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COUNCIL DIRECTIVE

of 20 March 1970

on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles

(70/220/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof;

Having regard to the proposal from the Commission;

Having regard to the Opinion of the European Parliament[1];

Having regard to the Opinion of the Economic and Social Committee[2];

Whereas a regulation of 14 October 1968 amending the *Straßenverkehrs-Zulassungs-Ordnung* was published in Germany in the *Bundesgesetzblatt* Part I of 18 October 1968; whereas that regulation contains provisions on measures to be taken against air pollution by positive-ignition engines of motor vehicles; whereas those provisions will enter into force on 1 October 1970;

Whereas a regulation of 31 March 1969 on the 'Composition of exhaust gases emitted from petrol engines of motor vehicles' was published in France in the *Journal officiel* of 17 May 1969; whereas that regulation is applicable:

— from 1 September 1971, to type-approved vehicles with a new type of engine, that is to say, a type of engine which has never before been installed in a type-approved vehicle;

— from 1 September 1972, to vehicles put into service for the first time;

Whereas those provisions are liable to hinder the establishment and proper functioning of the common market; whereas it is therefore necessary that all Member States adopt the same requirements, either in addition to or in place of their existing rules, in order, in particular, to allow the EEC type — approval procedure which was the subject of the Council Directive[3] of 6 February 1970 on the approximation of the laws of the Member States relating to the type approval of motor vehicles and their trailers to be applied in respect of each type of vehicle;

Whereas, however, the present Directive will be applied before the date laid down for the application of the Directive of 6 February 1970; whereas at that time therefore the procedures of this last Directive will not yet be applicable; whereas therefore an *ad hoc* procedure must be laid down in the form of a communication certifying that a vehicle type has been tested and that it satisfies the requirements of this Directive;

Whereas, on the basis of that communication, each Member State requested to grant national type approval of a type of vehicle must be able to ascertain whether that type has been submitted to the tests laid down in this Directive; whereas, to this end, each Member State should inform the other Member States of its findings by sending them a copy of the communication completed for each type of motor vehicle which has been tested;

Whereas a longer period of adaptation should be laid down for industry in respect of the requirements relating to the testing of the average emission of gaseous pollutants in a congested urban area after a cold start than in respect of the other technical requirements of this Directive;

Whereas it is desirable to use the technical requirements adopted by the UN Economic Commission for

[1] OJ No C 160, 18.12.1969, p. 7.

[2] OJ No C 48, 16.4.1969, p. 16.

[3] OJ No L 42, 23.2.1970, p. 1.

Europe in its Regulation No 15[1] (Uniform provisions concerning the approval of vehicles equipped with a positive-ignition engine with regard to the emission of gaseous pollutants by the engine), annexed to the Agreement of 20 March 1958 concerning the adoption of uniform conditions of approval and reciprocal recognition of approval for motor vehicle equipment and parts;

Whereas, furthermore, the technical requirements must be rapidly adapted to take account of technical progress; whereas, to this end, provision should be made for application of the procedure laid down in Article 13 of the Council Directive of 6 February 1970 on the type approval of motor vehicles and their trailers;

HAS ADOPTED THIS DIRECTIVE:

Article 1

For the purposes of this Directive, 'vehicle' means any vehicle with a positive-ignition engine, intended for use on the road, with or without bodywork, having at least four wheels, a permissible maximum weight of at least 400 kg and a maximum design speed equal to or exceeding 50 km/h, with the exception of agricultural tractors and machinery and public works vehicles.

Article 2

No Member State may refuse to grant EEC type approval or national type approval of a vehicle on grounds relating to air pollution by gases from positive-ignition engines of motor vehicles:

— from 1 October 1970, where that vehicle satisfies both the requirements contained in Annex I, with the exception of those in items 3.2.1.1 and 3.2.2.1, and the requirements contained in Annexes II, IV, V and VI;

— from 1 October 1971, where that vehicle satisfies, in addition, the requirements contained in items 3.2.1.1 and 3.2.2.1 of Annex I and in Annex III.

Article 3

1. On application being made by a manufacturer or his authorised representative, the competent authorities of the Member State concerned shall complete the sections of the communication provided for in Annex VII. A copy of that communication shall be sent to the other Member States and to the applicant. Other Member States which are requested to grant national type approval for the same type of vehicle shall accept that document as proof that the tests provided for have been carried out.

2. The provisions of paragraph 1 shall be revoked as soon as the Council Directive of 6 February 1970 on the type approval of motor vehicles and their trailers enters into force.

Article 4

The Member State which has granted type approval shall take the necessary measures to ensure that it is informed of any modification of a part or characteristic referred to in item 1.1 of Annex I. The competent authorities of that Member State shall determine whether fresh tests should be carried out on the modified prototype and whether a fresh report should be drawn up. Where such tests reveal failure to comply with the requirements of this Directive, the modification shall not be approved.

Article 5

The amendments necessary for adjusting the requirements of Annexes I to VII so as to take account of technical progress shall be adopted in accordance with the procedure laid down in Article 13 of the Council Directive of 6 February 1970 on the type approval of motor vehicles and their trailers.

Article 6

1. Member States shall adopt provisions containing the requirements needed in order to comply with this Directive before 30 June 1970 and shall forthwith inform the Commission thereof.

2. Member States shall ensure that they communicate to the Commission the text of the main provisions of national law which they adopt in the field covered by this Directive.

Article 7

This Directive is addressed to the Member States.

Done at Brussels, 20 March 1970.

For the Council

The President

P. HARMEL

[1] ECE (Geneva) Document W/TRANS/WP 29/293/Rev. 1, 11.4.1969.

ANNEX I

DEFINITIONS, APPLICATION FOR TYPE APPROVAL AND TEST SPECIFICATIONS

1. DEFINITIONS

1.1. **Vehicle type with regard to the limitation of the emission of gaseous pollutants from the engine**

'Vehicle type with regard to the limitation of the emission of gaseous pollutants from the engine' means vehicles which do not differ in essential respects, in particular as regards the following points:

1.1.1. The equivalent inertia determined in relation to the reference weight, as laid down in item 4.2 of Annex III;

1.1.2. The engine characteristics as defined in items 1-6 and 8 of Annex II.

1.2. **Reference weight**

'Reference weight' means the weight of the vehicle in running order, increased by a uniform weight of 120 kg. The weight of the vehicle in running order is its total unladen weight with all tanks full—with the exception of the fuel tank, which must only be half full—and a set of tools and the spare wheel on board.

