which gives maximum acceleration. 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.

5.1.3.2 Automatic gear box and torque converter

The position "road" 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 constant speed and deceleration. If the moped decelerates more rapidly without the use of the brakes the specifications of 5.5.6.3 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 Fuel and lubricant

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

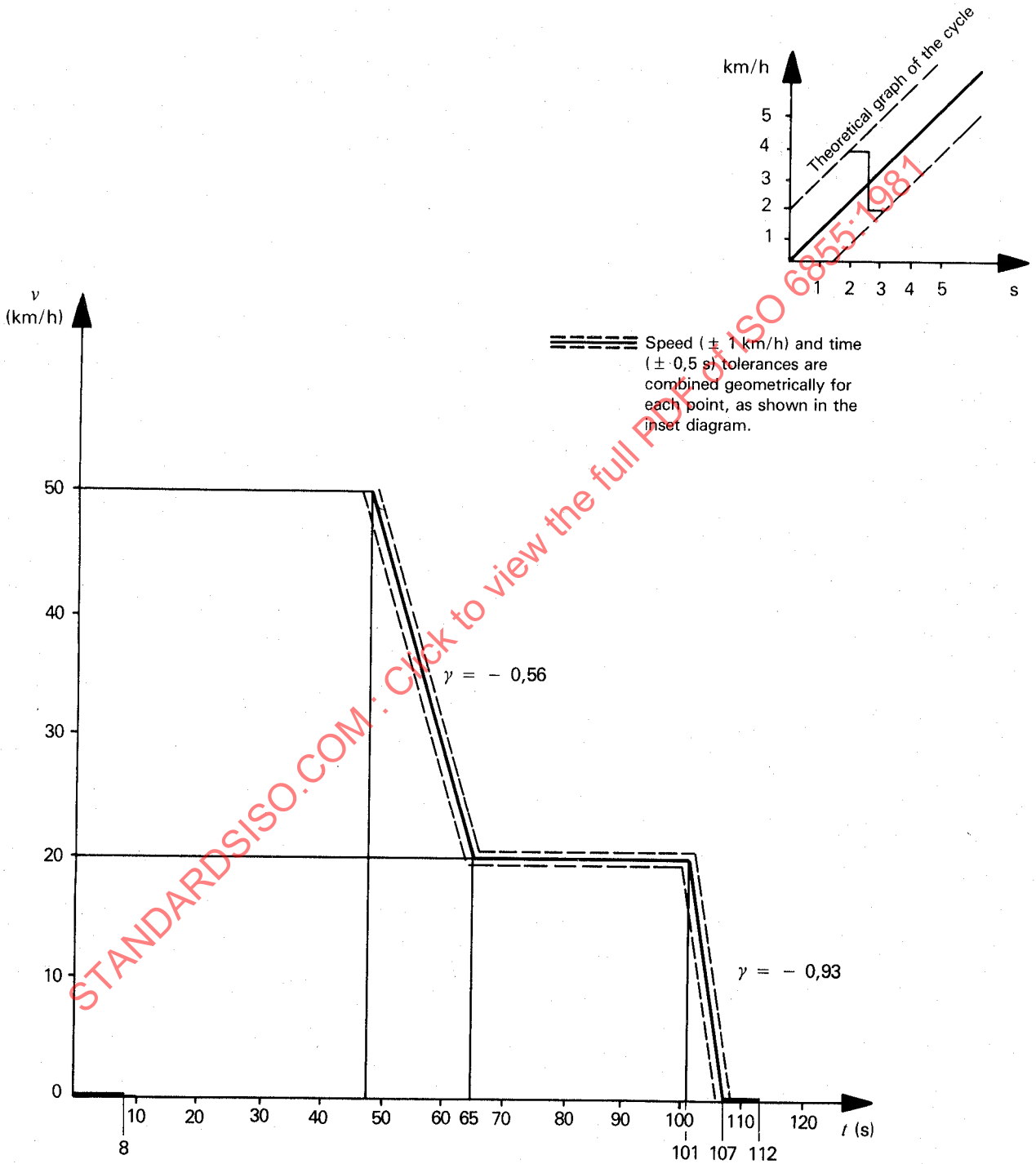

Figure 1 — Driving cycle on the roller bench (type 1 test)

5.3 Test equipment

5.3.1 Roller bench

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

— Number of points of contact between tyre and roller : one per 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 friction of the test bench shall be :

$0 < P_a < kv_{12}^3 + 0{,}05\ kv_{12}^3 + 0{,}05\ P_{v50}$ for speeds up to and including 12 km/h, and

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

(the method of verification to be in accordance with the method described in the annex).

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

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, maintaining the atmospheric pressure at the moped exhaust outlet(s).

