No. 4789. AGREEMENT CONCERNING THE ADOPTION OF UNIFORM CONDITIONS OF APPROVAL AND RECIPROCAL RECOGNITION OF APPROVAL FOR MOTOR VEHICLE EQUIPMENT AND PARTS. DONE AT GENEVA ON 20 MARCH 1958[1]

ENTRY INTO FORCE of Regulation No. 40 *(Uniform provisions concerning the approval of motor cycles equipped with a positive-ignition engine with regard to the emission of gaseous pollutants by the engine)* as an annex to the above-mentioned Agreement of 20 March 1958

The said Regulation came into force on 1 September 1979 in respect of France and Italy, in accordance with article 1 (5) of the Agreement.

1. SCOPE

This Regulation applies to the emission of gaseous pollutants from positive-ignition engines of two-wheeled or three-wheeled motor cycles with an unladen weight of less than 400 kg having a maximum design speed exceeding 50 km/h and/or cylinder capacity exceeding 50 cm^3.

2. DEFINITIONS

For the purposes of this Regulation:

2.1. "Approval of a vehicle" means the approval of a vehicle type with regard to the limitation of the emission of gaseous pollutants from the engine.

2.2. "Vehicle type" means a category of power-driven vehicles which do not differ in such essential respects as:

2.2.1. The equivalent inertia determined in relation to the reference weight as prescribed in annex 4, paragraph 5.2, to this Regulation; and

2.2.2. The engine and vehicle characteristics as defined in annex 1, items 1-6 and 8, and annex 2 to this Regulation.

2.3. "Reference weight" means the weight of the vehicle in running order, increased by a uniform figure of 75 kg. The weight of the vehicle in running order is its total unladen weight with all tanks full.

2.4. "Engine crank-case" means the spaces in or external to an engine which are connected to the oil sump by internal or external ducts through which gases and vapours can escape.

2.5. "Gaseous pollutants" means carbon monoxide, hydrocarbons and nitrogen oxides, the last-named being expressed in nitrogen dioxide (NO_2) equivalent.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a vehicle type with regard to limitation of the emission of gaseous pollutants from its engine shall be submitted by the vehicle manufacturer or by his duly accredited representative.

3.2. It shall be accompanied by the undermentioned documents in triplicate and the following particulars:

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[1] United Nations, *Treaty Series*, vol. 335, p. 211; for subsequent actions, see references in Cumulative Indexes Nos. 4 to 12, as well as annex A in volumes 801, 802, 808, 811, 814, 815, 818, 820, 825, 826, 829, 830, 834, 835, 848, 850, 854, 856, 857, 858, 860, 861, 865, 866, 871, 872, 882, 887, 891, 892, 893, 897, 899, 915, 917, 926, 932, 940, 943, 945, 950, 951, 955, 958, 960, 961, 963, 966, 973, 974, 978, 981, 982, 985, 986, 993, 995, 997, 1003, 1006, 1010, 1015, 1019, 1020, 1021, 1024, 1026, 1031, 1035, 1037, 1038, 1039, 1040, 1046, 1048, 1050, 1051, 1055, 1059, 1060, 1065, 1066, 1073, 1078, 1079, 1088, 1092, 1095, 1097, 1098, 1106, 1110, 1111, 1112, 1122, 1126, 1130, 1135, 1136, 1138, 1139 and 1143.

3.2.1. A description of the engine type comprising all the particulars shown in annex 1 to this Regulation;

3.2.2. Particulars concerning the vehicle as shown in annex 2 to this Regulation.

3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the technical service responsible for conducting approval tests, for the tests referred to in paragraph 5 of this Regulation.

4. APPROVAL

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraphs 5 and 6 below, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved, the first two digits of which shall be the highest number of the series of amendments incorporated in the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another vehicle type.

4.3. Notice of approval or of refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annex 2 to this Regulation and of drawings and diagrams supplied by the applicant for approval, in a format not exceeding A 4 (210 × 297 mm) or folded to that format and on an appropriate scale.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval,*

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1.

4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1 need not be repeated; in such a case the regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vertical data plate affixed by the manufacturer.

4.8. Annex 3 to this Regulation gives examples of arrangements of approval marks.

* 1 for the Federal Republic of Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for Czechoslovakia, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 for the German Democratic Republic, 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania and 20 for Poland. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

5. SPECIFICATIONS AND TESTS

5.1. *General*

The components liable to affect the emission of gaseous pollutants shall be so designed, constructed and assembled as to enable the vehicle in normal use, despite the vibration to which it may be subjected, to comply with the provisions of this Regulation.

5.2. *Description of tests*

5.2.1. The vehicle shall be subjected, according to its category, to tests of two types, I and II, as specified below.

5.2.1.1. *Type-I test (verifying the average emission of gaseous pollutants in a congested urban area)*

5.2.1.1.1. The test shall be carried out by the method described in annex 4 to this Regulation. The gases shall be collected and analysed by the prescribed methods.

5.2.1.1.2. Subject to the provisions of paragraph 5.2.1.1.3 below, the test shall be repeated three times. In each test, the mass of the carbon monoxide, the mass of the hydrocarbons and the mass of the nitrogen oxides obtained shall be less, for a vehicle of given reference weight, than the amounts shown in the tables I and II to this Regulation. The measurement of the mass per km of nitrogen oxides is made for information only.

5.2.1.1.2.1. Nevertheless, for each of the pollutants referred to in the foregoing paragraph, one of the three results obtained may exceed by not more than 10 per cent the limit prescribed in that paragraph for the vehicle concerned, provided the arithmetical mean of the three results is below the prescribed limit. In cases where the prescribed limits are exceeded for more than one pollutant, it shall be immaterial whether this occurs in the same test or in different tests.

5.2.1.1.3. The number of tests prescribed in paragraph 5.2.1.1.2 above shall be reduced in the conditions hereinafter defined, where V_1 is the result of the first test and V_2 the result of the second test for each of the pollutants referred to in paragraph 5.2.1.1.2 of this Regulation.

5.2.1.1.3.1. Only one test shall be made if, for all pollutants concerned, $V_1 \leqslant 0.70$ L.

5.2.1.1.3.2. Only two tests shall be made if, for all pollutants concerned, $V_1 \leqslant 0.85$ L but for at least one of the pollutants $V_1 > 0.70$ L. In addition, for each of the pollutants concerned, V_2 must satisfy the requirements that $V_1 + V_2 < 1.70$ L and $V_2 <$ L.

5.2.1.2. *Type-II test (verifying the emission of carbon monoxide at idling speed)*

5.2.1.2.1. The carbon monoxide content of the exhaust gases emitted with the engine idling shall not exceed 4.5 per cent by volume.

5.2.1.2.2. Conformity with this requirement shall be checked by a test carried out by the method described in annex 5 to this Regulation.

6. MODIFICATIONS OF THE VEHICLE TYPE

6.1. Every modification of the vehicle type shall be notified to the administrative department which approved the vehicle type. The department may then either:

6.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements; or

6.1.2. Require a further test report from the technical service responsible for conducting the tests.

6.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 4.3 above to the Parties to the Agreement applying this Regulation.

7. EXTENSION OF APPROVAL

7.1. *Vehicle types of different reference weights*

Approval of a vehicle type may be extended to vehicle types which differ from the type approved only in respect of their reference weight, provided that the reference weight of the vehicle type for which extension of the approval is requested requires merely the use of the next higher or next lower equivalent inertia.

7.2. *Vehicle types with different over-all gear ratios*

7.2.1. Approval granted to a vehicle type may under the following conditions be extended to vehicle types differing from the type approved only in respect of their over-all transmission ratios:

7.2.1.1. For each of the transmission ratios used in the type-I test, it shall be necessary to determine the proportion $E = \frac{V_2 - V_1}{V_1}$, where V_1 and V_2 are respectively the speed at 1,000 r.p.m. of the engine of the vehicle type approved and the speed of the vehicle type for which extension of the approval is requested.

7.2.2. If for each gear ratio $E \leq 8$ per cent, the extension shall be granted without repeating the type-I tests.

7.2.3. If for at least one gear ratio $E > 8$ per cent and if for each gear ratio $E \leq 13$ per cent, the type-I tests shall be repeated, but may be performed in a laboratory chosen by the manufacturer subject to the approval of the Administration granting approval. The report of the tests shall be sent to the recognized laboratory.

7.3. *Vehicle types of different reference weights and different over-all transmission ratios*

Approval granted to a vehicle type may be extended to vehicle types differing from the approved type only in respect of their reference weight and their over-all transmission ratios, provided that all the conditions prescribed in paragraphs 7.1 and 7.2 above are fulfilled.

7.4. *Three-wheeled vehicles*

Approval granted to a two-wheeled vehicle type may be extended to three-wheeled vehicles using the same engine and exhaust system and using a transmission that is either the same or differs only in respect of the over-all transmission ratios.