1.3. **Engine crankcase**

'Engine crankcase' 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.

1.4. **Gaseous pollutants**

'Gaseous pollutants' means carbon monoxide and hydrocarbons.

1.5. **Maximum weight**

'Maximum weight' means the technically permissible maximum weight declared by the vehicle manufacturer (this weight may be greater than the permissible maximum weight).

2. APPLICATION FOR TYPE APPROVAL

2.1. The following particulars must be submitted by the manufacturer or his authorised representative:

2.1.1. A description of the engine type, including all the particulars referred to in Annex II;

2.1.2. Drawings of the combustion chamber and of the piston, including the piston rings;

2.1.3. Maximum lifts of valves and angles of opening and closing in relation to dead centres.

2.2. A vehicle representative of the vehicle type to be approved shall be submitted to the technical service conducting the tests referred to in item 3.

3. TEST SPECIFICATIONS

3.1. **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 requirements of this Directive.

3.2. **Description of tests**

3.2.1. The vehicle shall be subjected, according to its weight category, to Types I, II and III tests, as specified below:

3.2.2.1. *Type I test* (verifying the average emission of gaseous pollutants in a congested urban area after a cold start).

3.2.1.1.1. This test shall be carried out on all vehicles referred to in Article 1 whose maximum weight does not exceed 3·5 metric tons.

3.2.1.1.2. The vehicle shall be placed on a dynamometer bench equipped with a brake and a flywheel. A test lasting a total of thirteen 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 collected in one or more bags. The gases shall be analysed and their volume measured at the end of the filling period.

3.2.1.1.3. The test shall be carried out by the procedure described in Annex III. The methods used to collect and analyse the gases shall be those laid down. Other methods may be approved if it is found that they yield equivalent results.

3.2.1.1.4. The mass of the carbon monoxide and the mass of the hydrocarbons obtained in the test must be less, for a vehicle of given reference weight, than the amounts shown in the table below:

Reference weight (RW) in kg	Mass of carbon monoxide per test in g	Mass of hydrocarbons per test in g
$RW \leq 750$	100	8·0
$750 < RW \leq 850$	109	8·4
$850 < RW \leq 1020$	117	8·7
$1020 < RW \leq 1250$	134	9·4
$1250 < RW \leq 1470$	152	10·1
$1470 < RW \leq 1700$	169	10·8
$1700 < RW \leq 1930$	186	11·4
$1930 < RW \leq 2150$	203	12·1
$2150 < RW$	220	12·8

3.2.1.2. *Type II test* (carbon-monoxide emission test at idling speed).

3.2.1.2.1. This test shall be carried out on all vehicles referred to in Article 1.

3.2.1.2.2. The carbon-monoxide content by volume of the exhaust gases emitted with the enging at idling speed must not exceed 4·5%.

3.2.1.2.3. This content shall be checked through a test carried out in accordance with the procedure described in Annex IV.

3.2.1.3. *Type III test* (verifying emissions of crankcase gases).

3.2.1.3.1. This test shall be carried out on all vehicles referred to in Article 1 with the exception of those having a two-stroke engine with compression in the crankcase.

3.2.1.3.2. The mass of the hydrocarbons contained in the crankcase gases which are not recycled by the engine must be less than 0·15% of the mass of the fuel consumed by the engine.

3.2.1.3.3. This mass shall be checked through a test carried out in accordance with the procedure described in Annex V.

3.2.2. As a general rule conformity of production models, with regard to limitation of the emission of gaseous pollutants from the engine, shall be verified on the basis of the description in the communication given in Annex VII and, where necessary, of all or some of the tests of Types I, II and III referred to in item 3.2. However:

3.2.2.1. In a Type I test carried out on a vehicle taken from the series the collected mass of the carbon monoxide and the collected mass of the hydrocarbons shall not exceed the values for L_1 and L_2 respectively given in the following table:

Reference weight (RW) in kg	Mass of carbon monoxide per test in g L_1	Mass of hydrocarbons per test in g L_2
$RW \leq 750$	120	10·4
$750 < RW \leq 850$	131	10·9
$850 < RW \leq 1020$	140	11·3
$1020 < RW \leq 1250$	161	12·2
$1250 < RW \leq 1470$	182	13·1
$1470 < RW \leq 1700$	203	14·0
$1700 < RW \leq 1930$	223	14·8
$1930 < RW \leq 2150$	244	15·7
$2150 < RW$	264	16·6

3.2.2.1.1. If the mass of the carbon monoxide or the mass of the hydrocarbons produced by the vehicle taken from the series exceeds the limits L_1 and L_2 above, the manufacturer may ask for measurements to be made on a sample of vehicles taken from the series, including the vehicle originally taken. The manufacturer shall determine the size n of the sample. The arithmetic mean $\bar{x}$ of the results obtained with the sample and the standard deviation S[1] 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:

$$\bar{x} + k.\,S \leq L,$$

where:

L = the limit value laid down in item 3.2.2.1 for each gaseous pollutant considered; and

k = a statistical factor dependent on n and given in 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 $n \geq 20$, $k = \frac{0{\cdot}860}{\sqrt{n}}$

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

ANNEX II

ESSENTIAL CHARACTERISTICS OF THE ENGINE AND INFORMATION CONCERNING THE CONDUCT OF TESTS[1]

1. **Description of engine**

1.1. Make ....

1.2. Type ....

1.3. Cycles: four-stroke/two-stroke[2]

1.4. Number of cylinders ....

1.5. Bore .... mm

1.6. Stroke .... mm

1.7. Cylinder capacity .... cm^3

1.8. Compression ratio[3] ....

1.9. System of cooling ....

1.10. Supercharger with/without[2] description of the system ....

1.11. Device for recycling crankcase gases (description and diagrams) ....

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

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)[2] .... Number ....

3.2.1.1. Make ....

3.2.1.2. Type ....

3.2.1.3. Adjustments[2]

3.2.1.3.1.	Jets	or	Fuel delivery curve plotted against air flow[2] [3]
3.2.1.3.2.	Venturis		
3.2.1.3.3.	Float-chamber level		
3.2.1.3.4.	Weight of float		
3.2.1.3.5.	Float needle		

3.2.1.4. Manual/automatic choke[2] Closure setting[3] ....

3.2.1.5. Feed pump

Pressure[3] .... or characteristic diagram[3] ....