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

This tube, and the collecting device, shall be made of stainless steel, or 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 An extractor device for the dilute exhaust mixture. This device shall ensure a constant volume flow and shall be large enough to ensure the extraction of all the exhaust gases.

5.3.2.4 A sample 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.

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

The minimum sample flow rate in these two sampling devices described above and in 5.3.2.4 shall be 150 l/h.

5.3.2.6 Three way valves, described in 5.3.2.4 and 5.3.2.5, on the sampling system to direct samples either to their respective bags or to the outside throughout the test.

5.3.2.7 Gas-tight collection bags for dilution air and dilute exhaust mixture, of sufficient capacity so as not to impede 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 to the analyzing system at the end of the test.

5.3.2.8 A method of determining the total volume of the dilute gases going through the sampling system during the test shall be provided.

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 bag-emptying tube. This sample probe shall be made of stainless steel or of some other material which will not adversely affect the gas composition. 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 As the brake is calibrated in a separate test (see 5.4.1), an indication of the accuracy of the roller bench is not required. 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 ± 5 kg.

5.3.4.2 The distance covered by the moped 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 moped 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 temperature shall be measured to within ± 2 °C.

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

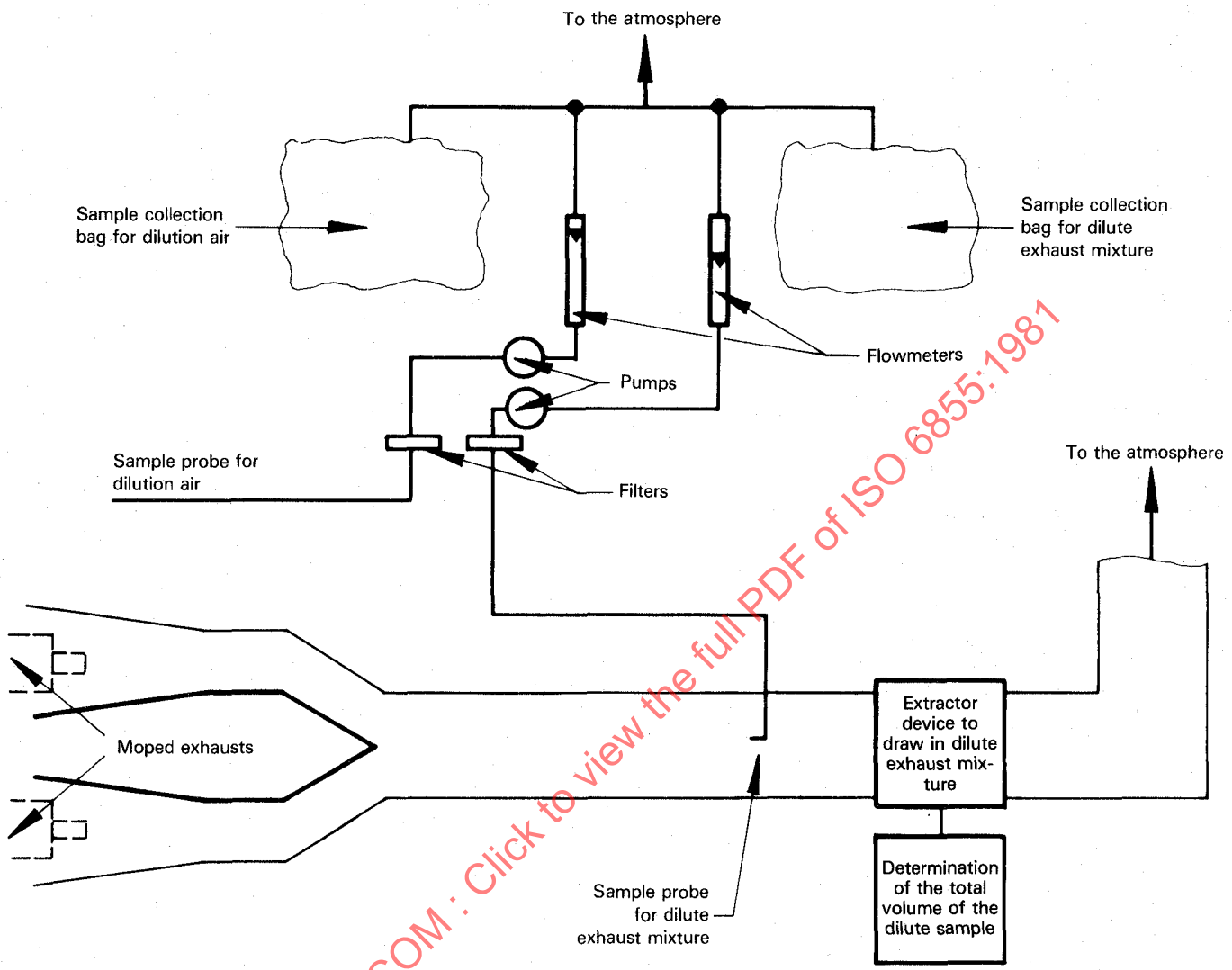

Figure 2 — Example of exhaust gas collection equipment

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

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

5.3.4.7 The accuracy required to measure the content of the various pollutants disregarding the accuracy of the calibration gases shall be within ± 3 %. The overall response time of the analysing circuit shall be less than 1 min.