7.5. *Restriction*

When a vehicle type has been approved in accordance with the provisions of paragraphs 7.1 to 7.4 above, such approval may not be extended to other vehicle types.

8. CONFORMITY OF PRODUCTION

8.1. Every vehicle bearing an approval mark as prescribed under this Regulation shall conform, with regard to components affecting the emission of gaseous pollutants by the engine, to the vehicle type approved.

8.2. In order to verify conformity as prescribed in paragraph 8.1 above, a vehicle bearing the approval mark required by this Regulation shall be taken from the series.

8.3. As a general rule, conformity of the vehicle with the approved type shall be verified on the basis of the description given in the approval form and its annexes, and if necessary a vehicle shall be subjected to all or some of the tests of types I and II referred to in paragraph 5.2 above.

8.3.1. In a type-I test carried out on a vehicle taken from the series the mass of carbon monoxide and hydrocarbons obtained shall not exceed the limits prescribed for this category of vehicles in tables I and II. The measurement of the mass per km of nitrogen oxides is made for information only.

8.3.1.1. If the mass of carbon monoxide or hydrocarbons produced by the vehicle taken from the series exceeds the aforementioned limits, the manufacturer may ask for measurements to be performed on a sample of vehicles taken from the series and including the vehicle originally taken. The manufacturer shall determine the size n of the sample. The arithmetical mean $\bar{x}$ of the results obtained with the sample and the standard deviation S* of the sample shall then be determined for each gaseous pollutant. The production of the series shall then be deemed to conform if the following condition is met:

$$\bar{x} + k.S \leqslant L$$

where:

L = the limit value prescribed in paragraph 8.3.1 for each gaseous pollutant considered; and

k = a statistical factor dependent on n and given by the following table:

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	11	12	13	14	15	16	17	18	19
k	0.265	0.253	0.242	0.233	0.224	0.216	0.210	0.203	0.198

If $n > 20$, $k = \frac{0.860}{\sqrt{n}}$.

9. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

9.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8.1 are not complied with or if the vehicle or vehicles taken fail to pass the tests prescribed in paragraph 8.3 above.

9.2. If a Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation APPROVAL WITHDRAWN.

* $S^2 = \Sigma \frac{(x - \bar{x})^2}{n - 1}$, where x is any one of the individual results obtained with the sample n.

10. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of motor cycle under this Regulation, he shall inform thereof the authority which granted the approval. Upon receiving the relevant communication that authority shall inform the other Parties to the Agreement which apply this Regulation thereof by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation PRODUCTION DISCONTINUED.

11. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or refusal or withdrawal of approval, issued in other countries, are to be sent.

TABLE I. LIMITS IN TERMS OF REFERENCE WEIGHT "R" FOR MOTOR CYCLES WITH TWO-STROKE ENGINES

	Type approval	*Conformity of production*
Carbon monoxide		
$R < 100$ kg	$CO = 16$ g/km	$CO = 20$ g/km
$100 \text{ kg} \leq R \leq 300$ kg	$CO = 16 + 24 \cdot \frac{R - 100}{200}$ g/km	$CO = 20 + 30 \cdot \frac{R - 100}{200}$ g/km
$R > 300$ kg	$CO = 40$ g/km	$CO = 50$ g/km
Unburnt hydrocarbons		
$R > 100$ kg	$HC = 10$ g/km	$HC = 13$ g/km
$100 \text{ kg} \leq R \leq 300$ kg	$HC = 10 + 5 \cdot \frac{R - 100}{200}$ g/km	$HC = 13 + 8 \cdot \frac{R - 100}{200}$ g/km
$R > 300$ kg	$HC = 15$ g/km	$HC = 21$ g/km

TABLE II. LIMITS IN TERMS OF REFERENCE WEIGHT "R" FOR MOTOR CYCLES WITH FOUR-STROKE ENGINES

	Type approval	*Conformity of production*
Carbon monoxide		
$R < 100$ kg	$CO = 25$ g/km	$CO = 30$ g/km
$100 \text{ kg} \leq R \leq 300$ kg	$CO = 25 + 25 \cdot \frac{R - 100}{200}$ g/km	$CO = 30 + 30 \cdot \frac{R - 100}{200}$ g/km
$R > 300$ kg	$CO = 50$ g/km	$CO = 60$ g/km
Unburnt hydrocarbons		
$R < 100$ kg	$HC = 7$ g/km	$HC = 10$ g/km
$100 \text{ kg} \leq R \leq 300$ kg	$HC = 7 + 3 \cdot \frac{R - 100}{200}$ g/km	$HC = 10 + 4 \cdot \frac{R - 100}{200}$ g/km
$R > 300$ kg	$HC = 10$ g/km	$HC = 14$ g/km

ANNEX 1. ESSENTIAL CHARACTERISTICS OF THE ENGINE AND INFORMATION CONCERNING THE CONDUCT OF TESTS*

1. DESCRIPTION OF ENGINE

1.1. Make .....

1.2. Type .....

1.3. Cycle: four-stroke/two-stroke** .....

1.4. Number and arrangement of cylinders .....

1.5. Bore ..... mm

1.6. Stroke ..... mm

1.7. Cylinder capacity ..... cm^3

1.8. Compression ratio***, **** .....

1.9. Drawings of the combustion chamber and of the piston, including the piston rings .....

1.10. System of cooling .....

1.11. Supercharger with/without ** description of the system .....

1.12. Device for recycling crank-case gases (description and diagrams) .....

1.13. Air filter: drawings, or makes and types .....

1.14. System of lubrication (two-stroke engines, separate or by mixture) .....

2. ADDITIONAL ANTI-POLLUTION DEVICES (IF ANY, AND IF NOT COVERED BY ANOTHER HEADING)

Description and diagrams .....

3. AIR INTAKE AND FUEL FEED

3.1. Description and diagrams of air intakes and their accessories (dashpot, heating device, additional air intakes, etc.) .....

3.2. Fuel feed

3.2.1. By carburettor(s)* ..... Number .....

3.2.1.1. Make .....

3.2.1.2. Type .....

3.2.1.3. Settings**

3.2.1.3.1. Jets .....

3.2.1.3.2. Venturis .....

3.2.1.3.3. Float-chamber level .... or Curve of fuel delivery plotted against air flow*,**

3.2.1.3.4. Weight of float .....

3.2.1.3.5. Float needle .....

3.2.1.4. Manual/automatic choke* ..... Closure setting** .....

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* In the case of unconventional engines and systems, particulars equivalent to those mentioned here shall be supplied.

** Strike out what does not apply.

*** Compression ratio = $\frac{\text{volume combustion chamber + cylinder capacity}}{\text{volume combustion chamber}}$

****Specify the tolerance.

3.2.1.5. Feed pump

Pressure** ..... Or characteristic diagram** .....

3.2.2. By injector* .....

3.2.2.1. Pump

3.2.2.1.1. Make .....

3.2.2.1.2. Type .....

3.2.2.1.3. Delivery ..... mm^3 per stroke at pump speed of ..... r.p.m.,*,** or characteristic diagram*,** .....

3.2.2.2. Injector(s)

3.2.2.2.1. Make .....

3.2.2.2.2. Type .....

3.2.2.2.3. Calibration ..... bars*,** or characteristic diagram*,** .....

4. VALVE TIMING

4.1. Timing for mechanically operated valves .....

4.1.1. Maximum lift of valves and angles of opening and closing in relation to dead centres .....

4.1.2. Reference and/or setting clearance* .....

4.2. Distribution by ports .....

4.2.1. Volume of crank-case cavity with piston at tdc .....

4.2.2. Description of reed valves if any (with dimensioned drawing) .....

4.2.3. Description (with dimensioned drawing) of inlet ports, scavenging and exhaust, with corresponding timing diagram .....

5. IGNITION

5.1. Distributor(s)

5.1.1. Make .....

5.1.2. Type .....

5.1.3. Ignition advance curve** .....

5.1.4. Ignition timing** .....

5.1.5. Contact-point gap** .....

6. EXHAUST SYSTEM

Description and diagrams .....

7. ADDITIONAL INFORMATION ON TEST CONDITIONS

7.1. Lubricant used

7.1.1. Make .....

7.1.2. Type .....

(State percentage of oil in mixture if lubricant and fuel mixed)

* Strike out what does not apply.
** Specify the tolerance.

7.2. Sparking plugs
7.2.1. Make .....
7.2.2. Type .....
7.2.3. Spark-gap setting .....
7.3. Ignition coil .....
7.3.1. Make .....
7.3.2. Type .....
7.4. Ignition condenser .....
7.4.1. Make .....
7.4.2. Type .....
7.5. Idling system. Description of setting and relevant requirements in accordance with paragraph 5.2.1.2.1 .....
7.6. Carbon monoxide content by volume in the exhaust gas, with the engine idling ..... per cent (manufacturer's standard).