3.2.2. By injector[2]

3.2.2.1. Pump

[1] In the case of non-conventional engines and systems, particulars equivalent to those referred to here shall be supplied.
[2] Delete as appropriate.
[3] Specify the tolerance.

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 .... rmp,[1] [2] or characteristic diagram[1] [2]..........

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[1] [2]

or characteristic diagram[1] [2] ....

4. **Valve timing**

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

....

4.2. Reference and/or setting ranges[1] ....

5. **Ignition**

5.1. Distributor(s)

5.1.1. Make ....

5.1.2. Type ....

5.1.3. Ignition advance curve[2] ....

5.1.4. Ignition timing[2] ....

5.1.5. Contact-point gap[2] ....

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 fuel if any lubricant is mixed with the fuel)

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 ....

8. **Engine performances**

8.1. Idling speed .... rpm[2]

8.2. Engine speed at maximum power .... rpm[2]

8.3. Maximum power .... CV/HP[1] (ISO; BSI; CUNA; DIN; IGM; SAE; etc.)[1];

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[1] Delete as appropriate.
[2] Specify the tolerance.

ANNEX III

TYPE I TEST

(verifying the average emission of pollutants in a congested urban area after a cold start)

Procedure for Type I test specified in item 3.2.1.1. of Annex I

1. OPERATING CYCLE ON THE DYNAMOMETER BENCH

1.1. **Description of cycle**

The operating cycle on the dynamometer bench shall be that indicated in the following table and plotted in Appendix 1. The analysis by operations is given in Appendix 2.

Operating cycle on the dynamometer bench

No of operation	Operation	Phase	Acceleration m/sec²	Speed km/h	Duration of each: Operation (sec)	Duration of each: Phase (sec)	Cumulative time (sec)	Gear to be used in the case of a manual gearbox
1	Idling	1			11	11	11	6 sec PM+5 sec K_1
2	Acceleration	2	1·04	0–15	4	4	15	1
3	Steady speed	3		15	8	8	23	1
4	Deceleration	4	— 0·69	15–10	2	5	25	1
5	Deceleration, clutch disengaged		— 0·92	10–0	3		28	K 1
6	Idling	5			21	21	49	16 sec PM+5 sec K_1
7	Acceleration	6	0·83	0–15	5	12	54	1
8	Gear change				2		56	
9	Acceleration		0·94	15–32	5		61	2
10	Steady speed	7		32	24	24	85	2
11	Deceleration	8	— 0·75	32–10	8	11	93	2
12	Deceleration, clutch disengaged		— 0·92	10–0	3		96	K_2
13	Idling	9			21	21	117	16 sec PM+5 sec K_1
14	Acceleration	10	0·83	0–15	5	26	122	1
15	Gear change				2		124	
16	Acceleration		0·62	15–35	9		133	2
17	Gear change				2		135	
18	Acceleration		0·52	35–50	8		143	3
19	Steady speed	11		50	12	12	155	3
20	Deceleration	12	— 0·52	50–35	8	8	163	3
21	Steady speed	13		35	13	13	176	3
22	Gear change	14			2	12	178	
23	Deceleration		— 0·86	32–10	7		185	2
24	Deceleration, clutch disengaged		— 0·92	10–0	3		188	K_2
25	Idling	15			7	7	195	7 sec PM

[1] PM = Gearbox in neutral, clutch engaged.
K_1, K_2 = First or second gear engaged, clutch disengaged.

1.2. **General conditions for carrying out the cycle**

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

1.3. **Use of the gearbox**

1.3.1. If the maximum speed which can be attained in first gear is below 15 km/h, the second, third and fourth gears shall be used.

1.3.2. Vehicles equipped with semi-automatic gearboxes shall be tested by using the ratios normally employed for driving, and the gear lever shall be operated in accordance with the manufacturer's instructions.

1.3.3. Vehicles equipped with fully automatic gearboxes shall be tested with the highest gear ('Drive') engaged. The accelerator shall be operated so as to obtain the steadiest acceleration possible, allowing the various gears to be engaged in the normal order. Furthermore, the gear-change points shown in Appendix 1 shall not apply; acceleration shall continue throughout the period represented by the straight lines connecting the end of each period of idling with the beginning of the next period of steady speed. The tolerances given in item 1.4 shall apply.

1.3.4. Vehicles equipped with an overdrive which can be actuated by the driver shall be tested with the overdrive out of action.

1.4. **Tolerances**

1.4.1. A tolerance of 1 km/h above or below the theoretical speed shall be allowed during acceleration during steady speed, and during deceleration when the vehicle's brakes are applied. If the vehicle decelerates more rapidly without the use of the brakes, only the requirements of item 5.6.3 shall apply. Speed tolerances greater than those prescribed shall be permitted during phase changes provided that the tolerances are never exceeded for more than 0·5 second on any one occasion.

1.4.2. Time tolerances of $\pm$ 0·5 sec. These tolerances shall apply at the beginning and at the end of each gear-changing period.[1]

1.4.3. The speed and time tolerances shall be combined as indicated in Appendix 1.

2. VEHICLE AND FUEL

2.1. **Test vehicle**

2.1.1. The vehicle shall be presented in good mechanical condition. It shall have been run in and have been driven at least 3 000 km before the test.

2.1.2. The exhaust device shall not have any leaks likely to reduce the quantity of gases collected, which shall be the quantity of gases emerging from the engine.

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

2.1.4. The settings of the engine and of the vehicle's controls shall be those prescribed by the manufacturer.

2.1.5. A vacuum gauge shall be installed in the intake circuit near the carburettor, beyond the throttle.

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

2.2. **Fuel**

2.2.1. The fuel shall be the reference fuel whose specifications are given in Annex VI. If the engine is lubricated by a mixture, the oil added to the reference fuel shall comply as to grade and quantity with the manufacturer's recommendations.

[1] It should be noted that the time of two seconds allowed includes the time for changing gear and, if necessary, a certain amount of latitude to catch up with the cycle.

3. TEST EQUIPMENT

3.1. **Dynamometer brake**

No particular model is prescribed. However, its adjustment shall not be affected by the lapse of time. It shall not produce any perceptible vibrations in the vehicle likely to impair the latter's normal operation. It must be equipped with an inertia adapter enabling the operation of the vehicle on the road to be reproduced (equivalent inertias).

