Directive 98/69/EC of the European Parliament and of the Council of 13 October 1998 relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC (repealed)

ANNEX

AMENDMENTS TO THE ANNEXES TO DIRECTIVE 70/220/EEC

1. The list of Annexes inserted between the Articles and Annex I shall read as follows:

LIST OF ANNEXES

ANNEX I:SCOPE, DEFINITIONS, APPLICATION FOR EC TYPE-APPROVAL, GRANTING OF EC TYPE-APPROVAL, REQUIREMENTS AND TESTS, EXTENSION OF EC TYPE-APPROVAL, CONFORMITY OF PRODUCTION AND IN-SERVICE VEHICLES, ON-BOARD DIAGNOSTIC (OBD) SYSTEMSAppendix 1:Verification of production conformity(1st statistical method)Appendix 2:Verification of production conformity(2nd statistical method)Appendix 3:In-service conformity checkAppendix 4:Statistical procedure for in-service conformity testingANNEX II:INFORMATION DOCUMENTAppendix:Information on text conditionsANNEX III:TYPE I TEST (verifying the average tailpipe emissions after a cold start)Appendix 1:Operating cycle used for the type I testAppendix 2:Chassis dynamometerAppendix 3:Measurement method on the road-simulation on a chassis dynamometerAppendix 4:Verification of inertias other than mechanicalAppendix 5:Description of tailpipe emission-sampling systemsAppendix 6:Method of calibrating the equipmentAppendix 7:Total system verificationAppendix 8:Calculation of the emission of pollutantsANNEX IV:TYPE II TEST (carbon monoxide emission test at idling speed)ANNEX V:TYPE III TEST (verifying emissions of crankcase gases)ANNEX VI:TYPE IV TEST (determination of evaporative emissions from vehicles with positive-ignition engines)Appendix 1:Calibration frequency and methodsAppendix 2:Diurnal ambient temperature profile for the diurnal emission testANNEX VII:TYPE VI TEST: Verifying the average low ambient temperature carbon monoxide and hydrocarbon tailpipe emissions after a cold startANNEX VIII:TYPE V TEST (ageing test for verifying the durability of anti-pollution devices)ANNEX IX:SPECIFICATIONS OF REFERENCE FUELSANNEX X:MODEL EC TYPE-APPROVAL CERTIFICATEAppendix:Addendum to EC information documentANNEX XI:ON-BOARD-DIAGNOSTICS (OBD) FOR MOTOR VEHICLESAppendix 1:Functional aspects of OBD systemsAppendix 2:Essential characteristics of the vehicle family

ANNEX I

2. The heading reads as follows:

SCOPE, DEFINITIONS, APPLICATION FOR EC TYPE-APPROVAL, GRANTING OF EC TYPE-APPROVAL, REQUIREMENTS AND TESTS, EXTENSION OF EC TYPE-APPROVAL, CONFORMITY OF PRODUCTION AND IN-SERVICE VEHICLES, ON-BOARD DIAGNOSTIC (OBD) SYSTEMS.

3. Section 1:

The first sentence reads as follows:

This Directive applies to

— tailpipe emissions at normal and low ambient temperature, evaporative emissions, emissions of crankcase gases, the durability of anti-pollution devices and on-board diagnostic (OBD) systems of motor vehicles equipped with positive-ignition engines,

and

— tailpipe emissions, the durability of anti-pollution devices and on-board diagnostic (OBD) systems of vehicles of category M_1 and N_1[(1)], equipped with compression-ignition engines,

covered by Article 1 of Directive 70/220/EEC in the version of Directive 83/351/EEC, with the exception of those vehicles of categories N_1 for which type-approval has been granted pursuant to Directive 88/77/EEC[(2)].

4. New sections 2.13, 2.14, 2.15 and 2.16 are added to read as follows:

2.13. 'OBD' an on-board diagnostic system for emission control which has the capability of identifying the likely area of malfunction by means of fault codes stored in computer memory.

2.14. 'In-service test' means the test and evaluation of conformity conducted in accordance with section 7.1.7 of this Annex.

2.15. 'Properly maintained and used' means, for the purpose of a test vehicle, that such a vehicle satisfies the criteria for acceptance of a selected vehicle laid down in section 2 of Appendix 3 to this Annex.

2.16. "Defeat device" means any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use. Such an element of design may not be considered a defeat device if:

I. the need for the device is justified in terms of protecting the engine against damage or accident and for safe operation of the vehicle,

or

II. the device does not function beyond the requirements of engine starting, or

III. conditions are substantially included in the Type 1 or Type VI test procedures.

5. Sections 3 to 3.2.1 read as follows:

3. APPLICATION FOR EC TYPE-APPROVAL

3.1. The application for EC type-approval pursuant to Article 3 (4) of Directive 70/156/EEC of a vehicle type with regard to its tailpipe emissions, evaporative emissions, durability of anti-pollution devices as well as to its on-board diagnostic (OBD) system must be submitted by the vehicle manufacturer.

Should the application concern an on-board diagnostic (OBD) system the procedure described in Annex XI, section 3 must be followed.

3.1.1. Should the application concern an on-board diagnostic (OBD) system, it must be accompanied by the additional information required in section 3.2.12.2.8 of Annex II together with:

3.1.1.1. a declaration by the manufacturer of:

3.1.1.1.1. in the case of vehicles equipped with positive-ignition engines, the percentage of misfires out of a total number of firing events that would result in emissions exceeding the limits given in section 3.3.2 of Annex XI if that percentage of misfire had been present from the start of a type I test as described in section 5.3.1 of Annex III;

3.1.1.1.2. in the case of vehicles equipped with positive-ignition engines, the percentage of misfires out of a total number of firing events that could lead to an exhaust catalyst, or catalysts, overheating prior to causing irreversible damage;

3.1.1.2. detailed written information fully describing the functional operation characteristics of the OBD system, including a listing of all relevant parts of the vehicle's emission control system, i. e. sensors, actuators and components, that are monitored by the OBD system;

3.1.1.3. a description of the malfunction indicator (MI) used by the OBD system to signal the presence of a fault to a driver of the vehicle;

3.1.1.4. the manufacturer must describe provisions taken to prevent tampering with and modification of the emission control computer;

3.1.1.5. when appropriate, copies of other type-approvals with the relevant data to enable extensions of approvals;

3.1.1.6. if applicable, the particulars of the vehicle family as referred to in Annex XI, Appendix 2.

3.1.2. For the tests described in section 3 of Annex XI, a vehicle representative of the vehicle type or vehicle family fitted with the OBD system to be approved must be submitted to the technical service responsible for the type-approval test. If the technical service determines that the submitted vehicle does not fully represent the vehicle type or vehicle family described in Annex XI, Appendix 2, an alternative and if necessary an additional vehicle must be submitted for test in accordance with section 3 of Annex XI.

3.2. A model of the information document relating to tailpipe emissions, evaporative emissions, durability and the on-board diagnostic (OBD) system is given in Annex II.

3.2.1. Where appropriate, copies of other type-approvals with the relevant data to enable extension of approvals and establishment of deterioration factors must be submitted.

6. Sections 4 to 4.2 read as follows:

4. GRANTING OF EC TYPE-APPROVAL

4.1. If the relevant requirements are satisfied, EC type-approval is granted pursuant to Article 4 (3) of Directive 70/156/EEC.

4.2. A model of the EC type-approval certificate relating to tailpipe emissions, evaporative emissions, durability and the on-board diagnostic (OBD) system is given in Annex X.

7. Section 5:

The note is replaced by the following text:
Note:

As an alternative to the requirements of this section, vehicle manufacturers whose world-wide annual production is less than 10 000 units may obtain EC type-approval on the basis of the corresponding technical requirements in:

— the California Code of Regulations, Title 13, Sections 1960.1 (f) (2) or (g) (1) and (g) (2), 1960.1 (p) applicable to 1996 and later model year vehicles, 1968.1, 1976 and 1975, applicable to 1995 and later model year light-duty vehicles, published by Barclay's Publishing.

The type-approval authority must inform the Commission of the circumstances of each approval granted under this provision.

8. Section 5.1.1:

The second paragraph is replaced by the following:

> The technical measures taken by the manufacturer must be such as to unsure that the tailpipe and evaporative emissions are effectively limited, pursuant to this Directive, throughout the normal life of the vehicle and under normal conditions of use. This will include the security of those hoses and their joints and connections, used within the emission control systems, which must be so constructed as to conform with the original design intent.
>
> For tailpipe emissions, these provisions are deemed to be met if the provisions of sections 5.3.1.4 (type-approval) and section 7 (conformity of production and in-service vehicles) respectively are complied with.
>
> For evaporative emissions, these provisions are deemed to be met if the provisions of section 5.3.4 (type-approval) and section 7 (conformity of production) are complied with.

The former third and fourth paragraphs are deleted and replaced by a new paragraph reading as follows:

> The use of a defeat device is prohibited..

9. A new section 5.1.3 is added to read as follows:

5.1.3. Provision must be made to prevent excess evaporative emissions and fuel spillage caused by a missing fuel filler cap.

This may be achieved by using one of the following:

— an automatically opening and closing, non-removable fuel filler cap,

— design features which avoid excess evaporative emissions in the case of a missing fuel filler cap,

— any other provision which has the same effect. Examples may include, but are not limited to, a tethered filler cap, a chained filler cap ore one utilizing the same locking key for the filler cap as for the vehicle's ignition. In this case the key must be removable from the filler cap only in the locked condition.

10. Figure I.5.2 is replaced by the following new figure:

FIGURE I.5.2

Different routes for type-approval and extensions

Type-approval test	**Positive-ignition engined vehicles of categories M and N**	**Compression-ignition engined vehicles of categories M_1 and N_1**
Type I	Yes (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t)

a The Commission will as soon as possible, but not later than 31 December 1999, propose value limits for Classes II and III, in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC. These value limits shall be applied no later than 2003.

b The Commission will study further the question of extending the type-approval test to vehicles in Categories M_2 and N_2 with a reference mass not exceeding 2 840 kg and put forward proposals no later than 2004 in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC, for measures to be applied in 2005.

Type II	Yes	—
Type III	Yes	—
Type IV	Yes (maximum mass ≤ 3,5 t)	—
Type V	Yes (maximum mass ≤ 3,5 t)	Yes (maximum mass ≤ 3,5 t)
Type VI	Yes (vehicles in Category M_1 and Category N_1, Class 1[a]	—
Extension	Section 6	— Section 6 — M_2 and N_2 with reference mass not more than 2 840 kg[b]
On-board diagnostics	Yes in accordance with section 8.1	Yes in accordance with section 8.2 and 8.3

a The Commission will as soon as possible, but not later than 31 December 1999, propose value limits for Classes II and III, in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC. These value limits shall be applied no later than 2003.

b The Commission will study further the question of extending the type-approval test to vehicles in Categories M_2 and N_2 with a reference mass not exceeding 2 840 kg and put forward proposals no later than 2004 in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC, for measures to be applied in 2005.

11. Section 5.1:

New section 5.1.4 is added, as follows:

5.1.4. *Provisions for electronic system security*

5.1.4.1. Any vehicle with an emission control computer must include features to deter modification, except as authorised by the manufacturer. The manufacturer shall authorise modifications if these modifications are necessary for the diagnosis, servicing, inspection, retrofitting or repair of the vehicle. Any reprogrammable computer codes or operating parameters must be resistant to tampering and the computer and any related maintenance instructions must conform to the provisions in ISO DIS 15031-7. Any removable calibration memory chips must be potted, encased in a sealed container or protected by electronic algorithms and must not be changeable without the use of specialized tools and procedures.

5.1.4.2. Computer-coded engine operating parameters must not be changeable without the use of specialized tools and procedures (e. g. soldered or potted computer components or sealed (or soldered) computer enclosures).

5.1.4.3. In the case of mechanical fuel-injection pumps fitted to compression-ignition engines, manufacturers must take adequate steps to protect the maximum fuel delivery setting from tampering while a vehicle is in service.

5.1.4.4. Manufacturers may apply to the approval authority for an exemption to one of these requirements for those vehicles which are unlikely to require protection. The criteria that the approval authority will evaluate in considering an exemption will include, but

are not limited to, the current availability of performance chips, the high-performance capability of the vehicle and the projected sales volume of the vehicle.

5.1.4.5. Manufacturers using programmable computer code systems (e. g. Electrical Erasable Programmable Read-Only Memory, EEPROM) must deter unauthorized reprogramming. Manufacturers must include enhanced tamperprotection strategies including data encryption using methods to secure the encryption algorithm and write protect features requiring electronic access to an off-site computer maintained by the manufacturer. Comparable methods may be considered by the authority if they give the same level of protection.

12. Sections 5.2.1 and 5.2.3 are replaced by the following:

5.2.1. Positive-ignition engined vehicles must be subject to the following tests:
— Type I (verifying the average tailpipe emissions after a cold start),
— Type II (carbon monoxide emission at idling speed),
— Type III (emission of crankcase gases),
— Type IV (evaporation emissions),
— Type V (durability of anti-pollution control devices),
— Type VI (verifying the average low ambient temperature carbon monoxide and hydrocarbon tailpipe emissions after a cold start,
— OBD-test.

‘5.2.3. Compression-ignition engined vehicles must be subject to the following tests:
— Type I (verifying the average tailpipe emissions after a cold start)
— Type V (durability of anti-pollution control devices)
— and, where applicable, OBD test.’

13. Section 5.3.1.4:
— After the first paragraph a new table is inserted to read as follows:

			‘Reference mass (RW) (kg)	Limit values								
				Mass of carbon monoxide (CO)		Mass of hydrocarbons (HC)		Mass of oxides of nitrogen (NO_x)		Combined mass of hydrocarbons and oxides of nitrogen ($HC + NO_x$)		Mass of particulates[a] (PM)
				L_1 (g/km)		L_2 (g/km)		L_3 (g/km)		$L_2 + L_3$ (g/km)		L_4 (g/km)
Category		Class		Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Diesel
A (2000)	M[b]	—	all	2,3	0,64	0,20	—	0,15	0,50	—	0,56	0,05
	N_1[c]	I	RW ≤ 1305	2,3	0,64	0,20	—	0,15	0,50	—	0,56	0,05

a For compression ignition engines

b Except vehicles the maximum mass of which exceeds 2 500 kg.

c And those Category M vehicles which are specified in note 2.’

		II	1305 < RW ≤ 1760	4,17	0,80	0,25	—	0,18	0,65	—	0,72	0,07
		III	1760 < RW	5,22	0,95	0,29	—	0,21	0,78	—	0,86	0,10
B (2005)	M[b]	—	all	1,0	0,50	0,10	—	0,08	0,25	—	0,30	0,025
	N_1[c]	I	RW ≤ 1305	1,0	0,50	0,10	—	0,08	0,25	—	0,30	0,025
		II	1305 < RW ≤ 1760	1,81	0,63	0,13	—	0,10	0,33	—	0,39	0,04
		III	1760 < RW	2,27	0,74	0,16	—	0,11	0,39	—	0,46	0,6

a For compression ignition engines

b Except vehicles the maximum mass of which exceeds 2 500 kg.

c And those Category M vehicles which are specified in note 2.'