5.3.4.8 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).

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

5.3.4.10 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.

5.3.4.11 The total volume of the dilute gases shall be measured with an accuracy of ± 3 %.

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

5.4 Preparing the test

5.4.1 Setting of brake

The brake shall be so adjusted as to ensure that the moped bench speed, with the throttle fully open, shall be equal to the maximum speed measured according ISO 7116 for the moped on the level. This adjustment is maintained during the whole test.

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

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

Table 2 — Equivalent inertias

Moped kerb weight (kg)	Equivalent inertia M (kg)
$m \leqslant 30$	100
$30 < m \leqslant 40$	110
$40 < m \leqslant 50$	120
$50 < m \leqslant 60$	130
$60 < m \leqslant 70$	140
$70 < m \leqslant 90$	150
$90 < m \leqslant 110$	170
$110 < m \leqslant 130$	190
$130 < m \leqslant 150$	210
$150 < m \leqslant 170$	230
$170 < m \leqslant 195$	260
$195 < m \leqslant 225$	280
$225 < m \leqslant 255$	310
$255 < m \leqslant 285$	340
$285 < m \leqslant 320$	380
$320 < m \leqslant 360$	410
$360 < m \leqslant 400$	—

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

5.4.3 Conditioning of moped

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 kg that of a moped in normal road use with a rider of 75 ± 5 kg and in the upright position. (See note in 3.2.)

5.4.4 Check of exhaust back-pressure

During the preliminary tests, a check shall be made to ensure that the back-pressure during the sampling of gases at the outlet of the exhaust duct(s) of the moped is equal to the atmospheric pressure to within $^{0}_{-10}$ 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 content 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. So 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.

5.5.1.2 The moped shall be as nearly level as possible when tested in order to prevent any abnormal fuel or engine oil distribution.

5.5.1.3 Throughout the test, an auxiliary cooling blower shall be positioned in front of the moped, so as to direct cooling air to the engine. The blower speed shall be 25 ± 5 km/h. The blower outlet shall have a cross-sectional area of at least 0,20 m^2 and shall be perpendicular to the longitudinal axis of the moped 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 20 cm away from the air outlet. This velocity shall be as nearly constant as possible across the whole of the blower outlet surface.

5.5.1.4 The moped may also be cooled in the following manner.

A current of air of variable speed shall be blown over the moped. 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. The blower outlet shall have a cross section area of at least 0,20 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 moped between 30 and 45 cm in front of its front wheel.

5.5.1.5 When the cycle is carried out, the speed considered shall be that of the roller. During the test, the speed shall be plotted against time so that the accuracy 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 the 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 after four consecutive cycles of 112 s each, in order to warm up the engine.

5.5.3 Idling

5.5.3.1 Manual change gear box

To enable the accelerations to be performed correctly, the moped shall be placed in first gear, with the clutch disengaged, within the 5 s preceding the acceleration following the idling period considered.

5.5.3.2 Automatic gear box and torque converter

The gear selector shall be locked at the start of the test. When two positions "town" and "road" are possible, the "road" position shall be used.

5.5.4 Accelerations

At the end of each period of idling, the acceleration phase shall be effected by fully opening the throttle and, if necessary, using the gear box to attain maximum speed as quickly as possible.

5.5.5 Constant speed

The constant maximum speed phase shall be effected by holding the throttle fully open, until the following deceleration phase commences.

During the constant speed phase at 20 km/h, the throttle position shall, as far as possible, be kept fixed.

5.5.6 Decelerations

5.5.6.1 All decelerations shall be effected by closing the throttle completely, the clutch remaining engaged. The manual clutch shall be disengaged independently of gear selection, at a speed of 10 km/h or before the engine starts to idle roughly.

5.5.6.2 If the rate of deceleration is lower than that prescribed for the corresponding phase, the moped's brake shall be used to enable the cycle to be followed.

5.5.6.3 If the rate of deceleration is higher than that prescribed for the corresponding phase, the timing of the theoretical cycle shall be restored by a period either of constant or idling speed, merging into the following idling operation.

5.5.6.4 At the end of the second deceleration period (the moped being stationary on the roller), the gears shall be in neutral and the clutch engaged.

5.6 Procedure for sampling and analysis

5.6.1 Sampling

5.6.1.1 Sampling shall start at the beginning of the test as indicated in 5.5.2.2.

5.6.1.2 The bags shall be hermetically closed as soon as filling is completed.

5.6.2 Analysis

5.6.2.1 The gases contained in each bag shall be analysed as soon as possible and in any event not later than 15 min after the filling of the bags has been completed.