3.2. **Gas-collection equipment**

3.2.1. The connecting tubes shall be made of steel and shall, so far as possible, be provided with rigid connections. However, a completely gas-tight flexible ring element shall be used to isolate the device from the vehicle vibrations. Other materials may be used if they do not affect the composition of the gases.

3.2.2. If the vehicle being tested is equipped with an exhaust pipe comprising several branches, the branches shall be interlinked as near as possible to the vehicle.

3.2.3. The temperature of the gases in the collecting system shall be compatible with the correct operation of the engine, with maintenance of the sampling bags in good condition, with the hydrocarbon absorption level laid down in item 4.5.1 and with the reduction to a minimum of condensation on the sides of the sampling bag or bags.

3.2.4. The various valves used to direct the exhaust gases either to the atmosphere or to the sampling device shall be quickly adjustable and quick-acting.

3.2.5. The collecting device shall comprise one or more bags of adequate capacity. The bags shall be made of such materials as will not affect either the accuracy of the measurements or the conservation of the gases.

3.3. **Analytical equipment**

3.3.1. The sampling probe may consist of the sampling tube leading into the collecting device or of the bag-emptying tube. It may also be independent but in no case shall its opening be at the bottom of the bag.

3.3.2. Analysers shall be of the non-dispersive type with absorption in the infra-red. The hydrocarbons analyser shall be sensitised for n-hexane.

3.4. **Volume-measuring equipment**

3.4.1. A volumetric gauge shall be used.

3.4.2. Pressure and temperature measurements enabling the volume to be referred to standard conditions shall be carried out at points selected in the light of the type of gauge used. The laboratory shall specify their positions.

3.4.3. The gas-bleeding device may consist of a pump or of any other system which keeps the pressure measured at the gauge constant.

3.5. **Accuracy of instruments**

3.5.1. As 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 item 4.2), shall be given to within $\pm$ 20 kg.

3.5.2. The speed of the vehicle shall be measured by the speed of rotation of the rollers connected to the brake flywheels. It shall be measurable to within $\pm$ 2 km/h in the speed range 0 to 10 km/h and to within $\pm$ 1 km/h for speeds above 10 km/h.

3.5.3 The temperatures considered in items 5.1.1 and 6.3.3 shall be measurable to within $\pm$ 2 °C.

3.5.4. The atmospheric pressure shall be measurable to within $\pm$ 1 mm of mercury.

3.5.5. The vacuum in the vehicle's intake system shall be measurable to within $\pm$ 5 mm of mercury. The other pressures (backpressure in the sampling device, pressure for correction of volume etc.) must be measurable to within $\pm$ 5 mm water gauge.

3.5.6. The size and accuracy of the gauge shall be appropriate to the volume of gas to be measured, so that the measurement of volume is accurate to within $\pm$ 2%.

3.5.7. The analysers shall have a measuring range compatible with the accuracy required to measure the content of the various constituents to within ± 3%, disregarding the accuracy of the standard (calibration) gases. The overall response time of the analysing circuit shall be less than one minute.

3.5.8. The content of the standard gases shall not differ by more than ± 2% from the reference value of each gas. The diluent shall be nitrogen.

4. PREPARING THE TEST

4.1. **Setting of brake**

4.1.1. The brake shall be so adjusted as to reproduce the operation of the vehicle on the level at a steady speed of 50 km/h.

4.1.2. For this purpose the vacuum shall be measured at the engine intake during a road test carried out at 50 km/h in third gear, or using the gears specified in item 1.3, the vehicle being loaded to its reference weight and the tyre pressure being that indicated by the manufacturer. The vacuum shall be measured when a steady speed on the level has been maintained for at least fifteen seconds. To take account of the effects of wind, the average of the results of measurements made twice in each direction shall be taken.

4.1.3. The vehicle shall then be placed on the dynamometer bench and the brake so adjusted as to obtain the same vacuum at the intake as that recorded in the road test referred to item 4.1.2 above. This brake setting shall be maintained throughout the test.

4.1.4. This setting is appropriate for brakes of hydraulic type. For other types it may be necessary to make sure that the setting so obtained is appropriate for other intermediate states between idling and the maximum speed in the cycle. If necessary, an average setting shall be adopted.

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

A flywheel shall be used enabling a total inertia of the rotating masses to be obtained proportional to the reference weight within the following limits:

Reference weight (RW) of vehicle in kg	Equivalent inertias in kg
RW ≤ 750	680
750 < RW ≤ 850	800
850 < RW ≤ 1020	910
1020 < RW ≤ 1250	1130
1250 < RW ≤ 1470	1360
1470 < RW ≤ 1700	1590
1700 < RW ≤ 1930	1810
1930 < RW ≤ 2150	2040
2150 < RW	2270

4.3. **Conditioning of vehicle**

4.3.1. Before the test the vehicle shall be kept at a temperature of between 20 ° and 30 °C for at least six hours. The cooling-water and engine-oil temperatures shall be measured before the test to make sure that they are between 20 ° and 30 °C.

4.3.2. The tyre pressure shall, as in the case of the preliminary road test for brake adjustment, be that indicated by the manufacturer. However, if the diamter of the rollers is less than 50 cm, the pressure in the tyres shall be increased by 30–50% to prevent damage to the tyres.

4.4. **Check of back-pressure**

During the preliminary tests a check shall be made to ensure that the back-pressure set up by the sampling device does not exceed 75 mm water gauge, measurements being performed at the various steady speeds prescribed in the cycle.

4.5. **Conditioning of bags**

4.5.1. The bags shall be so conditioned, particularly with regard to hydrocarbons, that hydrocarbon losses over a period of 20 minutes do not exceed 2% of the initial content. This conditioning shall be carried out during preliminary tests conducted at temperatures close to the extreme temperatures encountered during the various tests.

4.5.2. Losses shall be measured as follows. When the engine is running at a constant (rpm) speed the hydrocarbon content of the gases entering the bag shall be measured continuously until the bag has been filled. The content, when filling is completed, must be the average of the contents recorded during filling. The bag shall be emptied by the analyser pumps and the content recorded continuously or at fixed intervals. If after twenty minutes the content has varied by more than 2%, the bag shall be emptied and then refilled for a second measurement. This cycle shall be repeated as many times as is necessary to saturate the walls.

4.6. **Calibration of analytical apparatus**

4.6.1. 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 by means of the discharge gauge and the pressure-reducing valve mounted on each bottle. The apparatus shall be adjusted to indicate as a stabilised value the value shown on the standard-gas bottle. Starting from the setting obtained with the maximum-content bottle, the curve of the analyser's deviations shall be drawn as a function of the content of the various standard-gas bottles used.