14. A new section 5.3.5 is added as follows:

5.3.5.[(3)] Type VI test (verifying the average low ambient temperature carbon monoxide and hydrocarbon tailpipe emissions after a cold start).

5.3.5.1. This test must be carried out on all M_1 and N_1 Class I[(4)] vehicles equipped with a positive-ignition engine, except vehicles designed to carry more than six occupants and vehicles whose maximum mass exceeds 2 500 kg.

5.3.5.1.1. The vehicle is placed on a chassis dynamometer equipped with a means of load an inertia simulation.

5.3.5.1.2. The test consists of the four elementary urban driving cycles of part one of the Type I test. The Part One test is described in Annex III, Appendix 1 and illustrated in figures III.1.1 and III.1.2 of the Appendix. The low ambient temperature test lasting a total of 780 seconds must be carried out without interruption and start at engine cranking.

5.3.5.1.3. The low ambient temperature test must be carried out at an ambient test temperature of 266 ^{o}K (-7 ^{o}C). Before the test is carried out the test vehicles must be conditioned in a uniform manner to ensure that the test results may be reproducible. The conditioning and other test procedures are carried out as described in Annex VII.

5.3.5.1.4. During the test the exhaust gases are diluted and a proportional sample collected. The exhaust gases of the vehicle tested are diluted, sampled and analysed, following the procedure described in Annex VII, and the total volume of the diluted exhaust

is measured. The diluted exhaust gases are analysed for carbon monoxide and hydrocarbons.

5.3.5.2. Subject to the requirements in 5.3.5.2.2 and 5.3.5.3 the test must be performed three times. The resulting mass of carbon monoxide and hydrocarbon emission must be less than the limits shown in the table below:

Test temperature	**Carbon monoxideL_1 (g/km)**	**HydrocarbonsL_2 (g/km)**
266 ^{o}K (- 7 ^{o}C)	15	1,8

5.3.5.2.1. Notwithstanding the requirements of 5.3.5.2, for each pollutant, not more than one of the three results obtained may exceed the limit prescribed by not more than 10 %, provided the arithmetical mean value of the three results is below the prescribed limit. Where the prescribed limits are exceeded for more than one pollutant it is immaterial whether this occurs in the same test or in different tests.

5.3.5.2.2. The number of tests prescribed in 5.3.5.2 may, at the request of the manufacturer, be increased to 10 provided that the arithmetical mean of the first three results falls between 100 % to 110 % of the limit. In this case, the requirement after testing is only that the arithmetical mean of all 10 results must be less than the limit value.

5.3.5.3. The number of tests prescribed in 5.3.5.2 may be reduced according to 5.3.5.3.1 and 5.3.5.3.2.

5.3.5.3.1. Only one test is performed if the result obtained for each pollutant of the first test is less than or equal to 0,70 L.

5.3.5.3.2. If the requirement of 5.3.5.3.1 is not satisfied, only two tests are performed if for each pollutant the result of the first test is less than or equal to 0,85 L and the sum of the first two results is less than or equal to 1,70 L and the result of the second test is less than or equal to L.

($V_1 \leq 0{,}85$ L and $V_1 + V_2 \leq 1{,}70$ L and $V_2 \leq$ L).

15. The former section 5.3.5 is renumbered as 5.3.6 and 5.3.6.3 is amended as follows:

'Engine Category	**Deterioration factors**				
	CO	**HC**	**NO_x**	**HC + NO_x[a]**	**Particulates**
Positive-ignition engines	1,2	1,2	1,2	—	—
Compression-ignition engines	1,1	—	1,0	1,0	1,2

a For compression-ignition engined vehicles.

5.3.6.3. Deterioration factors are determined using either the procedure in 5.3.6.1 or using the values in the table in 5.3.6.2. The deterioration factors are used to establish compliance with the requirements of 5.3.1.4.'

16. Insert new section 5.3.7:

‘5.3.7. *Emissions data required for roadworthiness testing*

5.3.7.1. This requirement applies to all vehicles powered by a positive-ignition engine for which EC type-approval is sought in accordance with this Directive.

5.3.7.2. When tested in accordance with Annex IV (type II test) at normal idling speed:

— the carbon monoxide content by volume of the exhaust gases emitted must be recorded,

— the engine speed during the test must be recorded, including any tolerances.

5.3.7.3. When tested at ‘high idle’ speed (i. e. > 2 000 min^{-1}):

— the carbon monoxide content by volume of the exhaust gases emitted must be recorded,

— the Lambda value[(5)] must be recorded.

— the engine speed during the test must be recorded, including any tolerances.

5.3.7.4. The engine oil temperature at the time of the test must be measured and recorded.

5.3.7.5. The table in section 1.9 of the Appendix to Annex X must be completed.

5.3.7.6. The manufacturer must confirm the accuracy of the Lambda value recorded at the time of type-approval in section 5.3.7.3 as being representative of typical production vehicles within 24 months of the date of the granting of type-approval by the technical service. An assessment must be made on the basis of surveys and studies of production vehicles.

17. Section 6.1 is amended as follows:

6.1. Tailpipe emission related extension (type I, type II and type VI tests).

18. Sections 6.1.2.1, 6.1.2.2 and 6.1.2.3 are amended as follows:

6.1.2.1. Fore each of the transmission rations used in the type I and type VI tests, ... (rest unchanged).

6.1.2.2. If, for each gear ratio, E ≤ 8 %, the extension is granted without repeating the type I and type VI tests.

6.1.2.3. If, for at least one gear ratio, E ≤ 8 %, and if, for each gear ratio, E ≤13 %, the type I and type VI tests must be repeated, ... (rest unchanged).

19. A new section 6.4 is added to read as follows:

6.4. **On-board diagnostics**

6.4.1. Approval granted to a vehicle type with respect to the OBD system may be extended to different vehicle types belonging to the same vehicle-OBD family as described in Annex XI, Appendix 2. The engine emission control system must be identical to that of the vehicle already approved and comply with the description of the OBD engine family given in Annex XI, Appendix 2, regardless of the following vehicle characteristics:

— engine accessories,

— tyres,

— equivalent inertia,

— cooling system,
— overall gear ratio,
— transmission type,
— type of bodywork.

20. Section 7.1 is amended as follows:

7.1. Measures to ensure the conformity of production must be taken in accordance with the provisions of Article 10 of Directive 70/156/EEC, as last amended by Directive 96/27/EEC (whole vehicle type-approval). That Article entrusts the manufacturer with the responsibility for taking measures to ensure the conformity of production to the type approved. Conformity of production is checked on the basis of the description in the type-approval certificate set out in Annex X to this Directive.

As a general rule, conformity of production with regard to limitation of tailpipe and evaporative emissions from the vehicle is checked on the basis of the description in the type-approval certificate set out in Annex X and, where necessary, of all or some of the tests of types I, II, III and IV described in section 5.2.

Conformity of in-service vehicles

With reference to type-approvals granted for emissions, these measures must also be appropriate for confirming the functionality of the emission control devices during the normal useful life of the vehicles under normal conditions of use (conformity of in-service vehicles properly maintained and used). For the purpose of this Directive these measures must be checked for a period of up to 5 years of age or 80 000 km, whichever is the sooner, and from 1 January 2005, for a period of up to five years of age or 100 000 km, whichever is the sooner.

7.1.1. Audit of in-service conformity by the type-approval authority is conducted on the basis of any relevant information that the manufacturer has, under procedures similar to those defined in Article 10 (1) and (2), and in Annex 10 (1) and (2) of Directive 70/156/EEC.

An audit of in-service conformity will be conducted by the type-approval authority on the basis of information supplied by the manufacturer. Such information must include:
— relevant surveillance test data obtained in accordance with applicable requirements and test procedures, together with full information for each tested vehicle such as vehicle status, use history, service conditions and other relevant factors;
— relevant information on service and repair measures,
— other relevant tests and observations recorded by the manufacturer, including especially records of indications from the OBD system.[(6)]

7.1.2. The information gathered by the manufacturer must be sufficiently comprehensive to ensure that in-service performance can be assessed for normal conditions of use as defined in 7.1, and in a way representative of the manufacturer's geographic market penetration.[(6)]

Sections 7.1. to 7.1.3 are renumbered as 7.1.3 to 7.1.5.

21. A new title and section 7.1.6 are added to read as follows:
On-board Diagnostics (OBD)

7.1.6. If a verification of the performance of the OBD system is to be carried out, it must be conducted in accordance with the following:

7.1.6.1. When the approval authority determines that the quality of production seems unsatisfactory a vehicle is randomly taken from the series and subjected to the tests described in Annex XI, Appendix 1.

7.1.6.2. The production is deemed to conform if this vehicle meets the requirements of the tests described in Annex XI, Appendix 1.

7.1.6.3. If the vehicle taken from the series does not satisfy the requirements of section 7.1.6.1 a further random sample of four vehicles must be taken from the series and subjected to the tests described in Annex XI, Appendix 1. The tests may be carried out on vehicles which have been run in for no more than 15 000 km.

7.1.6.4. The production is deemed to conform if at least 3 vehicles meet the requirements of the tests described in Annex XI, Appendix 1.

22. A new section 7.1.7. is added as follows:

7.1.7. On the basis of the audit referred to in 7.1.1, the type-approval authority must either:

— decide that conformity in use is satisfactory and not take any further action, or

— decide that the information is insufficient or the conformity of vehicles in use is unsatisfactory, and proceed to have vehicles tested in accordance with Appendix 3 to this Annex.

7.1.7.1. Where type I tests are considered necessary to check the conformity of emission control devices with the requirements for their performance while in service, such tests must be carried out using a test procedure meeting the statistical criteria defined in Appendix 4 to this Annex.

7.1.7.2. The type-approval authority, in cooperation with the manufacturer, must select a sample of vehicles with sufficient mileage whose use under normal conditions can be reasonably assured. The manufacturer must be consulted on the choice of the vehicles in the sample and be allowed to attend the confirmatory checks of the vehicles.

7.1.7.3. The manufacturer is authorized, under the supervision of the type-approval authority, to carry out checks, even of a destructive nature, on those vehicles with emission levels in excess of the limit values with a view to establishing possible causes of deterioration which cannot be attributed to the manufacturer himself (e. g. use of leaded petrol before the test date). Where the results of the checks confirm such causes, those test results are excluded from the conformity check.

7.1.7.4. Where the type-approval authority is not satisfied with the results of the tests in accordance with the criteria defined in Appendix 4, the remedial measures referred to in Article 11 (2) and in Annex X to Directive 70/156/EEC are extended to vehicles in service belonging to the same vehicle type which are likely to be affected with the same defects in accordance with section 6 of Appendix 3.

The plan of remedial measures presented by the manufacturer must be approved by the type-approval authority. The manufacturer is responsible for the execution of the remedial plan as approved.

The type-approval authority must notify its decision to all Member States within 30 days. The Member States may require the same plan of remedial measures be applied to all vehicles of the same type registered in their territory.

7.1.7.5. If a Member State has established that a vehicle type does not conform to the applicable requirements of Appendix 3 to this Annex, it must notify without delay the Member

State which granted the original type-approval in accordance with the requirements of Article 11 (3) of Directive 70/156/EEC.

Then, subject to the provision of Article 11(6) of Directive 70/156/EEC, the competent authority of the Member State which granted the original type-approval shall inform the manufacturer that a vehicle type fails to satisfy the requirements of these provisions and that certain measures are expected of the manufacturer. The manufacturer shall submit to the authority, within two months after this notification, a plan of measures to overcome the defects, the substance of which should correspond to the requirements of sections 6.1 to 6.8 of Appendix 3. The competent authority which granted the original type-approval shall, within two months, consult the manufacturer in order to secure agreement on a plan of measures and on carrying out the plan. If the competent authority which granted the original type-approval establishes that no agreement can be reached, the procedure pursuant to Article 11(3) and (4) of Directive 70/156/EEC shall be initiated.

23. Section 8 is deleted.

24. A new section 8 is added to read as follows:

8. ON-BOARD DIAGNOSTIC (OBD) SYSTEM FOR MOTOR VEHICLES

8.1. Vehicles of Category M_1 and N_1 equipped with positive-ignition engines must be fitted with an onboard diagnostic (OBD) system for emission control in accordance with Annex XI.

8.2. Vehicles of category M_1 equipped with compression-ignition engines, except

— vehicles designed to carry more than six occupants including the driver,

— vehicles whose maximum mass exceeds 2 500 kg,

from 1 January 2003 for new types and from 1 January 2004 for all types, must be fitted with an on-board diagnostic (OBD) system for emission control in accordance with Annex XI.

Where new types of compression-ingnition engined vehicles entering into service prior to this date are fitted with an OBD system, the provisions of sections 6.5.3 to 6.5.3.5 of Annex XI, Appendix 1, are applicable.

8.3. New types of Category M_1 exempted by section 8.2, and new types of vehicles in Category N_1 class I equipped with compression-ignition engines, must, from 1 January 2005, be fitted with an on-board diagnostic (OBD) system for emission control in accordance with Annex XI. New types of vehicles in Category N_1 Classes II and III equipped with compression-ignition engines must, from 1 January 2006, be fitted with on-board diagnostic (OBD) systems for emission control in accordance with Annex XI.

Where compression-ignition engined vehicles entering into service prior to the dates given in this section are fitted with OBD systems, the provisions of sections 6.5.3 to 6.5.3.5 of Annex XI, Appendix 1, are applicable.

8.4. **Vehicles of other Categories**

Vehicles of other Categories or vehicles of Category M_1 and N_1 not covered by 8.1, 8.2 or 8.3, may be fitted with an on-board diagnostic system. In this case, sections sections 6.5.3 to 6.5.3.5 of Annex XI, Appendix 1, are applicable.

25. New Appendices 3 and 4 are added as follows:

Appendix 3

IN-SERVICE CONFORMITY CHECK

1. INTRODUCTION

This Appendix sets out the criteria referred to in section 7.1.7 of this Annex regarding the selection of vehicles for testing and the procedures for the in-service conformity control.

2. SELECTION CRITERIA

The criteria for acceptance of a selected vehicle are defined in sections 2.1 to 2.8 of this Appendix. Information is collected by vehicle examination and an interview with the owner/ driver.

2.1. The vehicle must belong to a vehicle type that is type-approved under this Directive and covered by a certificate of conformity in accordance with Directive 70/156/EEC. It must be registered and used in the European Community.

2.2. The vehicle must have been in service for at least 15 000 km or 6 months, whichever is the later, and for no more than 80 000 km or 5 years, whichever is the sooner.

2.3. There must be a maintenance record to show that the vehicle has been properly maintained, e. g. has been serviced in accordance with the manufacturer's recommendations.

2.4. The vehicle must exhibit no indications of abuse (e. g. racing, overloading, misfuelling, or other misuse), or other factors (e. g. tampering) that could affect emission performance. In the case of vehicles fitted with an OBD system, the fault code and mileage information stored in the computer are taken into account. A vehicle must not be selected for testing if the information stored in the computer shows that the vehicle has operated after a fault code was stored and a relatively prompt repair was not carried out.