8. ENGINE PERFORMANCE
8.1. Idling speed ..... r.p.m.*
8.2. Engine speed at maximum power ..... r.p.m.*
8.3. Maximum power ..... kW ECE

ANNEX 2

(Maximum format: A 4 (210 × 297 mm))

NAME
OF ADMINISTRATION

Communication concerning the approval (or refusal or withdrawal of approval) of a vehicle type (motor cycle) with regard to the emission of gaseous pollutants by the engine, pursuant to Regulation No. 40

Approval No.

1. Trade name or mark .....
2. Type of motor cycle .....
3. Manufacturer's name and address .....
4. If applicable, name and address of manufacturer's representative .....
5. Unladen weight of vehicle .....
5.1. Reference weight of vehicle .....
6. Maximum weight of vehicle .....

* Specify the tolerance.

7. Gear-box .....
7.1. Manual or automatic* .....
7.2. Number of gear ratios .....
7.3. Gear ratio:** First gear .....
Second gear .....
Third gear .....
Final drive ratio .....
Tyres: Dimensions .....
Dynamic rolling circumference .....
7.4. Check of performances referred to in annex 4, paragraph 3.1.5, to this Regulation
8. Reference fuel No. .....
9. Vehicle submitted for approval on .....
10. Technical service responsible for conducting approval tests .....
11. Date of report issued by that service .....
12. Number of report issued by that service .....
13. Approval granted/refused*
14. Position of approval mark on the vehicle .....
15. Place .....
16. Date .....
17. Signature .....
18. The following documents, bearing the approval number shown above, are annexed to this communication:

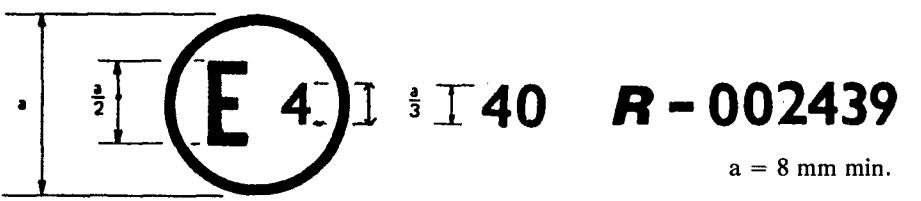
—1 copy of annex 1, duly completed and accompanied by the drawings and diagrams referred to;

—1 photograph of the engine and its compartment;

—1 copy of the test report.

ANNEX 3. ARRANGEMENTS OF APPROVAL MARKS

MODEL A
(see paragraph 4.4 of this Regulation)

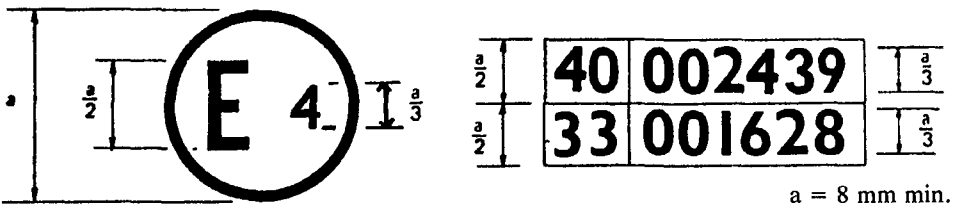


The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to the emission of gaseous pollutants of the engine, been approved in

* Strike out what does not apply.
** In the case of power-driven vehicles equipped with automatic-shift gear boxes, give all pertinent technical data.

the Netherlands (E 4) pursuant to Regulation No. 40. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No. 40 in its original form.

MODEL B
(see paragraph 4.5. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 40 and 33.* The approval numbers indicate that, at the dates when the respective approvals were given, Regulations Nos. 40 and 33 were still in their original form.

ANNEX 4. TYPE-I TEST (VERIFYING THE AVERAGE EMISSION OF GASEOUS POLLUTANTS IN A CONGESTED URBAN AREA)

1. INTRODUCTION

This annex describes the procedure for the type-I test defined in paragraph 5.2.1.1 of this Regulation.

1.1. The vehicle shall be placed on a dynamometer bench equipped with a brake and fly-wheel. A test lasting a total of 13 minutes and comprising four cycles shall be carried out without interruption. Each cycle shall comprise 15 phases (idling, acceleration, steady speed, deceleration, etc.). During the test, the exhaust gases shall be diluted with air to obtain a constant volumetric flow of mixture. Throughout the test, from the mixture thus obtained, samples at a constant rate of flow shall be collected in a bag for successive determination of the concentration (average for the test) of carbon monoxide, unburnt hydrocarbons, nitrogen oxides and carbon dioxide.

2. OPERATING CYCLE ON THE DYNAMOMETER BENCH

2.1. *Description of the cycle*

The operating cycle to be used on the dynamometer bench shall be that indicated in the following table and depicted in the graph shown in appendix I to this annex.

2.2. *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 control and, where necessary, the brake control so as to achieve a cycle approximating within the prescribed limits to the theoretical cycle.

* The latter number is given as an example only.

OPERATING CYCLE ON THE DYNAMOMETER BENCH

No. of operation	*Nature of operation*	*Phase*	*Acceleration (m/sec²)*	*Speed (km/h)*	*Duration of each*		*Cumulative time (sec)*	*Gear to be used in the case of a manual-shift gear-box*
					Operation (sec)	*Phase (sec)*		
1	Idling	1			11	11	11	6 sec. PM 5 sec. K*
2	Acceleration	2	1.04	0-15	4	4	15	According to manufacturer's instructions
3	Steady speed	3		15	8	8	23	
4	Deceleration	4	−0.69	15-10	2	5	25	
5	Deceleration, clutch disengaged		−0.92	10-0	3		28	K
6	Idling	5			21	21	49	16 sec. PM 5 sec. K
7	Acceleration	6	0.74	0-32	12	12	61	According to manufacturer's instructions
8	Steady speed	7		32	24	24	85	
9	Deceleration	8	−0.75	32-10	8	11	93	
10	Deceleration, clutch disengaged		−0.92	10-0	3		96	K
11	Idling	9			21	21	117	16 sec. PM 5 sec. K
12	Acceleration	10	0.53	0-50	26	26	143	According to manufacturer's instructions
13	Steady speed	11		50	12	12	155	
14	Deceleration	12	−0.52	50-35	8	8	163	
15	Steady speed	13		35	13	13	176	
16	Deceleration	14	−0.68	35-10	9	12	185	
17	Deceleration, clutch disengaged		−0.92	10-0	3		188	K
18	Idling	15			7	7	195	7 sec. PM

* PM = Gears in neutral, clutch engaged; K = Clutch disengaged.

2.3. *Use of the gear-box*

2.3.1. The gear-box shall be used in accordance with the manufacturer's instructions. In the absence of these instructions, the use of the gear-box shall be determined as follows:

2.3.1.1. At constant speed, the rotating speed of the engine shall be, if possible, within 50 and 90 per cent of the speed corresponding to the maximum power of the engine. When this speed can be reached in two or more gears, the motor cycle shall be tested with the highest gear engaged. During acceleration, the motor cycle 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 per cent 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 per cent of the speed corresponding to the maximum power of the engine. No change down to first gear shall be effected during deceleration.

2.3.2. Motor cycles equipped with automatic-shift gear-boxes shall be tested with the highest gear ("Drive") engaged. The accelerator shall be used in such a way as to obtain the steadiest possible acceleration at which the various gears can be engaged in the normal order. The tolerances prescribed in paragraph 2.4 shall apply.

2.4. *Tolerances*

2.4.1. A tolerance of 1 km/h above or below the theoretical speed shall be allowed during all phases of the cycle. Speed tolerances greater than those prescribed shall be accepted during phase changes provided that the tolerances are never exceeded for more than 0.5 second on any occasion with the exception of the provisions of paragraphs 6.5.2 and 6.6.3 of this annex.

2.4.2. The time tolerance shall be ± 0.5 sec.

2.4.3. The speed and time tolerances shall be combined as indicated in appendix 1 to this annex.

2.4.4. The distance driven during the cycle shall be measured to ± 2 per cent.

3. VEHICLE AND FUEL

3.1. *Test vehicle*

3.1.1. The vehicle shall be presented in good mechanical condition. It shall have been run in and have been driven at least 1,000 km before the test. The laboratory may decide if a vehicle which has been driven less than 1,000 km before the test should be accepted.

3.1.2. The exhaust device shall not exhibit any leak likely to reduce the quantity of gas collected, which shall be the quantity emerging from the engine.