5.6.2.2 If the sampling probes are not left permanently in the bags, entry of air into the latter during insertion of the probes and escape of gas from the bag during extraction of the probes must be avoided.

5.6.2.3 The analyser shall be in a stabilized condition within one minute after connecting it to the bag.

5.6.2.4 The concentrations in HC, CO and NO_x in the dilute exhaust mixture samples and in the dilution air collecting bags shall be determined from the measuring instrument readings or recordings by use of appropriate calibration curves.

5.6.2.5 The figure recorded as the content by volume of each of the pollutants measured shall be that read off after stabilization of the measuring apparatus.

5.7 Determination of the quantity of gaseous pollutants emitted

5.7.1 Dilute exhaust volume

The volume of the dilute exhaust extracted during the test shall be calculated and corrected to standard conditions of temperature and pressure by means of the following formula :

$$V = V_0 \times \frac{273}{273 + T} \times \frac{p_a}{1\,013}$$

where

V is the total dilute exhaust volume, expressed in cubic metres, corrected to standard conditions (273 K, 1 013 mbar);

V_0 is the volume of gas extracted, expressed in cubic metres per test;

T_m is the average temperature of the diluted gases entering the volume measuring device, expressed in degrees Celsius;

p_a is the average pressure of diluted gases entering the volume measuring device, expressed in millibars.

5.7.2 Mass of the gaseous pollutants emitted throughout the test

The mass of each gaseous pollutant emitted during the type 1 test shall be calculated by means of the formula corresponding to the gaseous pollutant considered.

5.7.2.1 Mass of hydrocarbons (expressed in grams per test phase)

$$HC_{mass} = d_{HC} \times c_{HC} \times V \times 10^{-6}$$

where

d_{HC} is the density of hydrocarbons in the exhaust gas under standard conditions (273 K, 1 013 mbar), expressed in carbon equivalent : 0,619 kg/m³;

c_{HC} is the difference between the concentration of hydrocarbons in the sample of the mixture of diluted gas and the concentration of hydrocarbons in the sample of dilution air, expressed in parts per million (ppm) of carbon equivalent (volume);

V is as defined in 5.7.1.

5.7.2.2 Mass of carbon monoxide (expressed in grams per test phase)

$$CO_{mass} = d_{CO} \times c_{CO} \times V \times 10^{-2}$$

where

d_{CO} is the density of carbon monoxide under standard conditions (273 K, 1 013 mbar) : 1,250 kg/m³;

c_{CO} is the difference between the concentration of carbon monoxide in the sample of the mixture of diluted gas and the concentration of carbon monoxide in the sample of dilution air, expressed as a percentage volume;

V is as defined in 5.7.1.

5.7.2.3 Mass of nitrogen oxides (expressed in grams per test phase)

$$NO_{x_{mass}} = d_{NO_2} \times c_{NO_x} \times V \times 10^{-6} \times K_H$$

where

d_{NO_2} is the density of nitrogen oxides in the exhaust gas under standard conditions (273 K, 1 013 mbar), expressed in NO_2 equivalent : 2,05 kg/m³;

c_{NO_x} is the difference between the concentration of nitrogen oxide in the sample of the mixture of diluted gas and the concentration of nitrogen oxide in the sample of dilution air, expressed in parts per million (volume);

V is as defined in 5.7.1;

K_H is humidity correction factor for nitrogen oxides, given by the formula :

$$K_H = \frac{1}{1 - 0{,}032\,9\,(H - 10{,}7)}$$

where H, absolute humidity, expressed in grams of water per kilogram of dry air, is calculated by using the formula :

$$H = \frac{6{,}211\,1\,R_a \times p_d}{p_a - p_d \dfrac{R_a}{100}}$$

where

R_a is the relative humidity of the ambient air, expressed as a percentage;

p_d is the saturated vapour pressure at the ambient temperature, expressed in millibars;

p_a is the atmospheric pressure, expressed in millibars.

5.8 Expression of results

The results shall be expressed in grams per kilometre (g/km):

$$HC = \frac{HC_{mass}}{d}$$

$$CO = \frac{CO_{mass}}{d}$$

$$NO_x = \frac{NO_{x_{mass}}}{d}$$

where

HC_{mass} is as defined in 5.7.2.1;

CO_{mass} is as defined in 5.7.2.2;

$NO_{x_{mass}}$ is as defined in 5.7.2.3;

d is the distance covered by the moped during the test.

NOTE — A global pollution index based on the following formula is currently under study :

$I = k\,(a\mathrm{HC} + b\mathrm{CO} + c\mathrm{NO}_x)$

where factors a, b, c and k will be determined later.