2.5. There must have been no unauthorized major repair to the engine or major repair of the vehicle.

2.6. The lead content and sulphur content of a fuel sample from the vehicle tank must meet applicable standards and there must be no evidence of misfuelling. Checks may be done in the tailpipe, etc.

2.7. There must be no indication of any problem that might jeopardize the safety of laboratory personnel.

2.8. All anti-pollution system components on the vehicle must be in conformity with the applicable type-approval.

3. DIAGNOSIS AND MAINTENANCE

Diagnosis and any normal maintenance necessary must be performed on vehicles accepted for testing, prior to measuring exhaust emissions, in accordance with the procedure laid down in section 3.1 to 3.7.

3.1. The following checks must be carried out: checks on air filter, all drive belts, all fluid levels, radiator cap, all vacuum hoses and electrical wiring related to the antipollution system for integrity; checks on ignition, fuel metering and anti-pollution device components for maladjustments and/or tampering. All discrepancies must be recorded.

3.2. The OBD system shall be checked for proper functioning. Any malfunction indications in the OBD memory must be recorded and the requisite repairs must be carried out. If the OBD malfunction indicator registers a malfunction during a preconditioning cycle, the fault may be identified and repaired. The test may be re-run and the results of that repaired vehicle used.

3.3. The ignition system must be checked and defective components replaced, for example spark plugs, cables, etc.

3.4. The compression must be checked. If the result is unsatisfactory the vehicle is rejected.

3.5. The engine parameters must be checked to the manufacturer's specifications and adjusted if necessary.

3.6. If the vehicle is within 800 km of a scheduled maintenance service, that service must be performed according to the manufacturer's instructions. Regardless of odometer reading, the oil and air filter may be changed at the request of the manufacturer.

3.7. Upon acceptance of the vehicle, the fuel must be replaced with appropriate emission test reference fuel, unless the manufacturer accepts the use of market fuel.

4. IN-SERVICE TESTING

4.1. When a check on vehicles is deemed necessary, emission tests in accordance with Annex III to this Directive are performed on pre-conditioned vehicles selected in accordance with the requirements of sections 2 and 3 of this Appendix.

4.2. Vehicles equipped with an OBD system may be checked for proper in-service functionality of the malfunction indication, etc., in relation to levels of emissions (e. g. the malfunction indication limits defined in Annex XI to this Directive) for the type-approved specifications.

4.3. The OBD system may be checked, for example, for levels of emissions above the applicable limit values with no malfunction indication, systematic erroneous activation of the malfunction indication and identified faulty or deteriorated components in the OBD system.

4.4. If a component or system operates in a manner not covered by the particulars in the type-approval certificate and/or information package for such vehicle types and such deviation has not been authorized under Article 5 (3) or (4) of Directive 70/156/EEC, with no malfunction indication by the OBD, the component or system must not be replaced prior to emission testing, unless it is determined that the component or system has been tampered with or abused in such a manner that the OBD does not detect the resulting malfunction.

5. EVALUATION OF RESULTS

5.1. The test results are submitted to the evaluation procedure in accordance with Appendix 4 to this Annex.

5.2. Test results must not be multiplied by deterioration factors.

6. PLAN OF REMEDIAL MEASURES

6.1. When the type-approval authority is certain that a vehicle type is not in conformity with the requirements of these provisions, it must request the manufacturer to submit a plan of remedial measures to remedy the non-compliance.

6.2. The plan of remedial measures must be filed with the type-approval authority not later than 60 working days from the date of the notification referred to in section 6.1. The type-approval authority must within 30 working days declare its approval or disapproval of the plan of remedial measures. However, where the manufacturer can demonstrate, to the satisfaction of the competent type-approval authority, that further time is required to investigate the non-compliance in order to submit a plan of remedial measures, an extension is granted.

6.3. The remedial measures must apply to all vehicles likely to be affected by the same defect. The need to amend the type-approval documents must be assessed.

6.4. The manufacturer must provide a copy of all communications related to the plan of remedial measures, and must also maintain a record of the recall campaign, and supply regular status reports to the type-approval authority.

6.5. The plan of remedial measures must include the requirements specified in 6.5.1 to 6.5.11. The manufacturer must assign a unique identifying name or number to the plan of remedial measures.

6.5.1. A description of each vehicle type included in the plan of remedial measures.

6.5.2. A description of the specific modifications, alterations, repairs, corrections, adjustments, or other changes to be made to bring the vehicles into conformity including a brief summary of the data and technical studies which support the manufacturer's decision as to the particular measures to be taken to correct the non-conformity.

6.5.3. A description of the method by which the manufacturer informs the vehicle owners.

6.5.4. A description of the proper maintenance or use, if any, which the manufacturer stipulates as a condition of eligibility for repair under the plan of remedial measures, and an explanation of the manufacturer's reasons for imposing any such condition. No maintenance or use conditions may be imposed unless it is demonstrably related to the non-conformity and the remedial measures.

6.5.5. A description of the procedure to be followed by vehicle owners to obtain correction of the non-conformity. This must include a date after which the remedial measures may be taken, the estimated time for the workshop to perform the repairs and where they can be done. The repair must be done expediently, within a reasonable time after delivery of the vehicle.

6.5.6. A copy of the information transmitted to the vehicle owner.

6.5.7. A brief description of the system which the manufacturer uses to assure an adequate supply of component or systems for fulfilling the remedial action. It must be indicated when there will be an adequate supply of components or systems to initiate the campaign.

6.5.8. A copy of all instructions to be sent to those persons who are to perform the repair.

6.5.9. A description of the impact of the proposed remedial measures on the emissions, fuel consumption, driveability, and safety of each vehicle type, covered by the plan of remedial measures with data, technical studies, etc. which support these conclusions.

6.5.10. Any other information, reports or data the type-approval authority may reasonably determine is necessary to evaluate the plan of remedial measures.

6.5.11. Where the plan of remedial measures includes a recall, a description of the method for recording the repair must be submitted to the type-approval authority. If a label is used, an example of it must be submitted.

6.6. The manufacturer may be required to conduct reasonably designed and necessary tests on components and vehicles incorporating a proposed change, repair, or modification to demonstrate the effectiveness of the change, repair, or modification.

6.7. The manufacturer is responsible for keeping a record of every vehicle recalled and repaired and the workshop which performed the repair. The type-approval authority must have access to the record on request for a period of 5 years from the implementation of the plan of remedial measures.

6.8. The repair and/or modification or addition of new equipment shall be recorded in a certificate supplied by the manufacturer to the vehicle owner.

Appendix 4[8]

STATISTICAL PROCEDURE FOR IN-SERVICE CONFORMITY TESTING

1. This Appendix describes the procedure to be used to verify the in-service conformity requirements for the type I test.

2. Two different procedures are to be followed:

1. One dealing with vehicles identified in the sample, due to an emission-related defect, causing outliers in the results (section 3).

2. The other dealing with the total sample (section 4).

3. PROCEDURE TO BE FOLLOWED WITH OUTLYING EMITTERS IN THE SAMPLE.

3.1. A vehicle is said to be an outlying emitter, when for any regulated component the limit value as shown in section 5.3.1.4 of Annex I is exceeded significantly.

3.2. With a minimum sample size of 3, and a maximum sample size as determined by the procedure of paragraph 4, the sample is scanned for the occurrence of outlying emitters.

3.3. When an outlying emitter is found, the cause of the excess emission must be determined.

3.4. When more than one vehicle is found to be an outlying emitter, due to the same cause, the sample is regarded as having failed.

3.5. When only one outlying emitter has been found, or when more than one outlying emitter is found, but due to different causes, the sample is increased by one vehicle, unless the maximum sample size has already been reached.

3.5.1. When in the increased sample more than one vehicle is found to be an outlying emitter, due to the same cause, the sample is regarded as having failed.

3.5.2. When in the maximum sample size not more than one outlying emitter is found, where the excess emission is due to the same cause, the sample is regarded as having passed with regard to the requirements of section 3 of this Appendix.

3.6. Whenever a sample is increased due to the requirements of 3.5, the statistical procedure of paragraph 4 is applied to the increased sample.

4. PROCEDURE TO BE FOLLOWED WITHOUT SEPARATE EVALUATION OF OUTLYING EMITTERS IN THE SAMPLE.

4.1. With a minimum sample size of three the sampling procedure is set so that the probability of a batch passing a test with 40 % of the production defective is 0,95 (producer's risk = 5 %) while the probability of a batch being accepted with 75 % of the production defective is 0,15 (consumer's risk = 15 %).

4.2. For each of the pollutants given in section 6.2.1 of Annex I, the following procedure is used (see Figure 1/7).

Where

L = the limit value for the pollutant,
X_i = the value of the measurement for the i-th vehicle of the sample,
n = the current sample number.

4.3. The test statistic quantifying the number of non-conforming vehicles, i. e. $x_i > L$, is computed for the sample.

4.4. Then:

— if the test statistic does not exceed the pass decision number for the sample size given in the following table, a pass decision is reached for the pollutant,

— if the test statistic equals or exceeds the fail decision number for the sample size given in the following table, a fail decision is reached for the pollutant,

— otherwise, an additional vehicle is tested and the procedure is applied to the sample with one extra unit.

In the following table the pass and fail decision numbers are computed in accordance with the International Standard ISO 8422:1991.

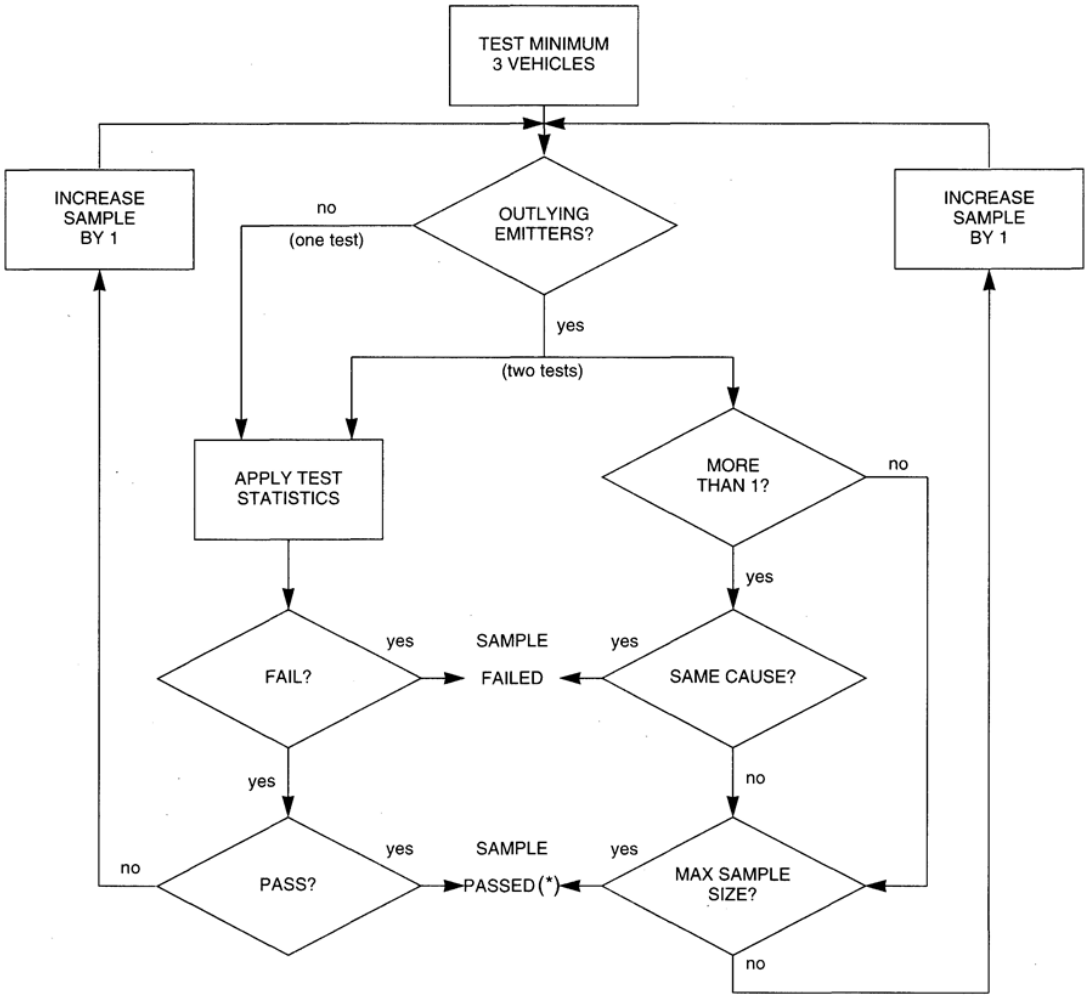
5. A sample is regarded as having passed the test when it has passed both the requirements of sections 3 and 4 of this Appendix.

TABLE FOR ACCEPTANCE — REJECTION SAMPLING PLAN BY ATTRIBUTES

Cumulative sample size	Pass decision number	Fail decision number
3	0	—
4	1	—
5	1	5
6	2	6
7	2	6
8	3	7
9	4	8
10	4	8
11	5	9

12	5	9
13	6	10
14	6	11
15	7	11
16	8	12
17	8	12
18	9	13
19	9	13
20	11	12

Figure



(*) If it fullfills both tests'.

I.7

ANNEX II

26. Section 3.2.1.6 is amended to read:

3.2.1.6. Normal engine idling speed (including tolerance)

min^{-1}

3.2.1.6.1. High idle engine speed (including tolerance)

min^{-1}

27. The following new sections and footnotes are added to section 3:

‘3.2.12.2.8. On-board-diagnostic (OBD) system

3.2.12.2.8.1. Written description and/or drawing of the MI:

...

3.2.12.2.8.2. List and purpose of all components monitored by the OBD system:

...

3.2.12.2.8.3. Written description (general working principles) for:

...

3.2.12.2.8.3.1. Positive-ignition engines[7]:

...

3.2.12.2.8.3.1.1. Catalyst monitoring[7]:

...

3.2.12.2.8.3.1.2. Misfire detection

...

3.2.12.2.8.3.1.3. Oxygen sensor monitoring[7]:

...

3.2.12.2.8.3.1.4. Other components monitored by the OBD system

...

3.2.12.2.8.3.2. Compression-ignition engines

...

3.2.12.2.8.3.2.1. Catalyst monitoring[7]:

...

3.2.12.2.8.3.2.2. Particulate trap monitoring[7]:

...

3.2.12.2.8.3.2.3. Electronic fuelling system monitoring[7]:

...

3.2.12.2.8.3.2.4. Other components monitored by the OBD system[7]:

...

3.2.12.2.8.4. Criteria for MI activation (fixed number of driving cycles or statistical method):

...

3.2.12.2.8.5. List of all OBD output codes and formats used (with explanation of each):

...

ANNEX III

28. Section 2.3.1:

— Paragraphs 2 and 3 are deleted.

— Paragraph 2 (former paragraph 4) reads as follows:

‘Vehicles which do not attain the acceleration ... ’ (rest unchanged).

29. Section 6.1.3:

The first sentence reads as follows:

A current of air of variable speed is blown over the vehicle.