3.1.3. The leakproofness of the intake system may be checked to ensure that carburation is not affected by an accidental intake of air.

3.1.4. The settings of the vehicle shall be those prescribed by the manufacturer.

3.1.5. The laboratory may verify that the vehicle conforms to the performances stated by the manufacturer, that it can be used for normal driving, and in particular that it is capable of starting when cold and when hot.

3.2. *Motor fuel*

The fuel shall be the reference fuel whose specifications are given in annex 6 to this Regulation. If the engine is lubricated by mixture, the oil added to

the reference fuel shall comply as to grade and quantity with the manufacturer's recommendations.

4. TEST EQUIPMENT

4.1. *Dynamometer bench*

The main characteristics of the bench are as follows:

One roller—tyre contact for each driving wheel:

—Roller diameter: [≥ 400 mm];[1]

—Equation of the power absorption curve: the test bench shall allow reproduction within ± 15 per cent from the initial speed of 12 km/h, of the road power developed by the engine, the motor cycle being driven on a horizontal road with a wind speed as near to zero as possible; if not, the power absorbed by the brake and the internal friction of the test bench shall be calculated according to annex 7, paragraph 11; if not, the power absorbed by the brake and the internal frictions of the test bench shall be equal to $K\ V^3$ + 5% of $K\ V^3$ + 5% of [P_{V50}];[1]

—Additional inertias: from 10 kg by 10 kg.*

4.1.1. The distance actually covered shall be measured with a revolution counter which is driven by the roller which drives the brake and the flywheels.

4.2. *Gas-sampling and volume-measuring equipment*

4.2.1. A simplified diagram of the collecting, diluting, sampling and volume-measuring equipment for use with the exhaust gases emitted during the test will be found in appendices 2 and 3 to this annex.

4.2.2. The testing equipment is described in the paragraphs which follow; each component is identified by the reference symbol used in the sketch in appendices 2 and 3. Different equipment may be used if, in the opinion of the Administration's technical officers, it gives equivalent results.

4.2.2.1. A device for collecting all exhaust gases emitted during the test; it is generally an open type device, maintaining the atmospheric pressure at the motor cycle exhaust outlet(s). Nevertheless, if the back pressure conditions are complied with (< ± 125 mm of 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.

4.2.2.2. A pipe (Tu) linking the device and the gas-sampling equipment. The pipe 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 withstands their temperatures.

4.2.2.3. A heat exchanger (Sc) capable of limiting the temperature variation of the diluted gases in the pump intake to ± 5°C throughout the test. This exchanger (Sc) 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.

4.2.2.4. A displacement pump Pl designed to draw in the diluted gases and actuated by a motor having several strictly constant speeds. The delivery shall be sufficient to ensure intake of the entire quantity of exhaust gas. A device using a critical-flow venturi tube may likewise be used.

* This item concerns additional masses that could possibly be replaced by an electronic device, provided that it is demonstrated that the results are equivalent.

[1] The modifications of the text appearing between brackets were effected by a Procès-verbal of Rectification dated 9 May 1980.

4.2.2.5. A device continuously recording the temperature of the diluted gases entering the pump.

4.2.2.6. A probe, S3, mounted alongside the gas-collecting device, for sampling the diluent air at a constant rate throughout the test through a pump, a filter and a flow-meter.

4.2.2.7. A probe S2, directed upstream into the stream of diluted gases upstream of the displacement pump, for sampling the mixture of diluted gases at a constant rate throughout the test through a pump, a filter and a flow-meter. The minimum rate of flow of the stream of gas in the above two sampling systems shall be at least 150 l/h.

4.2.2.8. Two filters, F2 and F3, placed after probes S2 and S3 respectively for the purpose of trapping any solid particles suspended in the samples *en route* to the collecting bags. Special care shall be taken that they do not cause any change of the concentrations of the gaseous components of the samples.

4.2.2.9. Two pumps, P2 and P3, whose purpose is to take samples through probes S2 and S3 respectively for collection in bags SA and SB.

4.2.2.10. Two manually adjustable valves, V2 and V3, mounted downstream of pumps P2 and P3 respectively to control the flow of the samples sent to the bags.

4.2.2.11. Two rotameters, R2 and R3, placed in series on the probe, filter, pump, valve, bag lines—S2, F2, P2, V2, SA and S3, F3, P3, V3, Sb, respectively—to provide an immediate visual check on the rate at which samples are being taken.

4.2.2.12. Sampling bags for the diluent air and the mixture of diluted gases, leakproof and of sufficient capacity not to hinder the normal flow of the samples. They shall have an automatic closure on the side of the bag and be able to be rapidly secured, and in such a way as to avoid leakage, either on the sampling circuit or on the measuring circuit at the end of the test.

4.2.2.13. Two differential pressure gauges, g1 and g2, placed as follows:

—g1: before the pump P1, to determine the pressure shortfall below atmospheric pressure of the exhaust gas/diluent air mixture;

—g2: before and after the pump P1, to evaluate the pressure increase induced in the gas stream.

4.2.2.14. A cumulative counter CT to count the revolutions of the rotary displacement pump P1.

4.2.2.15. Three-way cocks on the above sampling circuits to direct the sample streams either to the outside or to their respective collecting bags throughout the test. The valves shall be quick-acting. They shall be made of materials which do not affect the composition of the gases; furthermore, their flow sections and shapes shall be such as to minimize load losses so far as is technically possible.

4.3. *Analytical equipment*

4.3.1. *Determining HC concentration*

4.3.1.1. The concentration of unburnt hydrocarbons (HC) in the samples collected in bags SA and SB during the tests shall be determined by means of a flame ionization analyser.

4.3.2. *Determining CO and CO_2 concentrations*

4.3.2.1. The concentrations of carbon monoxide (CO) and carbon dioxide (CO_2) in the samples collected in bags SA and SB during the tests shall be determined by means of an analyser of the non-dispersive type with absorption in the infrared.

4.3.3. *Determining NO_x concentrations*

4.3.3.1. The concentrations of nitrogen oxides (NO_x) in the samples collected in bags SA and SB during the tests shall be determined by means of a chemiluminescence analyser.

4.4. *Accuracy of instruments*

4.4.1. Since the brake is calibrated in a separate test, the accuracy of the dynamometer is not indicated. The total inertia of the rotating masses, including that of the rollers and the rotating part of the brake (see paragraph 5.2), shall be given to within ± 2 per cent.

4.4.2. The speed of the vehicle shall be measured by the speed of rotation of the rollers connected to the brake and fly-wheels. It shall be measurable to within ± 2 km/h in the speed range 0-10 km/h and to within ± 1 km/h at speeds above 10 km/h.

4.4.3. The temperature considered in paragraph 4.2.2.5 shall be measurable to within ± 1°C. The temperature considered in paragraph 6.1.1 shall be measurable to within ± 2°C.

4.4.4. The atmospheric pressure shall be measurable to within ± 1 mm (mercury gauge).

4.4.5. The degree to which the pressure of the diluted gases falls short of atmospheric pressure at the intake of pump P1 (see paragraph 4.2.2.12) shall be measured to within ± 3 mm (mercury gauge). The difference in pressure of the diluted gases between the sections before and after pump P1 (see paragraph 4.2.2.13) shall be measured to within ± 3 mm (mercury gauge).

4.4.6. The volume displaced by each complete rotation of the pump P1 and the displacement value at the minimum feasible pumping speed, as recorded by the cumulative revolution counter CT, shall be such that the overall volume of the exhaust gas/diluent air mixture displaced by the pump P1 during the test can be determined to within ± 2 per cent.

4.4.7. The analysers shall have a measuring range compatible with the accuracy required to measure the content of the various constituents to within ± 3 per cent, disregarding the accuracy of the standard (calibration) gases. The flame ionization analyser used to determine the HC concentration shall be capable of reaching 90 per cent of full scale in less than one second.

4.4.8. The content of the standard calibration gases shall not differ by more than ± 2 per cent from the reference value of each gas. The diluent shall be nitrogen.

5. PREPARING THE TEST

5.1. *Setting the brake*

5.1.1. The brake shall be so adjusted as to reproduce the operation of the vehicle on the level at a steady speed between 45 and 55 km/h.

5.1.2. The brake shall be adjusted in the following manner:

5.1.2.1. An adjustable stop limiting the maximum speed to between 45 km/h and 55 km/h shall be mounted in the fuel-feed regulating device. The speed of the vehicle shall be measured by means of a precision speedometer or computed from the time measured over a given distance on a level, dry road, in both directions, with the stop applied. The measurements, which shall be repeated at least three times in both directions, shall be taken over a distance of at least 200 m and with a sufficiently long acceleration distance. The average speed shall be determined.

5.1.2.2. Other systems for measuring the power needed to propel the vehicle (e.g., measuring the torque on the transmission, measuring of deceleration) shall also be accepted.