4.6.2. Overall response time of the apparatus.

The gas from the maximum-content bottle shall be injected into the end of the sampling probe. A check shall be made to ensure that the indicated value corresponding to maximum deviation is attained in less than one minute. If this value is not attained, the analysing circuit shall be inspected from end to end for leaks.

4.7. **Adjustment of volume-measuring device**

The bag shall be filled during the preliminary tests and a check made to ensure that the volume can be measured with the desired accuracy. If necessary, a suitable (gas) gauge shall be selected in each case.

5. PROCEDURE FOR BENCH TESTS

5.1. **Special conditions for carrying out the cycle**

5.1.1. The temperature in the place where the roller bench is situated shall be between 20 ° and 30 °C throughout the test and approximate as closely as possible that of the place where the vehicle was conditioned for the test.

5.1.2. The vehicle shall be more or less horizontal during the test so as to avoid any abnormal distribution of the fuel.

5.1.3. The test shall be carried out with the bonnet raised. An auxiliary ventilating device acting on the radiator (water-cooled) or on the air intake (air-cooled) may be used, if necessary, to keep the engine temperature normal.

5.1.4. When the cycle is carried out the speed considered shall be that of the rollers connected to the brake flywheel. During the test the speed shall be plotted against time so that the correctness of the cycles performed can be assessed.

5.1.5. Recording of the vacuum shall be optional; however, if it is recorded at the same time as the speed, it will be possible to judge whether the accelerations have been made correctly.

5.1.6. The temperatures of the cooling water and of the crankcase oil may also be recorded if desired.

5.2. **Starting up the engine**

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.

5.2.2. The engine shall be kept idling on the choke for a period of forty seconds. The first cycle shall begin when the valve of the effluent-recovery device is operated, which shall be done at the end of the forty-second period.

5.3. **Use of the manual choke**

The choke shall be cut out as soon as possible, and in principle before acceleration from 0 to 50 km/h. If this requirement cannot be met, the moment of effective cut-out shall be indicated. The method used to adjust the choke shall be that indicated by the manufacturer.

5.4. **Idling**

5.4.1. Manual-shift gearbox:

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

5.4.1.2. To enable the accelerations to be performed according to the normal cycle the vehicle shall be put in first gear, with the clutch disengaged, five seconds before the acceleration following the idling period in question.

5.4.1.3. The first idling period at the beginning of the cycle shall consist of six seconds of idling in neutral with the clutch engaged and five seconds in first gear with the clutch disengaged.

5.4.1.4. For the idling periods during each cycle the corresponding times shall be sixteen seconds in neutral and five seconds in first gear with the clutch disengaged.

5.4.1.5. The last idling period in the cycle shall consist of seven seconds in neutral with the clutch engaged.

5.4.2. Semi-automatic gearboxes:

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

5.4.3. Automatic gearboxes:

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

5.5. **Accelerations**

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

5.5.2. If acceleration cannot be carried out in the prescribed time, the extra time required shall be deducted from the time allowed for changing the combination, if possible, and in any case from the next steady-speed period.

5.6. **Decelerations**

5.6.1. All decelerations shall be effected by removing the foot completely from the accelerator, the clutch remaining engaged. The clutch shall be disengaged, without touching the gear lever, at a speed of 10 km/h.

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

5.6.3. If the period of deceleration is shorter than that prescribed for the corresponding phase, the timing of the theoretical cycle shall be restored by an idling period merging into the following idling operation.

5.6.4. At the end of the deceleration period (stopping vehicle on the rollers) the gear shall be put into neutral and the clutch engaged.

5.7. **Steady speeds**

5.7.1. 'Pumping' or the closing of the throttle shall be avoided when passing from acceleration to the following steady speed.

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

6. PROCEDURE FOR SAMPLING AND ANALYSIS

6.1. **Sampling**

6.1.1. Sampling shall begin as soon as the valve has been opened as indicated in item 5.2.2.

6.1.2. If several bags are used the bag shall be changed at the beginning of the first idling period of a cycle.

6.1.3. The bag shall be hermetically closed as soon as it is full.

6.1.4. At the end of the last cycle the valve shall be operated to divert the gases produced by the engine into the atmosphere.

6.2. **Analysis**

6.2.1. The gases contained in each bag shall be analysed as soon as possible and in any event not later than twenty minutes after filling of the bag in question began.

6.2.2. If the sampling probe is not left permanently in the bag, the entry of air into the latter during insertion of the probe and the escape of gases from the bag during extraction of the probe should be avoided.

6.2.3. The analyser shall be in a stabilised condition within one minute of its connection to the bag.

6.2.4. The figure adopted as the content of the gases in each of the effluents measured shall be that read off after stabilisation of the measuring instrument.

6.3. **Measurement of volume**

6.3.1. To avoid wide temperature variations, the volume of the bag or bags shall be measured as soon as the gases have reached room temperature.

6.3.2. The bags shall be emptied by passing the gases through the gas gauge.

6.3.3. The temperature (tm) used for the calculations shall be the arithmetic mean of the temperatures at the beginning and at the end of emptying, the maximum permissible difference between these two temperatures being less than 5 °C.

6.3.4. The pressure (Pm) used for the calculations shall be the arithmetic mean of the absolute pressures recorded beginning and at the end of emptying, the maximum permissable difference between these two pressures being less than 4 mm of mercury.

6.3.5. The volume of gas drawn off for analysis shall be added to the volume measured by the meter if the first volume is equivalent to more than 1 per cent of the measured volume. The result obtained shall be designated by the symbol Vm.

7. DETERMINATION OF THE QUANTITY OF GASEOUS POLLUTANTS EMITTED

7.1. **Correction of the measured volumes of gas**

The volume of the gases contained in each bag shall be referred to normal temperature and pressure by means of the formula:

$$V = Vm \frac{273}{273 + tm} \times \frac{Pm - PH}{760},$$

Vm: is the volume, expressed in litres, recorded as indicated in item 6.3.5;

tm: is the arithmetic mean of the extreme temperatures recorded as indicated in item 6.3.3, expressed in degrees Celsius;

Pm: is the arithmetic mean of the extreme absolute pressures recorded as indicated in item 6.3.4, expressed in millimetres of mercury; and

PH: is the saturated-water-vapour pressure, expressed in millimetres of mercury, at temperature Tm.