30. Section 6.2.2:

The first cycle starts on the initiation of the engine start-up procedure

Section 7.1:

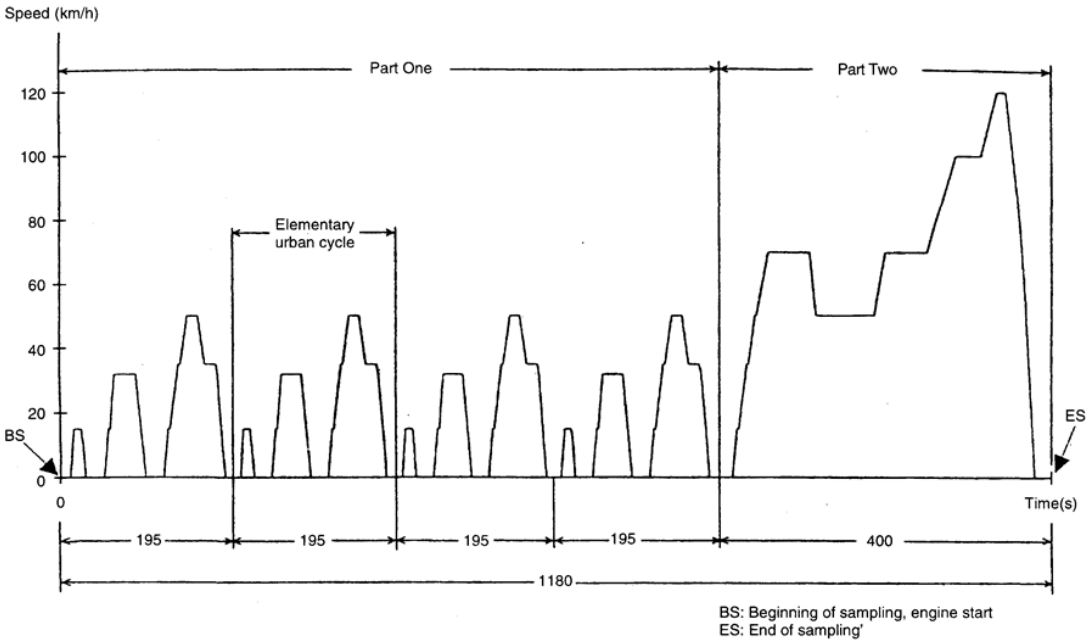
Sampling begins (BS) before or at the initiation of the engine start-up procedure and ends on conclusion of the final idling period in the extra-urban cycle (part two, end of sampling (ES)) or, in the case of test type VI of the final idling period of the last elementary cycle (part one).

Appendix 1

31. Section 1.1:

— Figure III.1.1 is replaced by the following new figure:

Figure III.1.1 **Operating cycle for the Type I test**



— In the English version in column 5 of Table III. 1.2 (entitled:'Speed (km/h)'); operation 23 reads as follows:

35-10

32. Sections 4 to 4.3 including Table III.1.4 and Figure III.1.4 are deleted.

Appendix 3

33. Section 5.1.1.2.7:

In the English version, the formula reads as follows:

$^{mm}P = \frac{M \, V \, \Delta \, V}{500 \, T^{abs}}$,,

ANNEX VI

34. Sections 1 to 6 read as follows:

'1. INTRODUCTION

This Annex describes the procedure for the Type IV test in accordance with section 5.3.4 of Annex I.

This procedure describes a method for a determination of the loss of hydrocarbons by evaporation from the fuel systems of vehicles with positive-ignition engines.

2. DESCRIPTION OF TEST

The evaporative emission test (Figure VI. 1) is designed to determine hydrocarbon evaporative emissions as a consequence of diurnal temperatures fluctuation, hot soaks during parking, and urban driving. The test consists of these phases:

— test preparation including an urban (Part One) and extra-urban (Part Two) driving cycle,
— hot soak loss determination,
— diurnal loss determination.

Mass emissions of hydrocarbons from the hot soak and the diurnal loss phases are added up to provide an overall result for the test.

3. VEHICLE AND FUEL

3.1. **Vehicle**

3.1.1. The vehicle must be in good mechanical condition and have been run in and driven at least 3 000 km before the test. The evaporative emission control system must be connected and have been functioning correctly over this period and the carbon canister(s) must have been subject to normal use, neither undergoing abnormal purging nor abnormal loading.

3.2. **Fuel**

3.2.1. The appropriate reference fuel must be used, as defined in Annex IX to this Directive.

4. TEST EQUIPMENT FOR EVAPORATIVE TEST

4.1. **Chassis dynamometer**

The chassis dynamometer must meet the requirements of Annex III.

4.2. **Evaporative emission measurement enclosure**

The evaporative emission measurement enclosure must be a gas-tight rectangular measuring chamber able to contain the vehicle under test. The vehicle must be accessible from all sides and the enclosure when sealed must be gas tight in accordance with Appendix 1. The inner surface of the enclosure must be impermeable and non-reactive to hydrocarbons. The temperature conditioning system must be capable of controlling the internal enclosure air temperature to follow the prescribed temperature versus time profile throughout the test, and an average tolerance of ± 1 K over the duration of the test.

The control system must be tuned to provide a smooth temperature pattern that has a minimum of overshoot, hunting, and instability about the desired long-term ambient temperature profile. Interior surface temperatures must not be less than 278 ^{o}K (5 ^{o}C) nor more than 320 ^{o}K (55 ^{o}C) at any time during the diurnal emission test.

Wall design must be such as to promote good dissipation of heat. Interior surface temperatures must not be below 293 ^{o}K (20 ^{o}C), nor above 325 ^{o}K (52 ^{o}C) for the duration of the hot soak test.

To accommodate the volume changes due to enclosure temperature changes, either a variable-volume or fixed-volume enclosure may be used.

4.2.1. *Variable-volume enclosure*

The variable-volume enclosure expands and contracts in response to the temperature change of the air mass in the enclosure. Two potential means of accommodating the internal volume changes are movable panel(s), or a bellows design, in which an impermeable bag or bags inside the enclosure expand(s) and contracts(s) in response to internal pressure changes by exchanging air from outside the enclosure. Any design for volume accommodation must maintain the integrity of the enclosure as specified in Appendix 1 over the specified temperature range.

Any method of volume accommodation must limit the differential between the enclosure internal pressure and the barometric pressure to a maximum value of ± 5 hPa.

The enclosure must be capable of latching to a fixed volume. A variable volume enclosure must be capable of accommodating a ± 7 % change from its 'nominal volume' (see Appendix 1 section 2.1.1), taking into account temperature and barometric pressure variation during testing.

4.2.2. *Fixed-volume enclosure*

The fixed-volume enclosure must be constructed with rigid panels that maintain a fixed enclosure volume, and meet the requirements below.

4.2.2.1. The enclosure must be equipped with an outlet flow stream that withdrawns air at a low, constant rate from the enclosure throughout the test. An inlet flow stream may provide make-up air to balance the outgoing flow with incoming ambient air. Inlet air must be filtered with activated carbon to provide a relatively constant hydrocarbon level. Any method of volume accommodation must maintain the differential between the enclosure internal pressure and the barometric pressure between 0 and -5 hPa.

4.2.2.2. The equipment must be capable of measuring the mass of hydrocarbon in the inlet and outlet flow streams with a resolution of 0,01 gram. A bag sampling system may be used to collect a proportional sample of the air withdrawn from and admitted to the enclosure. Alternatively, the inlet and outlet flow streams may be continuously analysed using an on-line FID analyser and integrated with the flow measurements to provide a continuous record of the mass hydrocarbon removal.

4.3. **Analytical systems**

4.3.1. *Hydrocarbon analyser*

4.3.1.1. The atmosphere within the chamber is monitored using a hydrocarbon detector of the flame ionization detector (FID) type. Sample gas must be drawn from the mid-point of one side wall or roof of the chamber and any bypass flow must be returned to the enclosure, preferably to a point immediately downstream of the mixing fan.

4.3.1.2. The hydrocarbon analyser must have a response time to 90 % of final reading of less than 1,5 seconds. Its stability must be better than 2 % of full scale at zero and at 80 % ± 20 % of full scale over a 15-minute period for all operational ranges.

4.3.1.3. The repeatability of the analyser expressed as one standard deviation must be better than 1 % of full scale deflection at zero and at 80 % ± 20 % of full scale on all ranges used.

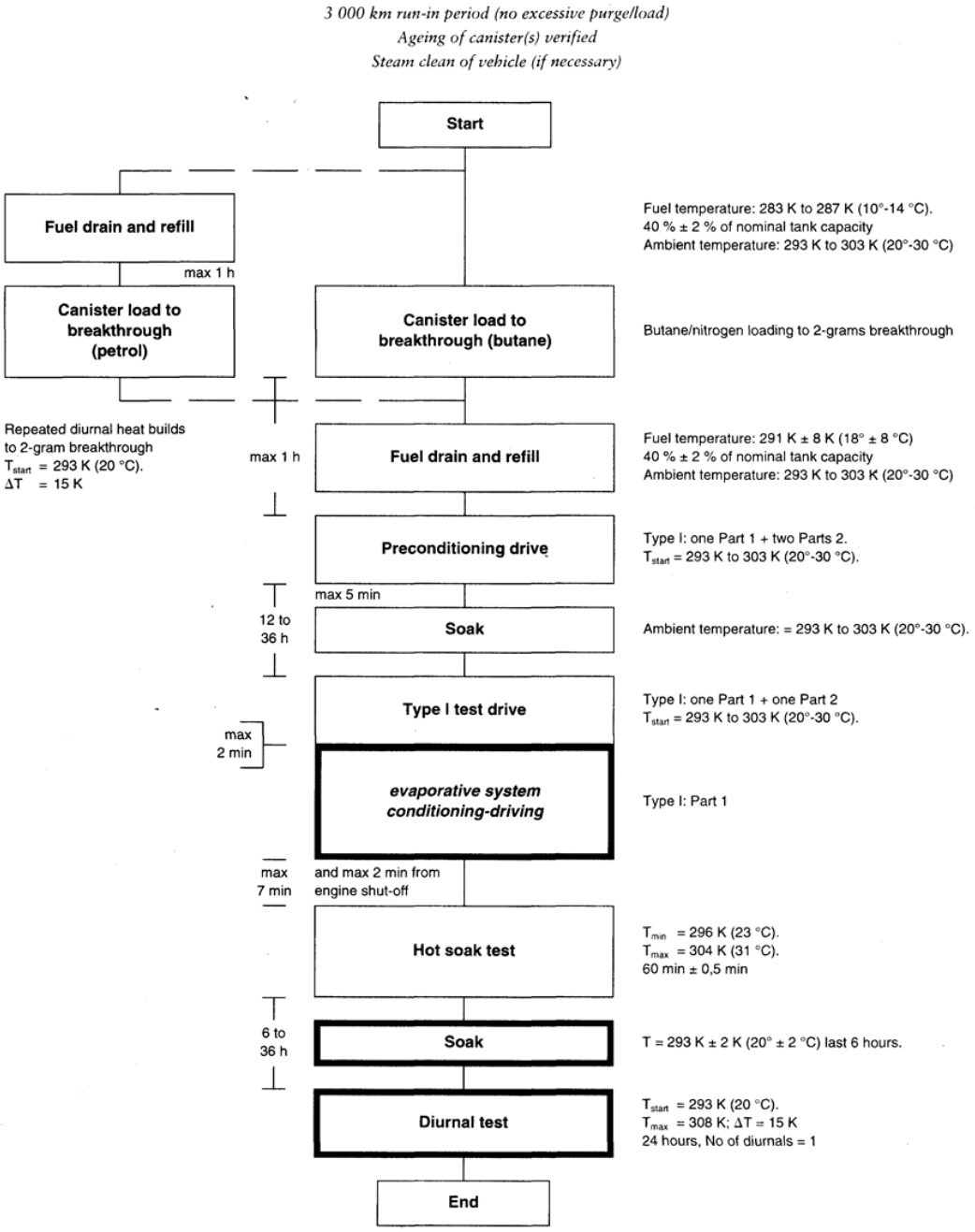
4.3.1.4. The operational ranges of the analyser must be chosen to give best resolution over the measurement, calibration and leak checking procedures.

4.3.2. *Hydrocarbon analyser data recording system*

4.3.2.1. The hydrocarbon analyser must be fitted with a device to record electrical signal output either by strip chart recorder or other data processing system at a frequency of at least once per minute. The recording system must have operating characteristics at least equivalent to the signal being recorded and must provide a permanent record of results. The record must show a positive indication of the beginning and end of the hot soak or diurnal emission test (including beginning and end of sampling periods along with the time elapsed between start and completion of each test).

Figure VI.1

Evaporative emission determination



Note: 1. Evaporative emission control families — details clarified.
2. Tailpipe emissions may be measured during type I test drive, but these are not used for legislative purposes. Exhaust emission legislative test remains separate.

4.4. Fuel tank heating (only applicable for gasoline canister load option)

4.4.1. The fuel in the vehicle tank(s) must be heated by a controllable source of heat; for example a heating pad of 2 000 W capacity is suitable. The heating system must apply heat evenly to the tank walls beneath the level of the fuel so as not to cause local overheating of the fuel. Heat must not be applied to the vapour in the tank above the fuel.

4.4.2. The tank heating device must make it possible to heat the fuel in the tank evenly by 14 ^{o}K from 289 ^{o}K (16 ^{o}C) within 60 minutes, with the temperature sensor position as in 5.1.1. The heating system must be capable of controlling the fuel temperature to ± 1,5 ^{o}K of the required temperature during the tank heating process.

4.5. **Temperature recording**

4.5.1. The temperature in the chamber is recorded at two points by temperature sensors which are connected so as to show a mean value. The measuring points are extended approximately 0,1 m into the enclosure from the vertical centre line of each side wall at a height of 0,9 ± 0,2 m.

4.5.2. The temperatures of the fuel tank(s) are recorded by means of the sensor positioned in the fuel tank as in 5.1.1 in the case of use of the gasoline canister load option (5.1.5).

4.5.3. Temperatures must, throughout the evaporative emission measurements, be recorded or entered into a data processing system at a frequency of at least once per minute.

4.5.4. The accuracy of the temperature recording system must be within ± 1,0 ^{o}K and the temperature must be capable of being resolved to ± 04, ^{o}K.

4.5.5. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.6. **Pressure recording**

4.6.1. The difference Δ_p between barometric pressure within the test area and the enclosure internal pressure must, throughout the evaporative emission measurements, be recorded or entered into a data processing system at a frequency of at least once per minute.

4.6.2. The accuracy of the pressure recording system must be within ± 2 hPa and the pressure must be capable of being resolved to ± 0,2 hPa.

4.6.3. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.7. **Fans**

4.7.1. By the use of one or more fans or blowers with the SHED door(s) open it must be possible to reduce the hydrocarbon concentration in the chamber to the ambient hydrocarbon level.

4.7.2. The chamber must have one or more fans or blowers of likely capacity 0,1 to 0,5 m^3s^{-1} with which to thoroughly mix the atmosphere in the enclosure. It must be possible to attain an even temperature and hydrocarbon concentration in the chamber during measurements. The vehicle in the enclosure must not be subjected to a direct stream of air from the fans or blowers.