5.1.2.3. The vehicle shall then be placed on the dynamometer bench and the brake so adjusted as to obtain the same speed as that reached in the road test (fuel-feed regulating device in stop position and same gear-box ratio). This brake setting shall be maintained throughout the test. After adjusting the brake, the stop in the feed device shall be removed.

5.1.2.4. Adjustment of the brake on the basis of road tests may be performed only if the barometric pressure does not differ by more than ± 10 torr, nor the air temperature by more than ± 8°C, between the road and the space housing the dynamometer bench.

5.1.3. Where the preceding method would not be applicable, the bench shall be adjusted in conformity with values indicated in the table of paragraph 5.2. Values in the table give the power in terms of the reference weight at a speed of 50 km/h. The power shall be determined by the method given in annex 7.

5.2. *Adjustment of equivalent inertias to the vehicle's translatory inertias*

The fly-wheel shall be adjusted to obtain a total inertia of the rotating masses proportional to the reference weight within the following limits:

Reference weight (kg)	*Equivalent inertia (kg)*	*Power absorbed (kW)*
R < 105	100	0.88
105 < R < 115	110	0.90
115 < R < 125	120	0.91
125 < R < 135	130	0.93
135 < R < 150	140	0.94
150 < R < 165	150	0.96
165 < R < 185	170	0.99
185 < R < 205	190	1.02
205 < R < 225	210	1.05
225 < R < 245	230	1.09
245 < R < 270	260	1.14
270 < R < 300	280	1.17
300 < R < 330	310	1.21
330 < R < 360	340	1.26
360 < R < 395	380	1.33
395 < R < 435	410	1.37
435 < R < 475	450	1.44

5.3. *Conditioning of vehicle*

5.3.1. Before the test, the vehicle shall be stored at a temperature between 20° and 30°C. After the engine has been kept idling for 40 seconds, two complete cycles are effected without collecting exhaust gas.

5.3.2. The tyre pressure shall be the same as that indicated by the manufacturer for the preliminary road test for brake adjustment. However, if the diameter of the rollers is less than 50 mm, the pressure in the tyres shall be increased by 30-50 per cent to prevent damage to them.

5.3.3. The weight on the driven wheel should be the same as the vehicle in normal driving conditions, with a driver weighing 75 kg.

5.4. *Adjustment of analytical apparatus*

5.4.1. *Calibration of analysers*

The quantity of gas at the indicated pressure compatible with the correct functioning of the equipment shall be injected into the analyser with the aid of the flow meter and the pressure reducing valve mounted on each gas cylinder. The apparatus shall be adjusted to indicate as a stabilized value the value inserted on the standard gas cylinder. Starting from the setting obtained with the gas cylinder of greatest capacity, a curve shall be drawn of the deviations of the apparatus according to the content of the various standard gas cylinders used. The flame ionization analyser shall be recalibrated periodically, at intervals of not more than one month, using air/propane or air/hexane mixtures with nominal hydrocarbon concentrations equal to 50 per cent and 90 per cent of full scale. Non-dispersive infrared absorption analysers shall be checked at the same intervals using nitrogen/CO and nitrogen/CO_2 mixtures in nominal concentrations equal to 10, 40, 60, 85 and 90 per cent of full scale. To calibrate the NO_x chemiluminescence analyser, nitrogen/nitrogen oxide (NO) mixtures with nominal concentrations equal to 50 per cent and 90 per cent of full scale shall be used. The calibration of all three types of analysers shall be checked before each series of tests, using mixtures of the gases which are to be measured, in a concentration equal to 80 per cent of full scale. A dilution device can be applied for diluting a 100 per cent calibration gas to required concentration.

6. PROCEDURE FOR BENCH TESTS

6.1. *Special conditions for carrying out the cycle*

6.1.1. The temperature in the room housing the roller-bed shall be between 20° and 30°C throughout the test and shall approximate as closely as possible to that of the room in which the vehicle has been conditioned for the test.

6.1.2. The vehicle shall be approximately level during the test so as to avoid any abnormal distribution of the fuel.

6.1.3. At the end of the first 40-second idling period (see paragraph 6.2.2), a current of air of variable speed shall be blown over the vehicle. There will follow two complete cycles during which time no exhaust gas shall be collected. The blower shall incorporate a mechanism controlled by the speed of the bench roller so that, within the range 10-50 km/h, the initial linear wind speed is within 10 per cent of the relative speed of the roller. For roller speeds below 10 km/h, the wind speed may be nil. The final section of the blower shall have the following characteristics:

—Area: at least 0.4 m^2;

—Height of lower edge above the ground: between 0.15 and 0.20 m;

—Distance from the front of the vehicle: between 0.3 and 0.45 m.

6.1.4. During the test, the speed shall be plotted against time so that the correctness of the cycles performed can be assessed.

6.1.5. The temperatures of the cooling water and the crank-case oil may also be recorded.

6.2. *Starting up the engine*

6.2.1. After the preliminary operations on the equipment for collecting, diluting, analysing and measuring the gases (see paragraph 7.1 below) have been carried out, the engine shall be started up by means of the devices provided for the purpose—the choke, the starter valve, etc.—in accordance with the manufacturer's instructions.

6.2.2. The engine shall be kept idling for a maximum period of 40 seconds. The first test cycle shall start at the same time as the beginning of the collection of samples and the measurements of the revolutions of the pump.

6.3. *Use of the manual choke*

The choke shall be cut out as soon as possible, and in principle before acceleration from zero to 50 km/h. If this principle cannot be applied the moment of effective cut-out shall be stated. The method used to adjust the choke shall be that indicated in the manufacturer's specifications.

6.4. *Idling*

6.4.1. *Manual-shift gear-box*

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

6.4.1.2. To enable the accelerations to be performed according to the normal cycle, the vehicle shall be placed in first gear, with the clutch disengaged, 5 seconds before the acceleration following the idling period considered.

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

6.4.1.4. For the idling periods in the middle of each cycle, the corresponding times shall be 16 seconds in neutral and 5 seconds in first gear with the clutch disengaged.

6.4.1.5. The last idling period in a cycle shall consist of 7 seconds in neutral with the clutch engaged.

6.4.2. *Semi-automatic-shift gear-boxes*

The manufacturer's instructions for driving in town or, in their absence, the rules applicable to manual-shift gear-boxes shall be followed.

6.4.3. *Automatic-shift gear-boxes*

The selector shall not be operated at any time during the test unless the manufacturer specifies otherwise. In the latter case the procedure prescribed for manual-shift gear-boxes shall be applied.

6.5. *Accelerations*

6.5.1. Accelerations shall be so performed that the rate of acceleration is as constant as possible throughout the phase.

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

6.6. *Decelerations*

6.6.1. All decelerations shall be effected by fully closing the accelerator, the clutch remaining engaged. The clutch shall be disengaged at a speed of 10 km/h.

6.6.2. If the period of deceleration is longer than that prescribed for the corresponding phase, the vehicle's brakes shall be used to enable the timing of the cycle to be maintained.

6.6.3. If the period of deceleration is shorter than that prescribed for the corresponding phase, the timing of the theoretical cycle shall be restored by a constant speed or idling period merging into the succeeding constant speed or idling operation. In that case, paragraph 2.4.3 to this annex is not applicable.

6.6.4. At the end of the deceleration period (halt of the vehicle on the rollers), the gears shall be placed in neutral and the clutch engaged.

6.7. *Steady speeds*

6.7.1. "Pumping" or the closing of the throttle shall be avoided when passing from acceleration to the succeeding steady speed.

6.7.2. Periods of constant speed shall be achieved by keeping the accelerator position fixed.

7. PROCEDURE FOR SAMPLING, ANALYSIS AND VOLUMETRIC MEASUREMENT OF EMISSIONS

7.1. *Operations prior to starting the vehicle*

7.1.1. The sample-collecting bags SA and SB shall be emptied and closed.

7.1.2. The rotary displacement pump P1 shall be started without the revolution counter.

7.1.3. Sampling-pumps P2 and P3 shall be started with the switching valves set for discharge into the atmosphere; valves V2 and V3 shall be used to adjust the flow.

7.1.4. The temperature sensing device T and the pressure gauges g1 and g2 shall be brought into operation.

7.1.5. The pump revolution counter CT and the roller revolution counter shall be set at zero.

7.2. *Start of sampling and volumetric measurement operations*

7.2.1. After 40 seconds' preliminary unladen idling and two preparatory cycles (initial moment of the first cycle), the operations specified in paragraphs 7.2.2 to 7.2.5 below shall be carried out strictly simultaneously.

7.2.2. The switching valves shall be set for collection in bags SA and SB of the samples which are still being taken by probes S2 and S3, and which have hitherto been discharged into the atmosphere.