7.2. **Mass of the gaseous pollutants contained in each bag**

The mass of the gaseous pollutants contained in each bag shall be determined by the product dCV, where C is the content by volume and d the volume mass of the gaseous pollutant considered:

— in the case of carbon monoxide, d = 1·250;

— in the case of hydrocarbons, d = 3·844 (n-hexane).

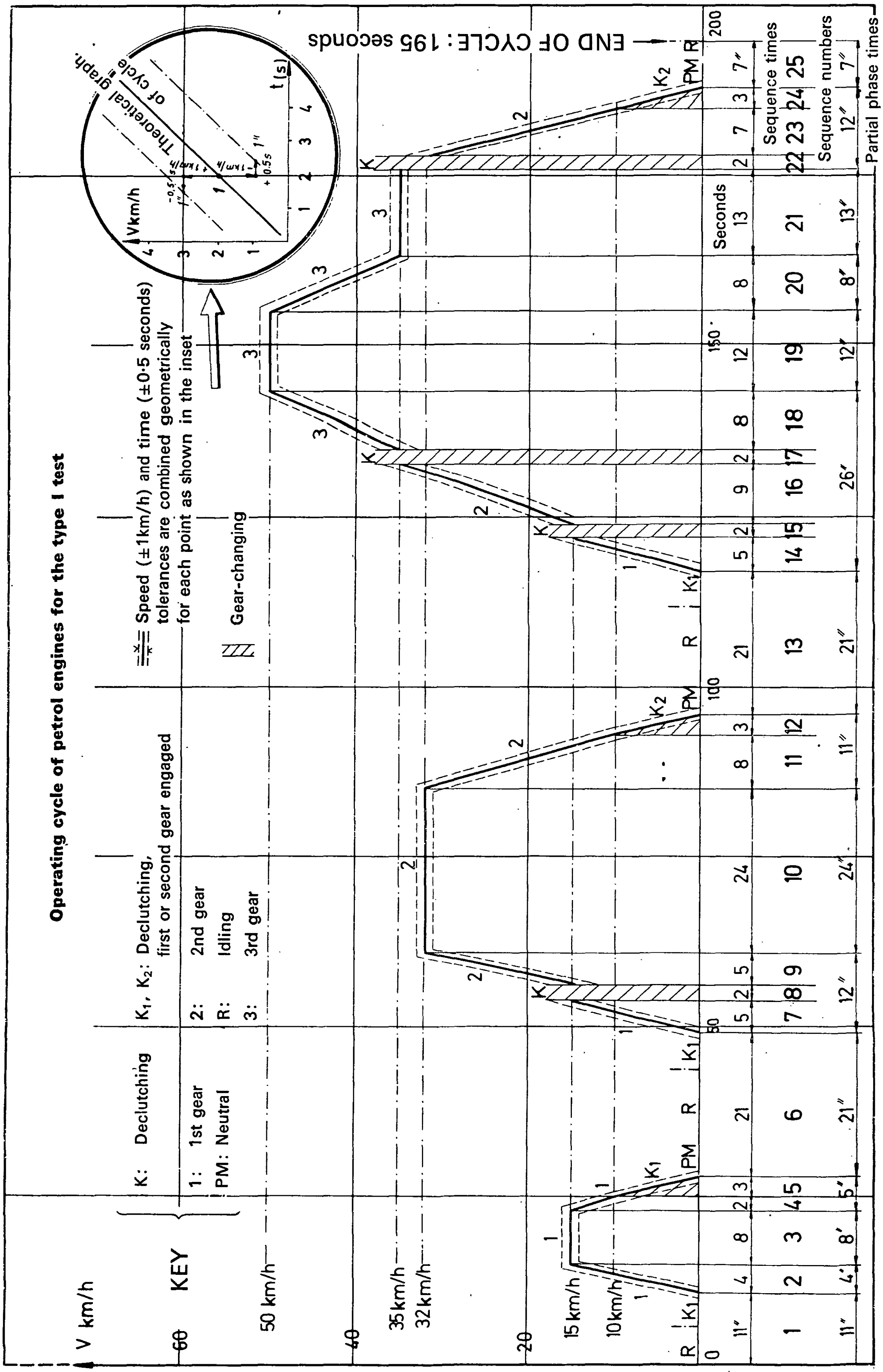
7.3. **Total mass of gaseous pollutants emitted**

The mass M of each gaseous pollutant emitted by the vehicle during the test shall be determined by adding the masses of the gaseous pollutants contained in each bag and calculated as indcated in item 7.2.

Note: Laboratories are recommended to check the analyses by also measuring the quantity of carbon dioxide produced.

APPENDIX 1

Operating cycle of petrol engines for the type I test



APPENDIX 2

Analysis of the operating cycle used for the type I test

	Time		%
1. Analysis by phases			
Idling	60 sec	30·8	35·4
Idling, vehicle moving, clutch engaged on one combination	9 sec	4·6	
Gear change	8 sec		4·1
Accelerations	36 sec		18·5
Steady speed	57 sec		29·2
Decelerations	25 sec		12·8
	195 sec		100
2. Analysis based on use of gearbox			
Idling	60 sec	30·8	34·5
Idling, vehicle moving, clutch engaged on one combination	9 sec	4·6	
Gear change	8 sec		4·1
— first gear	24 sec		12·3
— second gear	53 sec		27·2
— third gear	41 sec		21
	195 sec		100

Average speed during test: 19 km/h.
Effective running time: 195 sec.
Theoretical distance covered per cycle: 1·013 km.
Equivalent distance for the test (4 cycles): 4·052 km.

ANNEX IV

TYPE II TEST

(Carbon-monoxide emission test at idling speed)

Procedure for the Type II test specified in item 3.2.12 of Annex I

1. CONDITIONS OF MEASUREMENT

1.1. The fuel shall be the reference fuel whose specifications are given in Annex VI.

1.2. The carbon-monoxide content by volume shall be measured immediately after the fourth cycle of the Type I test, with the engine at idling speed.

1.3. In the case of vehicles with manual or semi-automatic transmission gearboxes the test shall be carried out with the gear lever in the 'neutral' position and with the clutch engaged.

1.4. In the case of vehicles with automatic transmission gearboxes the test shall be carried out with the gear selector in the 'zero' or 'parking' position.