4.8. **Gases**

4.8.1. The following pure gases must be available for calibration and operation:

— purified synthetic air (purity: < 1 ppm C_1 equivalent ≤ 1 ppm CO_2 ≤ 400 ppm CO_2, ≤ 0,1 ppm NO); oxygen content between 18 % and 21 % by volume,

— hydrocarbon analyser fuel gas (40 % ± 2 % hydrogen, and balance helium with less than 1 ppm C_1 equivalent hydrocarbon, less than 400 ppm CO_2),

— propane (C_3H_8), 99,5 % minimum purity,

— butane (C_4H_{10}), 98 % minimum purity,

— nitrogen (N_2), 98 % minimum purity.

4.8.2. Calibration and span gases must be available containing mixtures of propane (C_3H_8) and purified synthetic air. The true concentrations of a calibration gas must be within ± 2 % of stated figures. The accuracy of the diluted gases obtained when using a gas divider must be to within ± 2 % of the true value. The concentrations specified in Appendix 1 may also be obtained by the use of a gas divider using synthetic air as the diluent gas.

4.9. **Additional equipment**

4.9.1. The absolute humidity in the tests area must be measurable to within ± 5 %.

5. TEST PROCEDURE

5.1. **Test preparation**

5.1.1. The vehicle is mechanically prepared before the test as follows:

— the exhaust system of the vehicle must not exhibit any leaks,

— the vehicle may be steam cleaned before the test,

— in the case of use of the gasoline canister load option (5.1.5) the fuel tank of the vehicle must be equipped with a temperature sensor to enable the temperature to be measured at the mid-point of the fuel in the fuel tank when filled to 40 % of its capacity,

— additional fittings, adapters of devices may be fitted to the fuel system in order to allow a complete draining of the fuel tank. For this purpose it is not necessary to modify the shell of the tank,

— the manufacturer may propose a test method in order to take into account the loss of hydrocarbons by evaporation coming only from the fuel system of the vehicle.

5.1.2. The vehicle is taken into the test area where the ambient temperature is between 293 ^oK and 303 ^oK (20 and 30 ^oC).

5.1.3. The ageing of the canister(s) has to be verified. This may be done by demonstrating that it has accumulated a minimum of 3 000 km. If this demonstration is not given, the following procedure is used. In the case of a multiple canister system each canister must undergo the procedure separately.

5.1.3.1. The canister is removed from the vehicle. Special care must be taken during this step to avoid damage to components and the integrity of the fuel system.

5.1.3.2. The weight of the canister must be checked.

5.1.3.3. The canister is connected to a fuel tank, possibly an external one, filled with reference fuel, to 40 % volume of the fuel tank(s).

5.1.3.4. The fuel temperature in the fuel tank must be between 283 ^oK (10 ^oC) and 287 ^oK (14 ^oC).

5.1.3.5. The (external) fuel tank is heated from 288 ^oK to 318 ^oK (15 ^{o} to 45 ^oC) (1 ^oC increase every 9 minutes).

5.1.3.6. If the canister reaches breakthrough before the temperature reaches 318 ^{o}K (45 ^{o}C), the heat source must be turned off. Then the canister is weighed. If the canister did not reach breakthrough during the heating to 318 ^{o}K (45^{oo}C), the procedure from 5.1.3.3 must be repeated until breakthrough occurs.

5.1.3.7. Breakthrough may be checked as is described in 5.1.5 and 5.1.6 of this Annex, or with the use of another sampling and analytical arrangement capable of detecting the emission of hydrocarbons from the canister at breakthrough.

5.1.3.8. The canister must be purged with 25 ± 5 litres per minute with the emission laboratory air until 300 bed volume exchanges are reached.

5.1.3.9. The weight of the canister must be checked.

5.1.3.10. The steps of the procedure in 5.1.3.4 to 5.1.3.9 must be repeated nine times. The test may be terminated prior to that, after not less than three ageing cycles, if the weight of the canister after the last cycles has stabilized.

5.1.3.11. The evaporative emission canister is reconnected and the vehicle restored to its normal operating condition.

5.1.4. One of the methods specified in 5.1.5 and 5.1.6 must be used to precondition the evaporative canister. For vehicles with multiple canisters, each canister must be preconditioned separately.

5.1.4.1. Canister emissions are measured to determine breakthrough.

Breakthrough is here defined as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams.

5.1.4.2. Breakthrough may be verified using the evaporative emission enclosure as described in 5.1.5 and 5.1.6 respectively. Alternatively, breakthrough may be determined using an auxiliary evaporative canister connected downstream of the vehicle's canister. The auxiliary canister must be well purged with dry air prior to loading.

5.1.4.3. The measuring chamber must be purged for several minutes immediately before the test until a stable background is obtained. The chamber air mixing fan(s) must be switched on at this time.

The hydrocarbon analyser must be zeroed and spanned immediately before the test.

5.1.5. *Canister loading with repeated heat builds to breakthrough*

5.1.5.1. The fuel tank(s) of the vehicle(s) is (are) emptied using the fuel tank drain(s). This must be done so as not to abnormally purge or abnormally load the evaporative control devices fitted to the vehicle. Removal of the fuel cap is normally sufficient to achieve this.

5.1.5.2. The fuel tank(s) is (are) refilled with test fuel at a temperature of between 283 ^{o}K to 287 ^{o}K (10 to 14 ^{o}C) to 40 % ± 2 % of the tank's normal volumetric capacity. The fuel cap(s) of the vehicle must be fitted at this point.

5.1.5.3. Within one hour of being refuelled the vehicle must be placed, with the engine shut off, in the evaporative emission enclosure. The fuel tank temperature sensor is connected to the temperature recording system. A heat source must be properly positioned with respect to the fuel tank(s) and connected to the temperature controller. The heat source

is specified in 4.4. In the case of vehicles fitted with more than one fuel tank, all the tanks must be heated in the same way as described below. The temperatures of the tanks must be identical to within ± 1,5 ^{o}K.

5.1.5.4. The fuel may be artificially heated to the starting diurnal temperature of 293 ^{o}K (20 ^{o}C) ± 1 ^{o}K.

5.1.5.5. When the fuel temperature reaches at last 292 ^{o}K (19 ^{o}C), the following steps must be taken immediately: the purge blower must be turned off; enclosure doors closed and sealed; and measurement initiated of the hydrocarbon level in the enclosure.

5.1.5.6. When the fuel temperature of the fuel tank reaches 293 ^{o}K (20 ^{o}C) a linear heat build of 15 ^{o}K (15 ^{o}C) begins. The fuel must be heated in such a way that the temperature of the fuel during the heating conforms to the function below to within ± 1,5 ^{o}K. The elapsed time of the heat build and temperature rise is recorded.

$T_r = T_0 + 0{,}2333 \times t$

where:

T_r = required temperature (K);
T_0 = initial temperature (K);
t = time from start of the tank heat build in minutes.

5.1.5.7. As soon as breakthrough occurs or when the fuel temperature reaches 308 ^{o}K (35 ^{o}C), whichever occurs first, the heat source is turned off, the enclosure doors unsealed and opened, and the vehicle fuel tank cap(s) removed. If breakthrough has not occurred by the time the fuel temperature 308 ^{o}K (35 ^{o}C), the heat source is removed from the vehicle, the vehicle removed from the evaporative emission enclosure and the entire procedure outlined in 5.1.7 repeated until breakthrough occurs.

5.1.6. *Butane loading to breakthrough*

5.1.6.1. If the enclosure is used for the determination of the breakthrough (see 5.1.4.2) the vehicle must be placed, with the engine shut off, in the evaporative emission enclosure.

5.1.6.2. The evaporative emission canister must be prepared for the canister loading operation. The canister must not be removed from the vehicle, unless access to it in its normal location is so restricted that loading can only reasonably be accomplished by removing the canister from the vehicle. Special care must be taken during this step to avoid damage to the components and the integrity of the fuel system.

5.1.6.3. The canister is loaded with a mixture composed of 50 % butane and 50 % nitrogen by volume at a rate of 40 grams butane per hour.

5.1.6.4. As soon as the canister reaches breakthrough, the vapour source must be shut off.

5.1.6.5. The evaporative emission canister must then be reconnected and the vehicle restored to its normal operating condition.

5.1.7. *Fuel drain and refill*

5.1.7.1. The fuel tank(s) of the vehicle(s) is (are) emptied using the fuel tank drain(s). This must be done so as not to abnormally purge or abnormally load the evaporative control devices fitted to the vehicle. Removal of the fuel cap is normally sufficient to achieve this.

5.1.7.2. The fuel tank(s) is (are) refilled with test fuel at a temperature of between 291 ^{o}K ± 8 ^{o}K (18 ± 8 ^{o}C) to 40 ± 2 % of the tank's normal volumetric capacity. The fuel cap(s) of the vehicle must be fitted at this point.

5.2. **Preconditioning drive**

5.2.1. Within one hour from the completing of canister loading in accordance with 5.1.5 or 5.1.6 the vehicle is placed on the chassis dynamometer and driven through one Part One and two Part Two driving cycles of Type I test as specified in Annex III. Exhaust emissions are not sampled during this operation.

5.3. **Soak**

5.3.1. Within five minutes of completing the preconditioning operation specified in 5.2.1 the engine bonnet must be completely closed and the vehicle driven off the chassis dynamometer and parked in the soak area. The vehicle is parked for a minimum of 12 hours and a maximum of 36 hours. The engine oil and coolant temperatures must have reached the temperature of the area or within ± 3 ^{o}K of it at the end of the period.

5.4. **Dynamometer test**

5.4.1. After conclusion of the soak period the vehicle is driven through a complete Type I test drive as described in Annex III (cold start urban and extra urban test). Then the engine is shut off. Exhaust emissions may be sampled during this operation but the results must not be used for the purpose of exhaust emission type-approval.

5.4.2. Within two minutes of completing the Type I test drive specified in 5.4.1 the vehicle is driven a further conditioning drive consisting of one urban test cycle (hot start) of a Type I test. Then the engine is shut off again. Exhaust emissions need not be sampled during this operation.

5.5. **Hot soak evaporative emissions test**

5.5.1. Before the completion of the conditioning drive the measuring chamber must be purged for several minutes until a stable hydrocarbon background is obtained. The enclosure mixing fan(s) must also be turned on at this time.

5.5.2. The hydrocarbon analyser must be zeroed and spanned immediately prior to the test.

5.5.3. At the end of the conditioning drive the engine bonnet must be completely closed and all connections between the vehicle and the test stand disconnected. The vehicle is then driven to the measuring chamber with a minimum use of the accelerator pedal. The engine must be turned off before any part of the vehicle enters the measuring chamber. The time at which the engine is switched off is recorded on the evaporative emission measurement data recording system and temperature recording begins. The vehicle's windows and luggage compartments must be opened at this stage, if not already opened.

5.5.4. The vehicle must be pushed or otherwise moved into the measuring chamber with the engine switched off.

5.5.5. The enclosure doors are closed and sealed gas-tight within two minutes of the engine being switched off and within seven minutes of the end of the conditioning drive.

5.5.6. The start of a 60 ± 0,5 minute hot soak period begins when the chamber is sealed. The hydrocarbon concentration, temperature and barometric pressure are measured to give

the initial readings $C_{HC,i}$ P_i and T_i for the hot soak test. These figures are used in the evaporative emission calculation, section 6. The ambient SHED temperature T must not be less than 296 ^oK and no more than 304 ^oK during the 60-minute hot soak period.

5.5.7. The hydrocarbon analyser must be zeroed and spanned immediately before the end of the 60 ± 0,5 minute test period.

5.5.8. At the end of the 60 ± 0,5 minute test period the hydrocarbon concentration in the chamber must be measured. The temperature and the barometric pressure are also measured. These are the final readings $C_{HC,f}$, P_f and T_f for the hot soak test used for the calculation in section 6.

5.6. **Soak**

5.6.1. The test vehicle must be pushed or otherwise moved to the soak area without use of the engine and soaked for not less than 6 hours and not more than 36 hours between the end of the hot soak test and the start of the diurnal emission test. For at least 6 hours of this period the vehicle must be soaked at 293 ^oK ± 2 ^oK (20 ^oC ± 2 ^oC).

5.7. **Diurnal test**

5.7.1. The test vehicle must be exposed to one cycle of ambient temperature according to the profile specified in Appendix 2 with a maximum deviation of ± 2 ^oK at any time. The average temperature deviation from the profile, calculated using the absolute value of each measured deviation, must not exceed 1 ^oK. Ambient temperature must be measured at least every minute. Temperature cycling begins when time t_{start} = 0, as specified in 5.7.6.

5.7.2. The measuring chamber must be purged for several minutes immediately before the test until a stable background is obtainable. The chamber mixing fan(s) must also be switched on at this time.

5.7.3. The test vehicle, with the engine shut off and the test vehicle windows and luggage compartment(s) opened must be moved into the measuring chamber. The mixing fan(s) must be adjusted in such a way as to maintain a minimum air circulation of 8 km/h under the fuel tank of the test vehicle.

5.7.4. The hydrocarbon analyser must be zeroed and spanned immediately before the test.

5.7.5. The enclosure doors must be closed and gas-tight sealed.

5.7.6. Within 10 minutes of closing and sealing the doors, the hydrocarbon concentration, temperature and barometric pressure are measured to give the initial readings $C_{HC,i}$, P_f and T_f for the diurnal test. This is the point where time t_{Start} = 0.

5.7.7. The hydrocarbon analyser must be zeroed and spanned immediately before the end of the test.

5.7.8. The end of the emission sampling period occurs 24 hours ± 6 minutes after the beginning of the initial sampling, as specified in 5.7.6. The time elapsed is recorded. The hydrocarbon concentration, temperature and barometric pressure are measured to give the final readings $C_{HC,i}$, P_f and T_f for the diurnal test used for the calculation in section 6. This completes the evaporative emission test procedure.

6. CALCULATION

6.1. The evaporative emission tests described in section 5 allow the hydrocarbon emissions from the diurnal and hot soak phases to be calculated. Evaporative losses from each of theses phases is calculated using the initial and final hydrocarbon concentrations, temperatures and pressures in the enclosure, together with the net enclosure volume.

The formula below is used:

$$M_{HC} = k \cdot V \cdot 10^{-4} \cdot \left(\frac{C_{HC,f} \cdot P_f}{T_f} - \frac{C_{HC,i} \cdot P_i}{T_i} \right) + M_{HC,\,out} - M_{HC,\,i}$$

where:

M_{HC}	=	hydrocarbon mass in grams
$M_{HC,out}$	=	mass of hydrocarbon exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing (grams).
$M_{HC,i}$	=	mass of hydrocarbon entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing (grams).
C_{HC}	=	measured hydrocarbon concentration in the enclosure (ppm (volume) C_1 equivalent),
V	=	net enclosure volume in cubic metres corrected for the volume of the vehicle, with the windows and the luggage compartment open. If the volume of the vehicle is not determined a volume of 1,42 m^3 is subtracted.
T	=	ambient chamber temperature, in ^oK,
P	=	barometric pressure in kPA,
H/C	=	hydrogen to carbon ration,
k	=	1,2 · (12 + H/C);

where:

i	is the initial reading,
f	is the final reading,
H/C	is taken to be 2,33 for diurnal test losses,
H/C	is taken to be 2,20 for hot soak losses.