7.2.3. The moment of starting the test shall be marked on the graphs of the analogue recorders connected to the temperature sensing devices T and the differential pressure gauges g1 and g2.

7.2.4. The cumulative revolution counter CT shall be engaged with the pump P1.

7.2.5. The blower referred to in paragraph 6.1.3 shall be started.

7.3. *End of sampling, and volumetric measurement operations*

7.3.1. The operations specified in paragraphs 7.3.2 to 7.3.5 below shall be carried out strictly simultaneously at the end of the fourth test cycle.

7.3.2. The switching valves shall be set to close off bags SA and SB and to discharge into the atmosphere the samples taken by pumps P2 and P3 through probes S2 and S3.

7.3.3. The moment of ending the test shall be marked on the graphs of the analogue recorders (see paragraph 7.2.3).

7.3.4. The cumulative revolution counter CT shall be disengaged from the pump P1.

7.3.5. The blower referred to in paragraph 6.1.3 shall be switched off.

7.4. *Analysis of the samples contained in the bags*

The analysis shall begin as soon as possible, and in any event not later than 20 minutes after the end of the tests, in order to determine:

—The concentrations of hydrocarbons, carbon monoxide, nitrogen oxides and carbon dioxide in the sample of diluent air contained in bag SB;

—The concentrations of hydrocarbons, carbon monoxide, nitrogen oxides and carbon dioxide in the sample of diluted exhaust gases contained in bag SA.

7.5. *Measuring the distance covered*

The distance S actually covered shall be arrived at by multiplying the number of revolutions read from the cumulative counter (see paragraph 4.1.1) by the circumference of the roller. This distance shall be measured in km.

8. DETERMINATION OF THE QUANTITY OF GAS EMITTED

8.1. The mass of carbon gases shall be determined by means of the following formula:

$$CO_M = \frac{1}{S} \cdot V \cdot d_{co} \cdot \frac{CO_c}{10^6}$$

where:

8.1.1. CO_M is the mass of carbon monoxide emitted during the test in g/km;

8.1.2. S is the distance defined in paragraph 7.5 above;

8.1.3. d_{co} is the density of the carbon monoxide at a temperature of 0°C and a pressure of 760 mm (mercury gauge) = 1.250 kg/m³;

8.1.4. CO_c is the volumetric concentration, expressed in parts per million, of carbon monoxide in the diluted gases, corrected to take account of pollution in the diluent air

$$CO_c = CO_e - CO_d \left(1 - \frac{1}{DF}\right)$$

where:

8.1.4.1. CO_e is the concentration of carbon monoxide, measured in parts per million, in the sample of diluted gases contained in bag Sa;

8.1.4.2. CO_d is the concentration of carbon monoxide, measured in parts per million, in the sample of diluent air collected in bag Sb;

8.1.4.3. DF is the coefficient defined in paragraph 8.4 below;

8.1.5. V is the total volume of diluted gas, expressed in m³/test, adjusted to the reference conditions of 0°C (273° K) and 760 mm (mercury gauge):

$$V = V_o \cdot N \frac{(Pa - Pi) \cdot 273}{760 \cdot (T_p + 273)}$$

where:

8.1.5.1. V_o is the volume of gas displaced by pump P1 during one revolution, expressed in m³/revolution; this volume is a function of the differences between the intake and output sections of the pump;

8.1.5.2. N is the number of revolutions made by pump P1 during the four cycles of the test;

8.1.5.3. Pa is the ambient pressure in mm (mercury gauge);

8.1.5.4. Pi is the average under-pressure during the four test cycles in the intake section of pump P1, expressed in mm (mercury gauge);

8.1.5.5. T_p is the temperature of the diluted gases during the four test cycles, measured in the intake section of pump P1.

8.2. The mass of unburnt hydrocarbons emitted by the vehicle's exhaust during the test shall be calculated by means of the following formula:

$$HC_M = \frac{1}{S} \cdot V \cdot d_{HC} \cdot \frac{HC_c}{10^6}$$

where:

8.2.1. HC_M is the mass of hydrocarbons emitted during the test, in grammes/km;

8.2.2. S is the distance defined in paragraph 7.5 above;

8.2.3. d_{HC} is the density of the hydrocarbons at a temperature of 0°C and a pressure of 760 mm (mercury gauge), where the average carbon/hydrogen ratio is 1 : 1.85 = 0.619 kg/m³;

8.2.4. HC_c is the concentration of diluted gases, expressed in parts per million of carbon equivalent (e.g., the concentration in propane multiplied by 3), corrected to take account of the diluent air:

$$HC_c = HC_e - HC_d \frac{(1 - 1)}{DF}$$

where:

8.2.4.1. HC_e is the concentration of hydrocarbons, expressed in parts per million of carbon equivalent, in the sample of diluted gases collected in bag SA;

8.2.4.2. HC_d is the concentration of hydrocarbons expressed in parts per million of carbon equivalent, in the sample of diluent air collected in bag SB;

8.2.4.3. DF is the coefficient defined in paragraph 8.4 below;

8.2.5. V is the total volume (see paragraph 8.1.5).

8.3. The mass of nitrogen oxides emitted by the vehicle's exhaust during the test shall be calculated by means of the following formula:

$$NO_{xM} = \frac{1}{S} \cdot V \cdot d_{NO_2} \cdot \frac{NO_{xc} \cdot K_h}{10^6}$$

where:

8.3.1. NO_{xM} is the mass of nitrogen oxides emitted during the test, expressed in grammes/test;

8.3.2. S is the distance defined in paragraph 7.5 above;

8.3.3. d_{NO_2} is the density of nitrogen oxides in the exhaust gases, assuming that they will be in the form of nitric oxide at a temperature of 0°C and a pressure of 760 mm (mercury gauge) = 2.05 kg/m³;

8.3.4. NO_{xc} is the concentration of the diluted gases, expressed in parts per million, corrected to take account of the diluent air:

$$NO_{xc} = NO_{xe} - NO_{xd}\left(1 - \frac{1}{DF}\right)$$

where:

8.3.4.1. NO_{xe} is the concentration of nitrogen oxides, expressed in parts per million, in the sample of diluted gases;

8.3.4.2. NO_{xd} is the concentration of nitrogen oxides, expressed in parts per million, in the sample of diluent air collected in bag SB;

8.3.4.3. DF is the coefficient defined in paragraph 8.4 below;

8.3.5. K_h is the humidity correction factor.

$$K_h = \frac{1}{1 - 0.0329\ (H - 10.7)}$$

where:

8.3.5.1. H is the absolute humidity in grammes of water per kg of dry air.

$$H = \frac{6.2111 \cdot U \cdot P_d}{P_a - P_d \ \frac{U}{100}} \text{ [g/kg]}$$

where:

8.3.5.1.1. U is the percentage humidity;

8.3.5.1.2. P_d is the saturated pressurehoxmwater at the test temperature, in mm Hg;

8.3.5.1.3. P_a is atmospheric pressure in mm Hg.

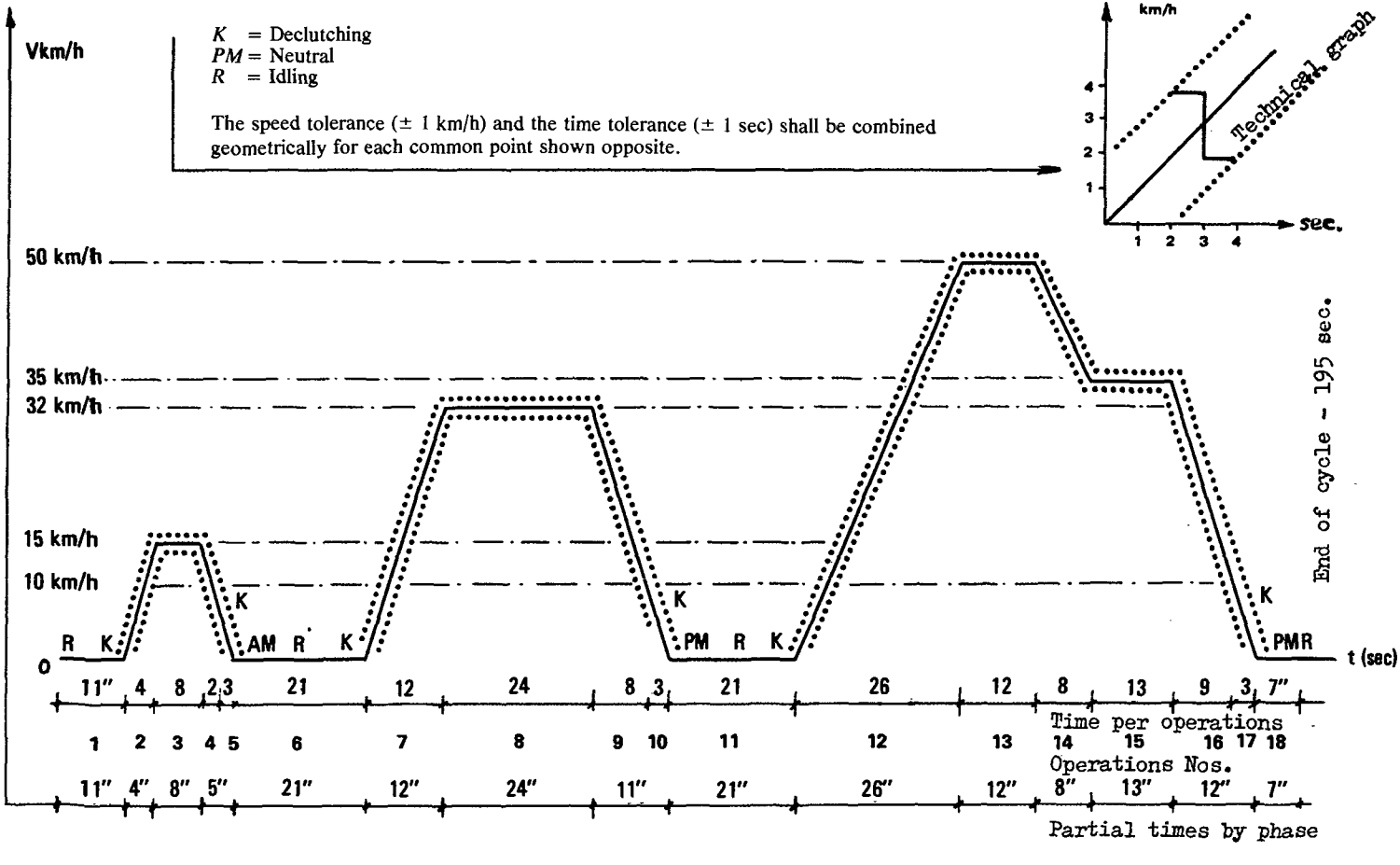
8.4. DF is a coefficient expressed by the formula:

$$DF = \frac{14.5}{CO_2 + 0.5\ CO + HC} \text{ \% vol.}$$

8.4.1. CO, CO_2 and HC are the concentrations of carbon monoxide, carbon dioxide and hydrocarbons, expressed in per cent, in the sample of diluted gases contained in bag SA.

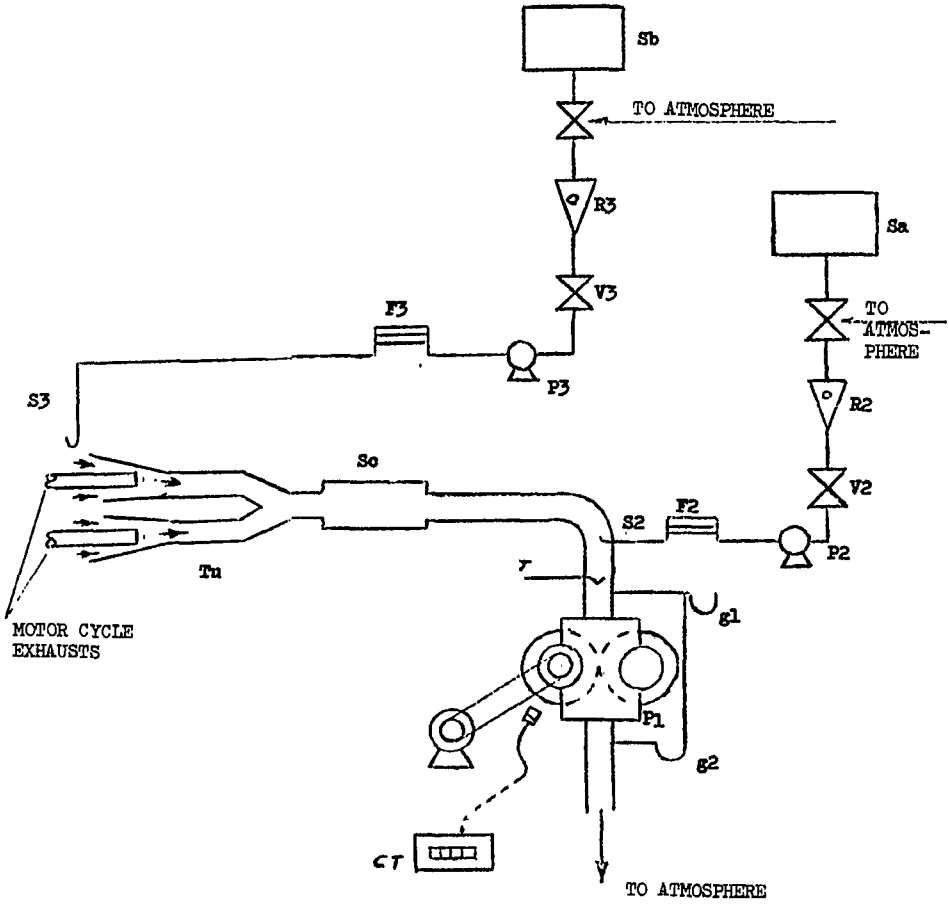
ANNEX 4

APPENDIX 1. OPERATING CYCLE FOR PETROL ENGINES FOR THE TYPE-I TEST



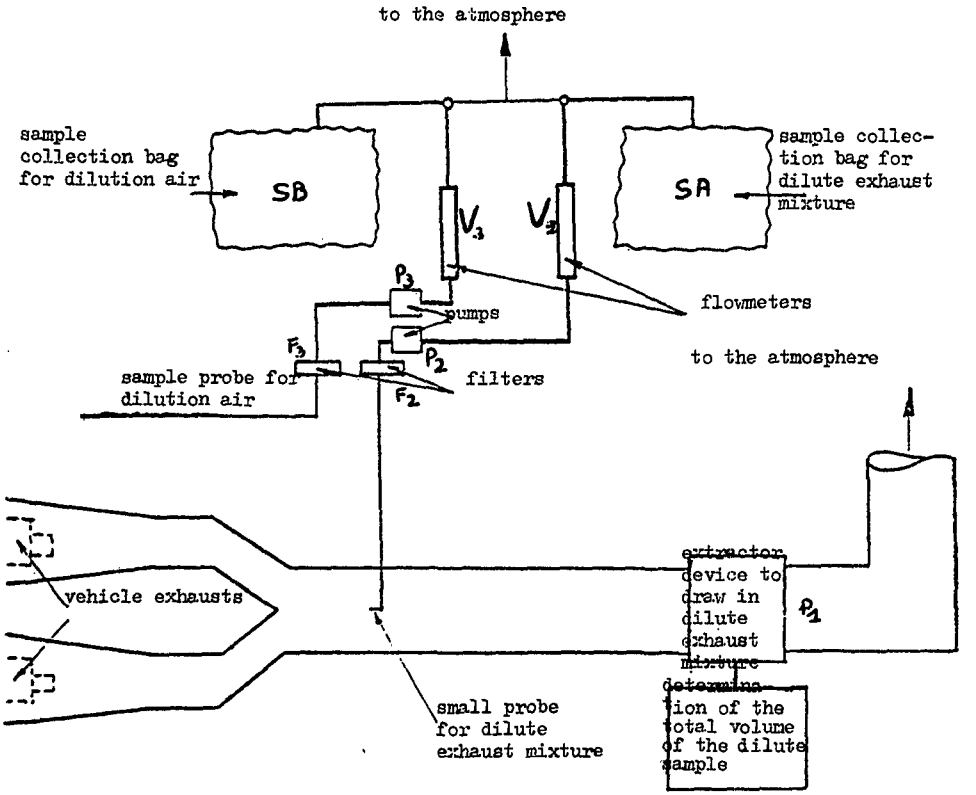
ANNEX 4

APPENDIX 2. EXAMPLE I OF GAS-SAMPLING AND VOLUME-MEASURING EQUIPMENT



ANNEX 4

APPENDIX 3. EXAMPLE II OF GAS-SAMPLING AND VOLUME-MEASURING EQUIPMENT



ANNEX 5. TYPE-II TEST (VERIFYING THE EMISSION OF CARBON MONOXIDE AT IDLING SPEED)

1. INTRODUCTION

This annex describes the procedure for the type-II test defined in paragraph 5.2.1.2 of this Regulation.

2. CONDITIONS OF MEASUREMENT

2.1. The fuel shall be the reference fuel whose specifications are given in annex 6 to this Regulation.

2.2. The content by volume of carbon monoxide and unburnt hydrocarbons shall be measured immediately after the type-I test, with the engine at idling speed.

2.3. In the case of vehicles with manually operated or semi-automatic-shift gear-boxes, the test shall be carried out with the gear lever in the NEUTRAL position and with the clutch engaged.