2. SAMPLING OF GASES

2.1. The sampling probe shall be placed in the pipe connecting the vehicle exhaust with the sampling bag and as close as possible to the exhaust.

2.2. In order to take account of possible dilution of the exhaust gases with air, the content by volume of carbon monoxide (T_1) and of carbon dioxide (T_2) shall be measured, and the content by volume (T) to be compared with the prescribed limit shall be calculated by the formula

$$T = T_1 \times \frac{0{\cdot}15}{(T_1 + T_2)}$$

ANNEX V

TYPE III TEST

(Verifying emissions of crankcase gases)

Procedure for the Type III test specified in item 3.2.1.3 of Annex I

1. GENERAL PROVISIONS

1.1. The Type III test shall be carried out on the vehicle subjected to the Type I and the Type II tests.

1.2. The engines tested shall include leak-proof engines other than those so designed that even a slight leakage may cause unacceptable operating faults (such as flat-twin engines).

2. TEST CONDITIONS

2.1. Idling shall be regulated in conformity with the manufacturer's recommendations; in the absence of such recommendations it shall be so regulated as to achieve a maximum vacuum in the intake manifold.

2.2. The measurements shall be performed in the following three sets of conditions of engine operation:

Condition No	Vehicle speed (km/h)	Vacuum at intake (mm mercury)	Weighting factor
1	Idling		0·25
2	50 ± 2	400 ± 8	0·25
3	50 ± 2	250 ± 8	0·50

2.3. If the engine cannot operate under a vacuum of 400 mm (mercury gauge) the vacuum shall be so adjusted as to equal that recorded on a level road at a constant speed of 50 km/h. The vacuum of condition 3 in the table above shall be that recorded as specified above multiplied by $\frac{250}{400} = 0{\cdot}625$.

2.4. The engine speed for measurements as referred to under 2 and 3 in item 2.2 shall be selected as the lowest engine speed at which, gear ratios being taken into account, the vehicle can travel at a speed of 50 km/h in normal operating conditions.

3. TEST METHOD

3.1. In each of the sets of conditions 1, 2 and 3 specified in item 2.2 above, the following shall be measured:

3.1.1. The volume Q_n not recycled by the device in the unit time;

3.1.2. The consumption by weight C_n of fuel in the same unit time.

3.2. The volumes Q_n, measured as specified in item 4.6 in each of the sets of conditions, shall be referred to the standard conditions (760 mm mercury; 0 °C) by the formula

$$Q'_n = Q_n \frac{H}{760} \times \frac{273}{T}$$

3.3. The content by volume of hydrocarbons, t, shall be measured as specified in item 4.4. If the manufacturer so requests, the crankcase gases shall not be analysed but shall be assumed to contain 15 000 ppm of hydrocarbons.

3.4. The volume mass (weight per unit volume) of hydrocarbons shall be assumed to be 3·84 g/litre; for each of the aforementioned sets of conditions the weight of hydrocarbons discharged to the atmosphere shall be determined by the formula:

$$P_n = Q'_n \times t \times 3{\cdot}84,$$

Q'_n being the corrected volumes.

3.5. The mean weight of hydrocarbons $\overline{P}$ and the consumption $\overline{C}$ of fuel shall be calculated from the values obtained for each of the aforementioned sets of conditions by applying the weighting factors specified in item 2.2. They shall be expressed in the same units.

3.6. Interpretation of results

The vehicle shall be deemed satisfactory if

$$\overline{P} \leqslant \frac{0{\cdot}15}{100} \times \overline{C}.$$

4. METHOD OF MEASUREMENT OF THE VOLUME Q_n NOT RECYCLED BY THE DEVICE

4.1. **Steps to be taken before the test**

Before the test, all apertures other than that required for the recovery of the gases shall be stopped up.

4.2. **Principle of the method**

4.2.1. A suitable take-off not introducing any additional loss of pressure shall be installed on the recycling circuit of the device directly at the engine-connection aperture.

4.2.2. A flexible bag made of a material not absorbing hydrocarbons shall be so connected to the outlet from the take-off so as to collect the gases which are not recycled by the engine (see Appendix). The bag shall be emptied at each measurement.

4.3. **Method of measurement**

The bag shall be stopped up before each measurement. It shall be brought into communication with the take-off for a known period of time and then emptied through a suitable volumetric meter.

During emptying as aforesaid the pressure H, expressed in mm (mercury gauge), and the temperature N, expressed in degrees Celsius, shall be measured for the purpose of volume correction as referred to in item 3.2.

4.4. **Measurement of hydrocarbon content**

4.4.1. During emptying as aforesaid the hydrocarbon content shall, if appropriate, be measured by means of a non-dispersive n-hexane-sensitised infra-red analyser. The reading shall be multiplied by the coefficient 1·24 to allow for the absolute hydrocarbons concentration in the crankcase gases.

4.4.2. The analysers and the reference gases shall meet the conditions laid down in Annex III, items 3.5.7 and 3.5.8.

4.5. **Measurement of fuel consumption**

The weight of fuel consumed in each of the conditions of operation defined in item 2.2 shall be determined. This weight shall be referred to the unit time.

4.6. **Expression of results of measurements**

The values Q'_n, in which n relates to each of the conditions referred to in item 2.2, and the consumptions C_n shall be referred to the same unit time for the purpose of applying the weighting coefficients and the calculations for determining the weighted weight of hydrocarbons and the weighted consumption of fuel.