6.2. **Overall results of test**

The overall hydrocarbon mass emission for the vehicle is taken to be:

$M_{total} = M_{DI} + M_{HS}$

where:

M_{total}	=	overall mass emissions of the vehicle (grams),
M_{DI}	=	HYDROCARBON MASS EMISSION FOR DIURNAL TEST (GRAMS),
M_{HS}	=	HYDROCARBON MASS EMISSION FOR THE HOT SOAK (GRAMS).'

Appendix 1

35. Sections 1 and 2 read as follows:

1. CALIBRATION FREQUENCY AND METHODS

1.1. All equipment must be calibrated before its initial use and then calibrated as often as necessary and in any case in the month before type-approval testing. The calibration methods to besued are described in this Appendix.

1.2. Normally the series of temperatures which are mentioned firstly must be used. The series of temperatures within square brackets may alternatively be used.

2. CALIBRATION OF THE ENCLOSURE

2.1. **Initial determination of enclosure internal volume**

2.1.1. Before its initial use, the internal volume of the chamber must be determined as follows. The internal dimensions of the chamber are carefully measured, allowing for any irregularities such as bracing struts. The internal volume of the chamber is determined from these measurements.

For variable-volume enclosures, the enclosure must be latched to a fixed volume when the enclosure is held at an ambient temperature of 303 ^{o}K (30 ^{o}C) [(302 ^{o}K (29 ^{o}C)]. This nominal volume must be repeatable within ± 0,5 % of the reported value.

2.1.2. The net internal volume is determined by subtracting 1,42 m^3 from the internal volume of the chamber. Alternatively the volume of the test vehicle with the luggage compartment and windows open may be used instead of the 1,42 m^3.

2.1.3. The chamber must be checked as in 2.3. If the propane mass does not agree with the injected mass to within ± 2 % then corrective action is required.

2.2. **Determination of chamber background emissions**

This operation determines that the chamber does not contain any materials that emit significant amounts of hydrocarbons. The check must be carried out at the enclosure's introduction to service, after any operations in the enclosure which may affect background emissions and at a frequency of at least once per year.

2.2.1. Variable-volume enclosures may be operated in either latched or unlatched volume configuration, as described in 2.1.1 Ambient temperatures must be maintained at 308 ^{o}K ± 2 ^{o}K (35^{o} ± 2 ^{o}C) [309 ^{o}K ± 2 ^{o}K (36^{o} ± 2 ^{o}C)|, throughout the 4-hour period mentioned below.

2.2.2. Fixed volume enclosures must be operated with inlet and outlet flow streams closed. Ambient temperatures must be maintained at 308 ^{o}K ± 2 ^{o}K (35^{o} ± 2 ^{o}C) [309 ^{o}K ± 2 ^{o}K (36^{o} ± 2 ^{o}C)] throughout the four-hour period mentioned below.

2.2.3. The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the four-hour background sampling period begins.

2.2.4. The analyser (if required) must be calibrated, then zeroed and spanned.

2.2.5. The enclosure must be purged until a stable hydrocarbon reading is obtained, and the mixing fan turned on if not already on.

2.2.6. The chamber is then sealed and the background hydrocarbon concentration, temperature and barometric pressure are measured. These are the initial readings $C_{HC,i}$, P_i and T_i used in the enclosure background calculation.

2.2.7. The enclosure is allowed to stand undisturbed with the mixing fan on for a period of four hours.

2.2.8. At the end of this time the same analyser is used to measure the hydrocarbon concentration in the chamber. The temperature and the barometric pressure are also measured. These are the final readings $C_{HC,f}$, P_f and T_f.

2.2.9. The change in mass of hydrocarbons in the enclosure must be calculated over the time of the test in accordance with 2.4 and must not exceed 0,05 g.

2.3. **Calibration and hydrocarbon retention test of the chamber**

The calibration and hydrocarbon retention test in the chamber provides a check on the calculated volume in 2.1 and also measures any leak rate. The enclosure leak rate must be determined at the enclosure's introduction to service, after any operations in the enclosure which may affect the integrity of the enclosure, and at least monthly thereafter. If six consecutive monthly retention checks are successfully completed without corrective action, the enclosure leak rate may be determined quarterly thereafter as long as no corrective action is required.

2.3.1. The enclosure must be purged until a stable hydrocarbon concentration is reached. The mixing fan is turned on, if not already switched on. The hydrocarbon analyser is zeroed, calibrated if required, and spanned.

2.3.2. On variable-volume enclosures the enclosure must be latched to the nominal volume position. On fixed-volume enclosures the outlet and inlet flow streams must be closed.

2.3.3. The ambient temperature control system is then turned on (if not already on) and adjusted for an initial temperature of 308 ^{o}K (35 ^{o}C) [309 ^{o}K (36 ^{o}C)].

2.3.4. When the enclosure stabilizes at 308 ^{o}K ± 2 ^{o}K (35^{o} ± 2 ^{o}C) [309 ^{o}K ± 2 ^{o}K (36^{o} ± 2 ^{o}C)], the enclosure is sealed and the background concentration, temperature and barometric pressure measured. These are the initial readings $C_{HC,i}$, P_i and T_i used in the enclosure calibration.

2.3.5. A quantity of approximately 4 grams of propane is injected into the enclosure. The mass of propane must be measured to an accuracy and precision of ± 02, % of the measured value.

2.3.6. The contents of the chamber must be allowed to mix for five minutes and then the hydrocarbon concentration, temperature and barometric pressure are measured. These are the final readings $C_{HC,f}$, P_f and T_f for the calibration of the enclosure as well as the initial readings $C_{HC,i,}$ P_i and T_i for the retention check.

2.3.7. On the basis of the readings taken in 2.3.4 and 2.3.6 and the formula in 2.4, the mass of propane in the enclosure is calculated. This must be within ± 2 % of the mass of propane measured in 2.3.5..

2.3.8. For variable-volume enclosures the enclosure must be unlatched from the nominal volume configuration. For fixed-volume enclosures, the outlet and inlet flow streams must be opened.

2.3.9. The process is then begun of cycling the ambient temperature from 308 ^{o}K (35 ^{o}C) to 293 ^{o}K (20 ^{o}C) and back to 308 ^{o}K (35 ^{o}C) [308,6 ^{o}K (35,6 ^{o}C) to 295,2 ^{o}K (22,2 ^{o}C) and back to 308,6 ^{o}K (35,6 ^{o}C)] over a 24-hour period according to the profile [alternative profile] specified in Appendix 2 within 15 minutes of sealing the enclosure. (Tolerances as specified in section 5.7.1 of Annex VI).

2.3.10. At the completion of the 24-hour cycling period, the final hydrocarbon concentration, temperature and barometric pressure are measured and recorded. These are the final readings $C_{HC,f}$, T_f and P_f for the hydrocarbon retention check.

2.3.11. Using the formula in 2.4, the hydrocarbon mass is then calculated from the readings taken in 2.3.10 and 2.3.6. The mass may not differ by more than 3 % from the hydrocarbon mass given by 2.3.7.

2.4. **Calculations**

The calculation of net hydrocarbon mass change within the enclosure is used to determine the chamber's hydrocarbon background and leak rate. Initial and final readings of hydrocarbon concentration, temperature and barometric pressure are used in the following formula to calculate the mass change.

$$M_{HC} = k \cdot V \cdot 10^{-4} \cdot \left(\frac{C_{HC,f} \cdot P_f}{T_f} - \frac{C_{HC,i} \cdot P_i}{T_i} \right) + M_{HC,out} - M_{HC,i}$$

where:

M_{HC} = hydrocarbon mass in grams
$M_{HC,out}$ = mass of hydrocarbon exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing (grams)
$M_{HC,i}$ = mass of hydrocarbon entering the enclosure, in the case of fixed volume enclosures for diurnal emission testing (grams)
C_{HC} = hydrocarbon concentration in the enclosure (ppm carbon (NB: ppm carbon = ppm propane x 3))
V = enclosure volume in cubic metres as measured in section 2.1.1.
T = ambient temperature in the enclosure in K,
P = barometric pressure in kPa,
k = 17,6;

where:

i is the initial reading.
f is the final reading

Appendix 2

36. The following new Appendix 2 is added:

AppendixDiurnal ambient temperature profile for the calibration 2 of the enclosure and the diurnal emission testTime(hours)Temperature(oCi)calibrationtest1602017120,218220,519321,220423,121525,122627,223

ALTERNATIVE DIURNAL AMBIENT TEMPERATURE PROFILE FOR THE CALIBRATION OF THE ENCLOSURE IN ACCORDANCE WITH APPENDIX 1, SECTIONS 1.2 AND 2.3.9

Time(hours)	**Temperature($^{o}C_i$)**
0	35,6
1	35,3
2	34,5
3	33,2

4	31,4
5	29,7
6	28,2
7	27,2
8	26,1
9	25,1
10	24,3
11	23,7
12	23,3
13	22,9
14	22,6
15	22,2
16	22,5
17	24,2
18	26,8
19	29,6
20	31,9
21	33,9
22	35,1
23	35,4
24	35,6

ANNEX VII

37. A new Annex VII is introduced as follows:

ANNEX VII

TYPE VI TEST

(Verifying the average low ambient temperature carbon monoxide and hydrocarbon tailpipe emissions after a cold start)

1. INTRODUCTION

This Annex applies only to vehicles with positive-ignition engines. It describes the equipment required and the procedure for the Type VI test defined in section 5.3.5 of Annex I in order to verify the emissions of carbon monoxide and hydrocarbons at low ambient temperatures. Topics addressed in this Annex include:

1. Equipment requirements;

2. Test conditions;

3. Test procedures and data requirements.

2. TEST EQUIPMENT

2.1. **Summary**

2.1.1. This chapter deals with the equipment needed for low ambient temperature exhaust emission tests on positive-ignition vehicles. Equipment required and specifications are equivalent to the requirements for the Type I test as specified in Annex III, with appendices, if specific requirements for the Type VI test are not prescribed. Sections 2.2 to 2.6 describe deviations applicable to Type VI low ambient temperature testing.

2.2. **Chassis dynamometer**

2.2.1. The requirements of section 4.1 of Annex III apply. The dynamometer must be adjusted to simulate the operation of a vehicle on the road at 266 ^{o}K (-7 ^{o} C). Such adjustment may be based on a determination of the road load force profile at 266 ^{o}K (-7 ^{o} C). Alternatively the driving resistance determined according to Appendix 3 of Annex III may be adjusted for a 10 % decrease of the coast-down time. The technical service may approve the use of other methods of determining the driving resistance.

2.2.2. For calibration of the dynamometer the provisions of Appendix 2 of Annex III apply.

2.3. **Sampling system**

2.3.1. The provisions of section 4.2 of Annex III and Appendix 5 of Annex III apply. Section 2.3.2 in Appendix 5 is modified to read: "The piping configuration, flow capacity of the CVS, and the temperature and specific humidity of the dilution air (which may be different from the vehicle combustion air source) must be controlled so as to virtually eliminate water condensation in the system (a flow of 0,142 to 0,165 m^2/s is sufficient for most vehicles)."

2.4. **Analytical equipment**

2.4.1. The provisions of section 4.3 of Annex III apply, but only for carbon monoxide, carbon dioxide, and hydrocarbon testing.

2.4.2. For calibrations of the analytical equipment the provisions of Appendix 6 of Annex III apply.

2.5. **Gases**

2.5.1. The provisions of section 4.5 of Annex III apply, where they are relevant.

2.6. **Additional equipment**

2.6.1. For equipment used for the measurement of volume, temperature, pressure and humidity the provisions in sections 4.4 and 4.6 of Annex III apply.

3. TEST SEQUENCE AND FUEL

3.1. **General requirements**

3.1.1. The test sequence in Figure VII. 1 shows the steps encountered as the test vehicle undergoes the procedures for the Type VI test. Ambient temperature levels encountered by the test vehicle must average: 266 ^{o}K (-7 ^{o}C) ± 3 ^{o}K and must:

not be less than 260 ^{o}K (-13 ^{o}C), no more than 272 ^{o}K (-1 ^{o}C).

The temperature may:

not fall below 263 ^{o}K (-10 ^{o}C), or exceed 269 ^{o}K (-4 ^{o}C)

for more than three consecutive minutes.

3.1.2. The test cell temperature monitored during testing must be measured at the output of the cooling fan (section 5.2.1 of this Annex). The ambient temperature reported must be an arithmetic average of the test cell temperatures measured at constant intervals no more than one minute apart.

3.2. **Test procedure**

The part one urban driving cycle according to Figure III.1.1 in Annex III - Appendix 1, consists of four elementary urban cycles which together makes a complete part one cycle.

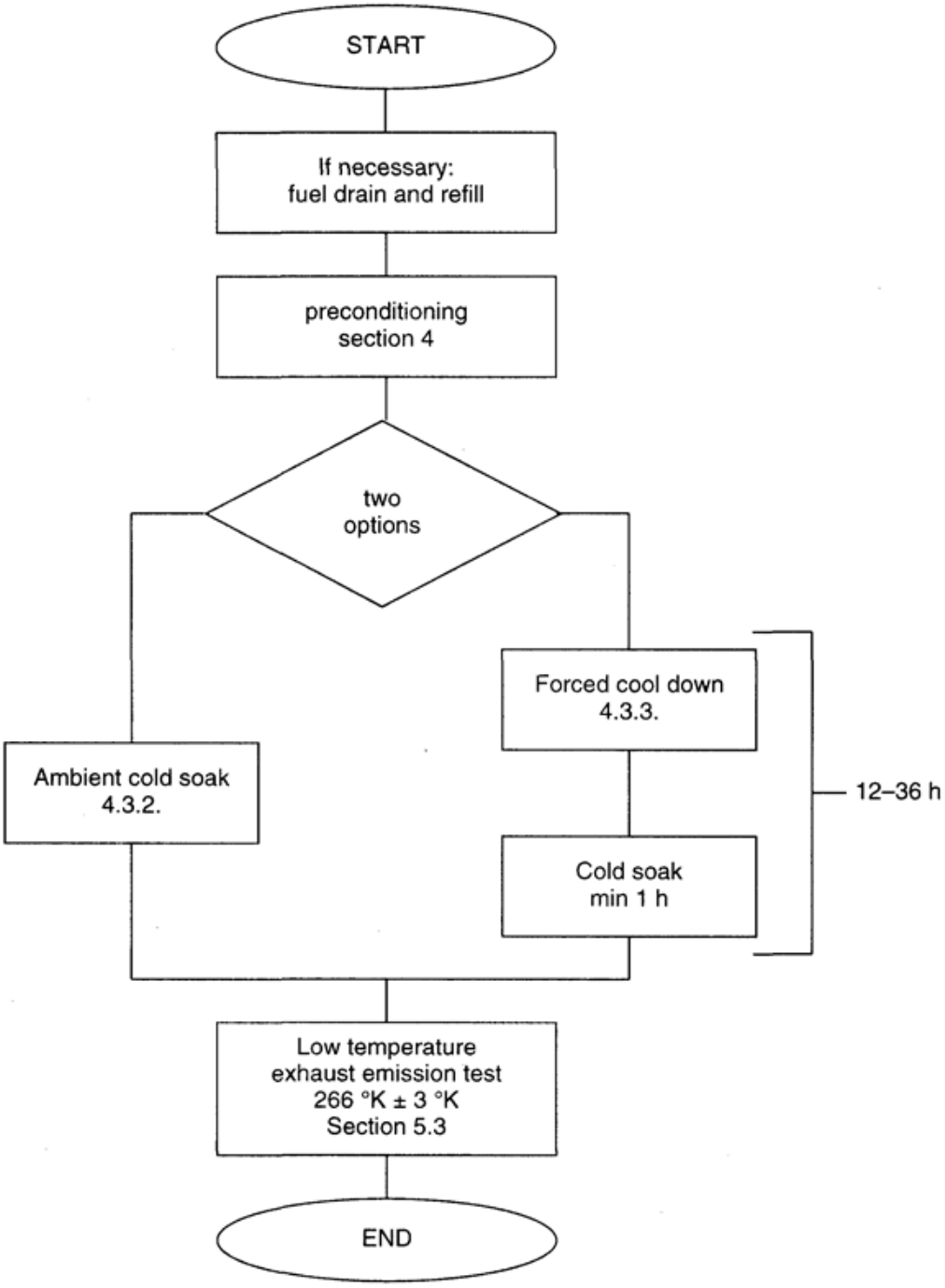
3.2.1. Start of engine, start of the sampling and the operation of the first cycle must be in accordance with Table III.1.2 and Figure III. 1.2.