2.4. In the case of vehicles with automatic-shift gear-boxes, the test shall be carried out with the gear selector in either the NEUTRAL or the PARKING position.

3. SAMPLING OF EXHAUST GASES

3.1. The exhaust outlets shall be provided with an air-tight extension, so that the sample probe used to collect exhaust gases may be inserted into the exhaust outlet at least 60 cm, without increasing the back pressure of more than 125 mm H_2O, and without disturbance of the vehicle running. The shape of this extension shall however be chosen in order to avoid, at the location of the sample probe, any appreciable dilution of exhaust gases in the air. Where a motor cycle is equipped with an exhaust system having multiple outlets, either these shall be joined to a common pipe or the content of carbon monoxide must be collected from each of them, the result of the measurement being reached from the arithmetical average of these contents.

3.2. The concentrations in CO (C_{CO}) and CO_2 (C_{CO_2}) shall be determined from the measuring instrument readings or recordings, by use of appropriate calibration curves.

3.3. The corrected concentration for carbon monoxide regarding two-stroke engines is:

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

3.4. The corrected concentration for carbon monoxide regarding four-stroke engines is:

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

3.5. The concentration in C_{CO} (paragraph 3.2) measured according to the formulas contained in paragraphs 3.3 and 3.4 need not be corrected if the total of the concentrations measured ($C_{CO} + C_{CO_2}$) is at least 10 for two-stroke engines and 15 for four-stroke engines.

ANNEX 6. SPECIFICATIONS OF REFERENCE FUELS*

REFERENCE FUEL No. 1 (IDENTICAL WITH REGULATION No. 15)

	Limits and units	*Method*
Research octane number	99 ± 1	ASTM** D 908-67
Specific gravity 15/4°C	0.742 ± 0.007	ASTM D 1298-67
Reid vapour pressure	0.6 ± 0.04 bars 8.82 ± 0.59 psi	ASTM D 323-58
Distillation		ASTM D 86-67
Initial boiling point		
—10% vol.	50 ± 5°C	
—50% vol.	100 ± 10°C	
—90% vol.	160 ± 10°C	
Final boiling point	195 ± 10°C	
—Residue (% vol.)	Max. 2	
—Loss (% vol.)	Max. 1	
Hydrocarbon analysis		ASTM D 1319-66 T
—Olefins	18 ± 4% by volume	
—Aromatics	35 ± 5% by volume	
—Saturates	Balance	
Oxidation stability	Min. 480 minutes	ASTM D 525-55
Gum (residues)	Max. 4 mg/100 ml.	ASTM D 381-64
Antioxidant	Min. 50 ppm	
Sulphur content	0.03 ± 0.015% by weight	ASTM D 1266-64 T
Lead content	0.57 ± 0.03 g/l 2.587 ± 0.136 g/IG	ASTM D 526-66
Nature of scavenger	Motor mix	
Nature of lead alkyl	Not specified	
Other additives	Nil	

* In blending the reference fuel, only conventional European base materials should be used, unconventional components such as pyrolysis gasoline, thermally cracked material and motor benzole being excluded.

** Initials of the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pennsylvania 19103, United States of America. The figures after the dash denote the year when a standard was adopted or revised. Should any ASTM standards be amended, the standards adopted in the years quoted above shall remain applicable unless all Parties to the 1958 Agreement applying this Regulation agree to replace them by later standards.

REFERENCE FUEL NO. (CEC-RF-05-T-76). APPLICATION: REGULAR GASOLINE, UNLEADED, FOR UNITED STATES OF AMERICA EXHAUST AND EVAPORATIVE EMISSION TEST

	Limits and units	*ASTM method**
Research octane number	Min. 91.0	D 2699
Reid vapour pressure**	Min. 0.58 bar	323
Distillation***		86
Initial boiling point	Min. 24°C Max. 40	
—10 vol.-per cent-point	Min. 49 Max. 57	
—50 vol.-per cent-point	Min. 93 Max. 110	
—90 vol.-per cent-point	Min. 149 Max. 163	
Final boiling point	Max. 213	
Hydrocarbon analysis		1319
—Olefins	Max. 10 per cent vol.	
—Aromatics	Max. 55	
—Saturates	Balance	
Oxidation stability	Min. 480 minutes	525
Sulphur content	Max. 0.10 per cent-wt.	526 or 1266
Lead content	Max. 0.005 g/l	5237
Phosphorus content	Max. 0.001 g/l	3231

ANNEX 7. METHOD OF DETERMINING THE POWER ABSORBED ON THE ROAD BY THE DYNAMOMETRIC BRAKE FOR MOTOR CYCLES

This annex describes the method to be used to determine the power absorbed, as measured on the road by a dynamometric brake.

The power absorbed, as measured on the road, comprises the power absorbed by frictional effects and the power absorbed by the power-absorption device. The dynamometer is brought into operation beyond the range of test speeds. The device used for starting up the dynamometer is then disconnected from the dynamometer, and the rotational speed of the roller or rollers decreases.

The kinetic energy of the device is dissipated by the power-absorption unit of the dynamometer and by the frictional effects of the dynamometer. This method disregards variations in the roller's internal frictional effects caused by the rotating mass of the vehicle. The difference between the stopping time of the free rear roller and that of the front drive roller can be disregarded in the case of two-roller dynamometers.

The following procedures will be used:

1. Measure the rotational speed of the roller if this has not already been done; a fifth wheel, a revolution counter or some other method may be used;

* Equivalent ISO methods will be adopted when issued for all specifications listed above.
** For tests unrelated to evaporative losses, RVP can be min. 0.55, max. 0.66 bar.
*** The figures quoted show the total evaporated quantities (per cent evaporated + per cent loss).
NOTE. In reaching a decision on acceptability of a fuel with relation to these specifications, reference is to be made on "Recommended procedures for applying precision data to specifications for petroleum products".

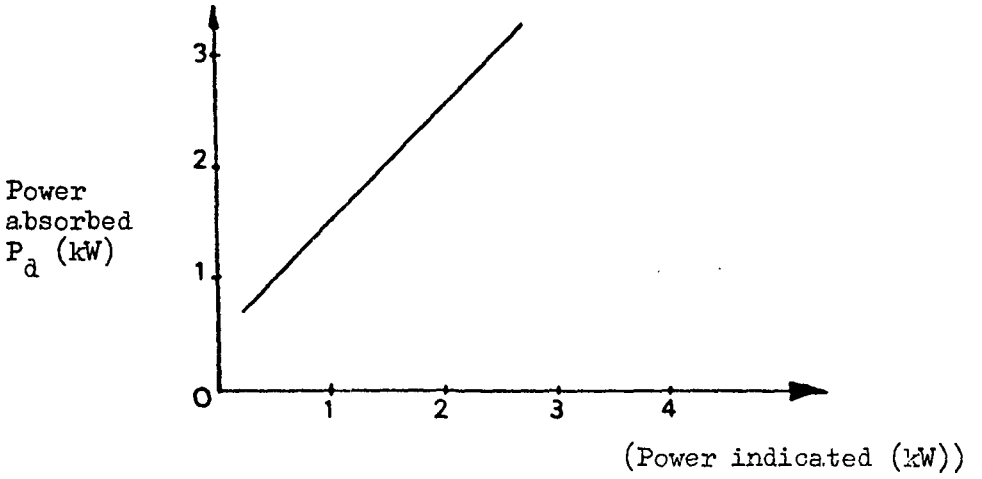
2. Place the vehicle on the dynamometer or devise some other method of starting up the dynamometer;
3. Use the fly-wheel or any other system of inertia simulation for the vehicle-mass category most commonly used with the dynamometer;
4. Bring the dynamometer to a speed of 50 km/h;
5. Note the power absorbed;
6. Bring the dynamometer to a speed of 60 km/h;
7. Disconnect the device used to start up the dynamometer;
8. Note the time taken by the dynamometer to pass from a speed of 55 km/h to a speed of 45 km/h;
9. Set the power-absorption device at a different level;
10. Repeat phases 4 to 9 above sufficiently often to cover the range of road powers used;
11. Calculate the power absorbed, using the formula:

$$P_d = \frac{M_1 (V_1^2 - V_2^2)}{2000\ t} = \frac{0.03858\ M_1}{t}$$

where

P_d = power in kW;
M_1 = equivalent inertia in kg;
V_1 = initial speed in m/s (55 km/h = 15.28 m/s);
V_2 = final speed in m/s (45 km/h = 12.50 m/s);
t = time taken by the rollers to pass from 55 km/h to 45 km/h;

12. Plot indicated power absorbed by the dynamometer against the power indicated for speed of 50 km/h used as the test speed in phase 4 above.



Authentic texts: English and French.
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