4.7. **Accuracy of measurements**

4.7.1. The pressure in the bag during measurement of the volumes shall be measured to within ± 1 mm (mercury gauge).

4.7.2. The vacuum at intake shall be measured to within ± 8 mm (mercury gauge).

4.7.3. The vehicle speed shall be taken at the rollers and measured to within ± 2 km/h.

4.7.4. The quantity of gas discharged shall be measured to within ± 5%.

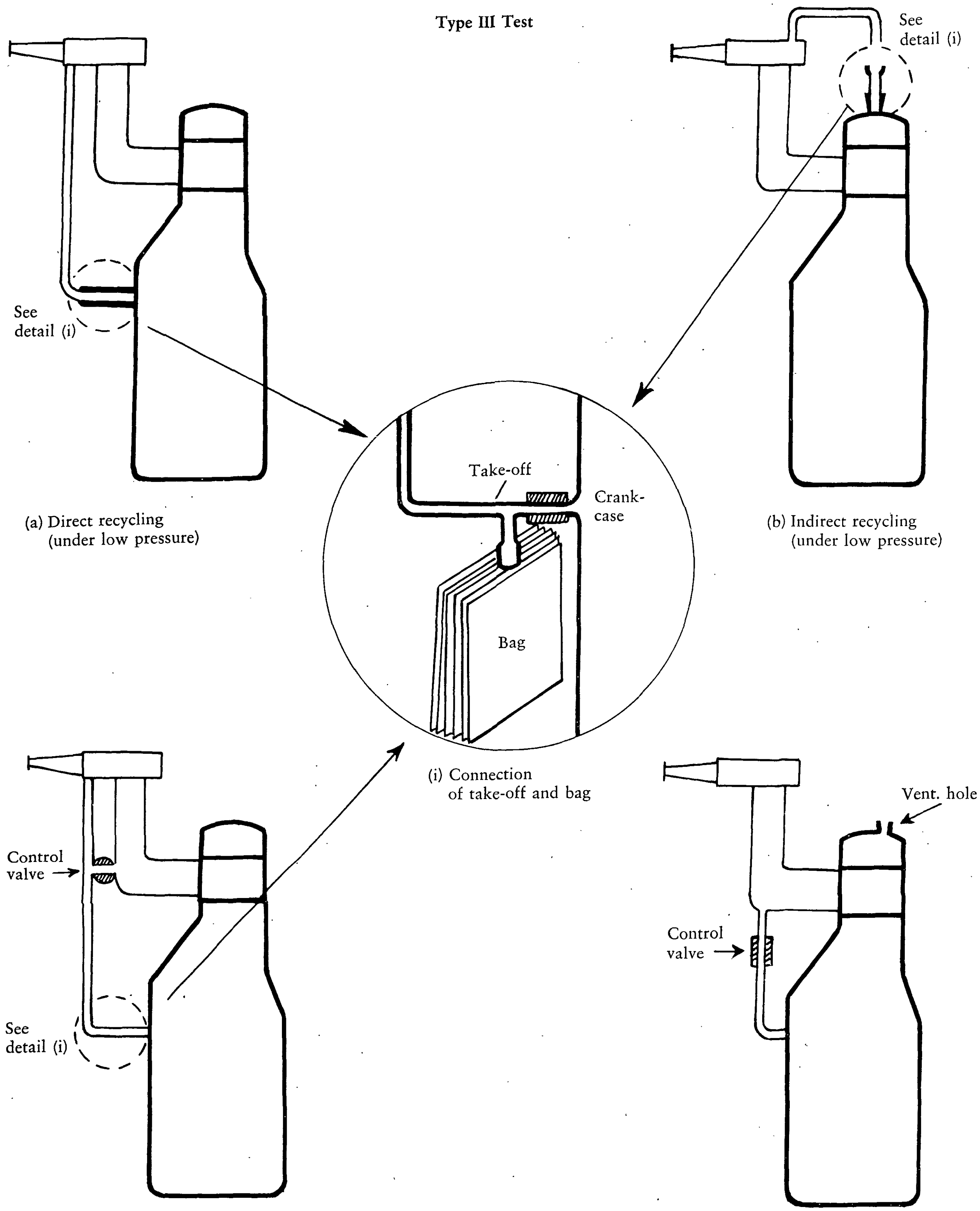
4.7.5. The temperature of the gases during measurement of the volume shall be measured to within ± 2 °C.

4.7.6. The hydrocarbon content shall be measured, if appropriate, to within ± 5%, irrespective of the degree of accuracy of the reference gases.

4.7.7. The fuel consumption shall be measured to within ± 4%.

APPENDIX

Type III Test



(a) Direct recycling
(under low pressure)

(b) Indirect recycling
(under low pressure)

(i) Connection
of take-off and bag

(c) Double-circuit direct recycling

(d) Crankcase with control valve
(The bag must be connected on the vent. hole)

ANNEX VI

Characteristics of reference fuel[1] and methods used to determine them

	Limits and units	Method
Research octane number	99 ± 1	ASTM[2] 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 Initial boiling point		
— 10% vol	50 ± 5 °C	ASTM D 86-67
— 50% vol	100 ± 10 °C	
— 90% vol	160 ± 10 °C	
Final boiling point	195 ± 10 °C	
— residue	max. 2% vol	
— loss	max. 1% vol	
Hydrocarbon analysis		ASTM D 1319-66 T
— olefins	18 ± 4% vol	
— aromatics	35 ± 5% vol	
— saturates	balance	
Oxidation stability	min. 480 minutes	ASTM D 525-55
(residual)	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
Lead content	0·57 ± 0·03 g/l 2·587 ± 0·136 g/IG	ASTM D 526-66
— nature of scavenger	motor mix	
— organic lead compound	not specified	
Other additives	nil	

[1] 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.

[2] Initials of the American Society for Testing and Materials, 1916 Race St Philadelphia, Pennsylvania 19103, U.S.A. The figures after the dash denote the year in which a standard was adopted or revised.
Should any ASTM standards be amended, the standards adopted in the years quoted above will remain applicable unless it is agreed to replace them by later standards.

ANNEX VII

Communication concerning the application of the Council Directive of 20 March 1970 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles

Name of administration

Registration No ....

1. Make (name of undertaking) ....

2. Type and trade description ....

3. Manufacturer's name and address ....

4. If applicable, name and address of manufacturer's authorised representative ....

5. Reference weight of vehicle ....

6. Technically permissible maximum weight of vehicle ....

7. Gearbox ....

7.1. Manual or automatic[1] ....

7.2. Number of gear ratios ....

7.3. Speed attained for each gear ratio at engine speed of 1000 rpm[2]

(first) ....

(second) ....

(third) ....

....

7.4. Check of performances referred to in Annex III, item 2.1.6 ....

....

8. Vehicle submitted for checks on ....

9. Technical service conducting tests ....

10. Date of report issued by that service ....

11. Number of report issued by that service ....

12. The vehicle satisfies/does not satisfy[1] the requirements

— mentioned in the first indent of Article 2 of this Directive

— mentioned in the second indent of Article 2 of this Directive.

13. The following documents, bearing the registration number shown above, are annexed to this communication:

one copy of Annex II, duly completed and with the drawings and diagrams referred to attached

one photograph of the engine and its compartment

one copy of the test report.

14. Place ....

15. Date ....

16. Signature ....

[1] Delete as appropriate.

[2] In the case of motor vehicles equipped with automatic gearboxes give all pertinent technical data.