3.3. **Preparation for the test**

3.3.1. For the test vehicle the provisions of section 3.1 of Annex III apply. For setting the equivalent inertia mass on the dynamometer the provisions of section 5.1 of Annex III apply.

Figure VII.1

Procedure for low ambient temperature test



3.4. **Test fuel**

3.4.1. The test fuel used must have the specification that follows from the provisions in section 3 of Annex IX. A manufacturer may chose to use the test fuel specified in section 1 of Annex IX.

4. VEHICLE PRECONDITIONING

4.1. **Summary**

4.1.1. To ensure reproducible emission tests, the test vehicles must be conditioned in a uniform manner. The conditioning consists of a preparatory drive on a chassis dynamometer followed by a soak period before the emission test according to 4.3.

4.2. **Preconditioning**

4.2.1. The fuel tank(s) must be filled with the specified test fuel. If the existing fuel in the fuel tank(s) does not meet the specifications contained in 3.4.1, the existing fuel must be drained prior to the fuel fill. The test fuel must be at a temperature less than or equal to 289 ^{o}K (+ 16 ^{o}C). For the above operations the evaporative emission control system must neither be abnormally purged nor abnormally loaded.

4.2.2. The vehicle is moved to the test cell and placed on the chassis dynamometer.

4.2.3. The preconditioning consists of the driving cycle according to Annex III — Appendix 1 Figure III.1.1, parts one and two. At the request of the manufacturer, vehicles with a positive-ignition engine may be preconditioned with one Part I and two Part II driving cycles.

4.2.4. During the preconditioning the test cell temperature must remain relatively constant and not be higher than 303 ^{o}K (30 ^{o}C).

4.2.5. The drive-wheel tyre pressure must be set in accordance with the provisions of section 5.3.2 of Annex III.

4.2.6. Within ten minutes of completion of the preconditioning, the engine must be switched off.

4.2.7. If requested by the manufacturer and approved by the technical service, additional preconditioning may in exceptional cases be allowed. The technical service may also choose to conduct additional preconditioning. The additional preconditioning consists of one or more driving schedules of the part one cycle as described in Annex III — Appendix 1. The extent of such additional preconditioning must be recorded in the test report.

4.3. **Soak methods**

4.3.1. One of the following two methods, to be selected by the manufacturer, must be utilized to stabilize the vehicle before the emission test.

4.3.2. *Standard method.* The vehicle is stored for not less than 12 hours nor for more than 36 hours prior to the low ambient temperature tailpipe emission test. The ambient temperature (dry bulb) during this period must be maintained at an average termperature of:

266 ^{o}K (-7 ^{o}C) ± 3 ^{o}K during each hour of this period and must not be less than 260 ^{o}K (-13 ^{o}C) nor more than 272 (-1 ^{o}C). In addition, the temperature may not fall below 263 ^{o}K (-10 ^{o}C) nor more than 269 ^{o}K (-4 ^{o}C) for more than three consecutive minutes.

4.3.3. *Forced method*[9]. The vehicle must be stored for not more than 36 hours prior to the low ambient temperature tailpipe emission test.

4.3.3.1. The vehicle must not be stored at ambient temperatures which exceed 303 ^{o}K (30 ^{o}C) during this period.

4.3.3.2. Vehicle cooling may be accomplished by force-cooling the vehicle to the test temperature. If cooling is augmented by fans, the fans must be placed in a vertical position so that the maximum cooling of the drive train and engine is achieved and not primarily the sump. Fans must not be placed under the vehicle.

4.3.3.3. The ambient temperature need only be stringently controlled after the vehicle has been cooled to:

266 ^{o}K (-7 ^{o}C) ± 2 ^{o}K,

as determined by a representative bulk oil temperature. A representative bulk oil temperature is the temperature of the oil measured near the middle of the oil, not at the surface or at the bottom of the oil sump. If tow or more diverse locations in the oil are monitored, they must all meet the temperature requirements.

4.3.3.4. The vehicle must be stored for at least one hour after is has been cooled to 266 ^{o}K (-7 ^{o}C) ± 2 ^{o}K, prior to the low ambient temperature tailpipe emission test. The ambient temperature (dry bulb) during this period must average 266 ^{o}K (-7 ^{o}C) ± 3 ^{o}K, and must:

not be less than 260 ^{o}K (-13 ^{o}C) nor more than 272 ^{o}K (-1 ^{o}C),

In addition, the temperature may:

not fall below 263 ^{o}K (-10 ^{o}C) or exceed 269 ^{o}K (-4 ^{o}C),

for more than three consecutive minutes.

4.3.4. If the vehicle is stabilized at 266 ^{o}K (-7 ^{o}C), in a separate area and is moved through a warm area to the test cell, the vehicle must be restabilized in the test cell for at least six times the period the vehicle is exposed to warmer temperatures. The ambient temperature (dry bulb) during this period

must average 266 ^{o}K (-7 ^{o}C) ± 3 ^{o}K and must not be less than 260 ^{o}K (-13 ^{o}C) nor more than 272 ^{o}K (-1 ^{o}C).

In addition, the temperature may:

not fall below 263 ^{o}K (-10 ^{o}C) or exceed 269 ^{o}K (-4 ^{o}C), for more than three consecutive minutes.

5. DYNAMOMETER PROCEDURE

5.1. Summary

5.1.1. The emission sampling is performed over a test procedure consisting of the part one cycle (Annex III — Appendix 1 Figure III. 1.1). Engine start-up, immediate sampling, operation over the part one cycle and engine shut-down make a complete low ambient temperature test, with a total test time of 780 seconds. The tailpipe emissions are diluted with ambient air and a continuously proportional sample is collected for analysis. The exhaust gases collected in the bag are analysed for hydrocarbons, carbon monoxide, and carbon dioxide. A parallel sample of the dilution air is similarly analysed for carbon monoxide, hydrocarbons and carbon dioxide.

5.2. **Dynamometer operation**

5.2.1. *Cooling fan*

5.2.1.1. A cooling fan is positioned so that cooling air is appropriately directed to the radiator (water cooling) or to the air intake (air-cooling) and to the vehicle.

5.2.1.2. For front-engined vehicles, the fan must be positioned in front of the vehicle, within 300 mm of it. In the case of rear-engined vehicles or if the above arrangement is impractical, the cooling fan must be positioned so that sufficient air is supplied to cool the vehicle.

5.2.1.3. The fan speed must be such that, within the operating range of 10 km/h to at least 50 km/h, the linear velocity of the air at the blower outlet is within ± 5 km/h of the corresponding roller speed. The final selection of the blower must have the following characteristics:

— area: at least 0,2 m^2,

— height of the lower edge above ground: approximately 20 cm.

As an alternative the blower speed must be at least 6 m/s (21,6 km/h). At the request of the manufacturer, for special vehicles (e. g. vans, off-road) the height of the cooling fan may be modified.

5.2.1.4. The vehicle speed as measured from the dynamometer roll(s) must be used (section 4.1.4.4 of Annex III).

5.2.3. Preliminary testing cycles may 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, or to permit sampling system adjustment. Such driving must be carried out before “START” according to Figure VII. 1.

5.2.4. Humidity in the air must be kept low enough to prevent condensation on the dynamometer roll(s).

5.2.5. The dynamometer must be thoroughly warmed as recommended by the dynamometer manufacturer, and using procedures or control methods that assure stability of the residual frictional horsepower.

5.2.6. The time between dynamometer warming and the start of the emission test must be no longer than 10 minutes if the dynamometer bearings are not independently heated. If the dynamometer bearings are independently heated, the emission test must begin no longer than 20 minutes after dynamometer warming.

5.2.7. If the dynamometer horsepower must be adjusted manually, it must be set within one hour prior to the tailpipe emission test phase. The test vehicle may not be used to make the adjustment. The dynamometer, using automatic control of preselectable power settings, may be set at any time prior to the beginning of the emission test.

5.2.8. Before the emission test driving schedule may begin, the test cell temperature must be 266 ^{o}K (-7 ^{o}C) ± 2 ^{o}K, as measured in the air stream of the cooling fan with a maximum distance of 1 m-1,5 m from the vehicle.

5.2.9. During operation of the vehicle the heating and defrosting devices must be shut off.

5.2.10. The total driving distance or roller revolutions measured are recorded.

5.2.11. A four-wheel drive vehicle must be tested in a two-wheel drive mode of operation. The determination of the total road force for dynamometer setting is performed while operating the vehicle in its primary designed driving mode.

5.3. **Performing the test**

5.3.1. The provisions of sections 6.2 to 6.6, excluding 6.2.2, of Annex III apply in respect of starting the engine, carrying out the test and taking the emission samples. The sampling begins before or at the initiation of the engine start-up procedure and ends on conclusion of the final idling period of the last elementary cycle of the part one (urban driving cycle), after 780 seconds.

The first driving cycle starts with a period of 11 seconds idling as soon as the engine has started.

5.3.2. For the analysis of the sampled emissions the provisions of section 7.2 of Annex III apply. In performing the exhaust sample analysis the technical service must exercise care to prevent condensation of water vapour in the exhaust gas sampling bags.

5.3.3. For the calculations of the mass emissions the provisions of section 8 of Annex III apply.

6. OTHER REQUIREMENTS

6.1. **Irrational emission control strategy**

6.1.1. Any irrational emission control strategy which results in a reduction in effectiveness of the emission control system under normal operating conditions at low temperature driving, so far as not covered by the standardized emission tests, may be considered a defeat device.

Annexes VII, VIII and IX become Annexes VIII, IX and X.
ANNEX VIII

38. The first subparagraph of section 6 reads as follows:

At the start of the test (0 km), and every 10 000 km (± 400 km) or more frequently, at regular intervals until having covered 80 000 km, tailpipe emissions are measured in accordance with the type I test as defined in section 5.3.1 of Annex I. The limit values to be complied with are those laid down in section 5.3.1.4 of Annex I.

ANNEX IX

39. Annex IX is replaced by the following text:

‘ANNEX IX

SPECIFICATIONS OF REFERENCE FUELS

1. TECHNICAL DATA OF THE REFERENCE FUEL TO BE USED FOR TESTING VEHICLES EQUIPPED WITH POSITIVE-IGNITION ENGINES

*Type:***Unleaded petrol**

Parameter	**Unit**	**Limits**[a]		**Test Method**	**Publication**
		Minimum	**Maximum**		
Research octane number, RON		95,0	—	EN 25164	1993

Motor octane number, MON		85,0	—	EN 25163	1993
Density at 15 °CN	kg/m	748	762	ISO 3675	1995
Reid vapour pressure	kPa	56,0	60,0	EN 12	1993
Distillation:					
— initial boiling point	°C	24	40	EN-ISO 3405	1988
— evaporated at 100 °C	% v/v	49,0	57,0	EN-ISO 3405	1988
— evapored at 150 °C	% v/v	81,0	87,0	EN-ISO 3405	1988
— final boiling point	°C	190	215	EN-ISO 3405	1998
Residue	%	—	2	EN-ISO 3405	1998
Hydrocarbon analysis:					
— olefins	% v/v	—	10	ASTM D 1319	1995
— aromatics[c]	% v/v	28,0	40,0	ASTM D 1319	1995
— benzene	% v/v	—	1,0	pr. EN 12177	[1998][b]
— saturates	% v/v	—	balance	ASTM D 1319	1995
Carbon/ hydrogen ratio		report	report		
Oxidation stability[d]	min.	480	—	EN-ISO 7536	1996
Oxygen content[e]	% m/m	—	2,3	EN 1601	[1997][b]

Existent gum	mg/ml	—	0,04	EN-ISO 6246	[1997][b]
Sulphur content[f]	mg/kg	—	100	pr. EN-ISO/ DIS 14596	[1998][b]
Copper corrosion at 50 °C		—	1	EN-ISO 2160	1995
Lead content	g/l	—	0,005	EN 237	1996
Phosphorus content	g/l	—	0,0013	ASTM D 3231	1994

a The values quoted in the specification are "true values". In establishment of their limit values the terms of ISO 4259 "Petroleum products — Determination and application of precision data in relation to methods of test" have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility). Notwithstanding this measure, which is necessary for statistical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits.
Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

b The month of publication will be completed in due course.

c The reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.3.1.4 of Annex I to this Directive shall have a maximum aromatics content of 35 % v/v. The Commission will as soon as possible, but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel aromatics content in respect of the fuel defined in Annex III of Directive 98/70/EC.

d The fuel may contain oxidation inhibitors and metal deactivators normally used to stabilise refinery gasoline streams, but detergent/dispersive additives and solvent oils must not be added.

e The actual oxygen content of the fuel for the Type I and IV tests shall be reported. In addition the maximum oxygen content of the reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.1.3.4 of the Annex I to this Directive shall be 2,3 %. The Commission will as soon as possible, but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel oxygen content of the fuel defined in Annex III of Directive 98/70/EC.

f The actual sulphur content of the fuel used for the Type I test shall be reported. In addition the reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.1.3.4 of Annex I to this Directive shall have a maximum sulphur content of 50 ppm. The Commission will as soon as possible, but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel sulphur content in respect of the fuel defined in Annex III of Directive 98/70/EC.

2. TECHNICAL DATA OF THE REFERENCE FUEL TO BE USED FOR TESTING VEHICLES EQUIPPED WITH A DIESEL ENGINE

Type: **Diesel fuel**

Parameter	**Unit**	**Limits[a]**		**Test Method**	**Publication**
		Min	**Max**		
Cetane number[b]		52,0	54,0	EN-ISO 5165	1998[c]
Density at 15 °C	kg/m	833	837	EN-ISO 3675	1995
Distillation					

— 50 % point	°C	245	—	EN-ISO 3405	1988
— 95 % point	°C	345	350	EN-ISO 3405	1988
— final boiling point	°C	—	370	EN-ISO 3405	1988
Flash point	°C	55	—	EN 22719	1993
CFPP	°C	—	-5	EN 116	1981
Viscosity at 40 °C	mm ^{2}/s	2,5	3,5	EN-ISO 3104	1996
Polycyclic aromatic hydrocarbons	% m/m	3	6,0	IP 391	1995
Sulphur content[d]	mg/kg	—	300	pr. EN-ISO/ DIS 14596	1998[e]
Copper corrosion		—	1	EN-ISO 2160	1995
Conradson carbon residue (10 % DR)	% m/m	—	0,2	EN-ISO 10370	1995
Ash content	% m/m	—	0,01	EN-ISO 6245	1995
Water content	% m/m	—	0,05	EN-ISO 12937	[1998][e]
Neutralisation (stron acid) number	mg KOH/g	—	0,02	ASTM D 974-95	1998
Oxidation stability[e]	mg/ml	—	0,025	EN-ISO 12205	1996
New and better method for polycyclic aromatics under development	% m/m	—	—	EN 12916	[1997][e]

a The values quoted in the specification are “true values”. In establishment of their limit values the terms of ISO 4259 “Petroleum products — Determination and application of precision data in relation to methods of test” have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).

	Notwithstanding this measure, which is necessary for statistical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.
b	The range for cetane number is not in accordance with the requirement of a minimum range of 4R. However, in the case of a dispute between fuel supplier and fuel user, the terms in ISO 4259 may be used to resolve such disputes provided replicate measurements, of sufficient number to archive the necessary precision, are made in preference to single determinations.
c	The month of publication will be completed in due course.
d	The actual sulphur content of the fuel used for the Type 1 test shall be reported. In addition the reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.1.3.4 of Annex I to this Directive shall have a maximum sulphur content of 50 ppm. The Commission will as soon as possible, but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel sulphur content in respect of the fuel defined in Annex III of Directive 98/70/EC.
e	Even though oxidation stability is controlled, it is likely that shelf life will be limited. Advice should be sought from the supplier as to storage conditions and life.

3.

TECHNNICAL DATA OF THE REFERENCE FUEL TO BE USED FOR TESTING VEHICLES EQUIPPED WITH POSITIVE-IGNITION ENGINES AT LOW AMBIENT TEMPERATURE TYPE VI TEST[0]

*Type:***Unleaded premium petrol**

Parameter	**Unit**	**Limits**[b]		**Test Method**	**Publication**
		Min	**Max**		
Research octane number, RON		95,0	—	EN 25164	1993
Motor octane number, MON		85,0	—	EN 25163	1993
Density at 15 °C	kg/m	748	775	ISO 3675	1995
Reid vapour presssure	kPa	56,0	95,0	EN 12	1993
Distillation					
— initial boiling point	°C	24	40	EN-ISO 3405	1988
— evaporated at 100 °C	% v/v	49,0	57,0	EN-ISO 3405	1988
— evaporated at	% v/v	81,0	87,0	EN-ISO 3405	1988

150 °C					
— final boiling point	°C	190	215	EN-ISO 3405	1988
Residue	%	—	2	EN-ISO 3405	
Hydrocarbon analysis:					
— olefins	% v/v	—	10	ASTM D 1319	1995
— aromatics[d]	% v/v	28,0	40,0	ASTM D 1319	1995
— benzene	% v/v	—	1,0	pr. EN 12177	[1998][c]
— saturates		—	balance	ASTM D 1319	1995
Carbon/ hydrogen ratio		report	report		
Oxidation stability[e]	mn.	480	—	EN-ISO 7536	1996
Oxygen content[f]	% m/m	—	2,3	EN 1601	[1997][c]
Existent gum	mg/ml	—	0,04	EN-ISO 6246	[1997][c]
Sulphur content[g]	mg/kg	—	100	pr. EN-ISO/ DIS 14596	[1998][c]
Copper corrosion at 50 °C		—	1	EN-ISO 2160	1995
Lead content	g/l	—	0,005	EN 237	1996
Phosphorous content	g/l	—	0,0013	ASTM D 3231	1994

a Petrol having the specification in the above table must be used in low ambient temperature Type VI testing, if the manufacturer does not specifically choose the fuel in section 1 of this Annex in accordance with section 3.4 of Annex VII.

b The values quoted in the specification are “true values”. In establishment of their limit values the terms of ISO 4259 “Petroleum products — Determination and application of precision data in relation to methods of test” have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).
Notwithstanding this measure, which is necessary for statistical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

c The month of publication will be completed in due course.

d The reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.3.1.4 of Annex I to this Directive shall have a maximum aromatics content of 35 % v/v. The Commission will as soon as possible,

	but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel aromatics content in respect of the fuel defined in Annex III of Directive 98/70/EC.
e	The fuel may contain oxidation inhibitors and metal deactivators normally used to stabilise refinery gasoline streams, but detergent/dispersive additives and solvent oils must not be added.
f	The actual oxygen content of the fuel used for the Type I and IV tests shall be reported. In addition the maximum oxygen content of the reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.1.3.4 of Annex I to this Directive shall be 2,3 %. The Commission will as soon as possible, but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel oxygen content in respect of the fuel defined in Annex III of Directive 98/70/EC.
g	The actual sulphur content of the fuel used for the Type I test shall be reported. In addition the reference fuel used to approve a vehicle against the limit values set out in row B of the table in section 5.1.3.4 of Annex I to this Directive shall have a maximum sulphur content of 50 ppm. The Commission will as soon as possible, but no later than 31 December 1999, bring forward a modification to this Annex reflecting the market average for fuel sulphur content in respect of the fuel defined in Annex III of Directive 98/70/EC.’

ANNEX X

40. Section 1.8 of the Appendix is replaced by the following:

'1.8. **Test results:** .....

Type I	CO (g/km)	HC (3)	NO_x (3)	HC + NO_x (g/km)	Particulates (2) (g/km)
measured					
with DF					

Type II: ..... %

Type III: .....

Type IV: ..... g/test

Type V: — Durability type: 80 000 km, not applicable (1)

— Deterioration factor DF: calculated, fixed (1)

— Specify the values:

.....

Type VI	CO (g/km)	HC (g/km)
Measured value		

1.8.1. Written description and/or drawing of the MI:

.....

1.8.2. List and function of all components monitored by the OBD system:

.....

1.8.3. Written description (general working principles) for:

.....

1.8.3.1. Misfire detection (4):

.....

1.8.3.2. Catalyst monitoring (4):

.....

1.8.3.3. Oxygen sensor monitoring (4):

.....

1.8.3.4. Other components monitored by the OBD system (4):

.....

1.8.3.5. Catalyst monitoring (5):

.....

1.8.3.6. Particulate trap monitoring (5):

.....

1.8.3.7. Electronic fuelling system actuator monitoring (5):

.....

1.8.3.8. Other components monitored by the OBD system (5):

.....

1.8.4. Criteria for MI activation (fixed number of driving cycles or statistical method):

.....

1.8.5. List of all OBD output codes and formats used (with explanation of each):

.....

(1) Delete where inapplicable.
(2) For compression-ignition engined vehicles.
(3) For vehicles equipped with positive-ignition engines.
(4) In the case of positive-ignition engines.
(5) In the case of compression-ignition engines.'.

41. A new section 1.9 of the Appendix is added as follows:

1.9. **Emissions data required for roadworthiness testing**

Test	**CO value(% vol)**	**Lambda[a]**	**Engine speed(min^{-1})**	**Engine oil temperature(^oC)**
Low idle test		N/A		
High idle test.				

a Lambda formula: see Annex I, section 5.3.7.3, footnote 1.

ANNEX XI

42. A new Annex XI is added to read as follows:

'ANNEX XI

ON-BOARD DIAGNOSTICS (OBD) FOR MOTOR VEHICLES

1. INTRODUTION

This Annex applies to the functional aspects of on-board diagnostic (OBD) system for the emission control of motor vehicles.

2. DEFINITIONS

For the purposes of this Annex:

2.1. 'OBD' means an on-board diagnostic system for emission control which must have the capability of identifying the likely area of malfunction by means of fault codes stored in computer memory.

2.2. 'Vehicle type' means a category of power-driven vehicles which do not differ in such essential engine and OBD system characteristics as defined in Appendix 2.

2.3. 'Vehicle family' means a manufacturer's grouping of vehicles which, through their design, are expected to have similar exhaust emission and OBD system characteristics. Each engine of this family must have complied with the requirements of this Directive.

2.4. 'Emission control system' means the electronic engine management controller and any emission-related component in the exhaust or evaporative system which supplies an input to or receives an output from this controller.

2.5. 'Malfunction indicator (MI)' means a visible or audible indicator that clearly informs the driver of the vehicle in the event of a malfunction of any emission-related component connected to the OBD system, or the OBD system itself.

2.6. 'Malfunction' means the failure of an emission-related component or system that would result in emissions exceeding the limits in section 3.3.2.

2.7. 'Secondary air' refers to air introduced into the exhaust system by means of a pump or aspirator valve or other means that is intended to aid in the oxidation of HC and CO contained in the exhaust gas stream.

2.8. 'Engine misfire' means lack of combustion in the cylinder of a positive-ignition engine due to absence of spark, poor fuel metering, poor compression or any other cause. In terms of OBD monitoring it is that percentage of misfires out of a total number of firing events (as declared by the manufacturer) that would result in emissions exceeding the limits given in section 3.3.2 or. that percentage that could lead to an exhaust catalyst, or catalysts, overheating causing irreversible damage.

2.9. 'Type I test' means the driving cycle (Parts One and Two) used for emission approvals, as detailed in Annex III, Appendix 1.

2.10. 'A driving cycle' consists of engine start-up, driving mode where a malfunction would be detected if present, and engine shut-off.

2.11. 'A warm-up cycle' means sufficient vehicle operation such that the coolant temperature has risen by a least 22 ^{o}K from engine starting and reaches a minimum temperature of 343 ^{o}K (70 ^{o}C).

2.12. 'Fuel trim' refers to feedback adjustments to the base fuel schedule. Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. These long-term adjustments compensate for vehicle differences and gradual changes that occur over time.

2.13. 'Calculated load value' refers to an indication of the current airflow divided by peak airflow, where peak airflow is corrected for altitude, if available. This definition provides a dimensionless number that is not engine specific and provides the service technician with an indication of the proportion of engine capacity that is being used (with wide open throttle as 100 %);

$$\text{CLV} = \frac{\text{Current airflow}}{\text{Peak airflow (at sea level)}} \times \frac{\text{Atmospheric pressure (at sea level)}}{\text{Barometric pressure}}$$

2.14. ‘Permanent emission default mode’ refers to a case where the engine management controller permanently switches to a setting that does not require an input from a failed component or system where such a failed component or system would result in an increase in emissions from the vehicle to a level above the limits given in section 3.3.2.

2.15. ‘Power take-off unit’ means an engine-driven output provision for the purposes of powering auxiliary, vehicle mounted, equipment.

2.16. ‘Access’ means the availability of all emission-related OBD data including all fault codes required for the inspection, diagnosis, servicing or repair of emissions-related parts of the vehicle, via the serial interface for the standard diagnostic connection (pursuant to Appendix 1, section 6.5.3.5 of this Annex).

2.17. ‘Unrestricted’ means

— access not dependent on an access code obtainable only from the manufacturer, or a similar device, or

— access allowing evaluation of the data produced without the need for any unique decoding information, unless that information itself is standardised.

2.18. ‘Standardised’ means that all data stream information, including all fault codes used, shall be produced only in accordance with industry standards which, by virtue of the fact that their format and their permitted options are clearly defined, provide for a maximum level of harmonisation in the motor vehicle industry, and whose use is expressly permitted in this Directive.

3. REQUIREMENTS AND TESTS

3.1. All vehicles must be equipped with an OBD system so designed, constructed and installed in a vehicle as to enable it to identify types of deterioration or malfunction over the entire life of the vehicle. In achieving this objective the approval authority must accept that vehicles which have travelled distances in excess of the Type V durability distance, referred to in 3.3.1, may show some deterioration in OBD system performance such that the emission limits given in 3.3.2 may be exceeded before the OBD system signals a failure to the driver of the vehicle.

3.1.1 Access to the OBD system required for the inspection, diagnosis, servicing or repair of the vehicle must be unrestricted and standardised. All emission-related fault codes must be consistent with ISO DIS 15031-6 (SAE J 2012, dated July 1996).

3.1.2. No later than three months after the manufacturer has provided any authorised dealer or repair shop within the Community with repair information, the manufacturer shall make that information (including all subsequent amendments and supplements) available upon reasonable and non-discriminatory payment and shall notify the approval authority accordingly.

In the event of failure to comply with these provisions the approval authority shall take appropriate measures to ensure that repair information is available, in accordance with the procedures laid down for type-approval and in-service surveys.

3.2. The OBD system must be so designed, constructed and installed in a vehicle as to enable it to comply with the requirements of this Annex during conditions of normal use.

3.2.1. *Temporary disablement of the OBD system*

3.2.1.1. A manufacturer may disable the OBD system if its ability to monitor is affected by low fuel levels. Disablement must not occur when the fuel tank level is above 20 % of the nominal capacity of the fuel tank.

3.2.1.2. A manufacturer may disable the OBD system at ambient engine starting temperatures below 266 ^{o}K (-7 ^{o}C) or at elevations over 2 500 metres above sea level provided the manufacturer submits data and/or an engineering evaluation which adequately demonstrate that monitoring would be unreliable when such conditions exist. A manufacturer may also request disablement of the OBD system at other ambient engine starting temperatures if he demonstrates to the authority with data and/or an engineering evaluation that misdiagnosis would occur under such conditions.

3.2.1.3. For vehicles designed to accommodate the installation of power take-off units, disablement of affected monitoring systems is permitted provided disablement occurs only when the power take-off unit is active.

3.2.2. *Engine misfire — vehicles equipped with positive-ignition engines*

3.2.2.1. Manufacturers may adopt higher misfire percentage malfunction criteria than those declared to the authority, under specific engine speed and load conditions where it can be demonstrated to the authority that the detection of lower levels of misfire would be unreliable.

3.2.2.2. Manufacturers who can demonstrate to the authority that the detection of higher levels of misfire percentages is still not feasible may disable the misfire monitoring system when such conditions exist.

3.3. **Description of tests**

3.3.1. The test are carried out on the vehicle used for the Type V durability test, given in Annex VIII, and using the test procedure in Appendix I to this Annex. Tests are carried out at the conclusion of the Type V durability testing. When no Type V durability testing is carried out, or at the request of the manufacturer, a suitably aged and representative vehicle may be used for these OBD demonstration tests.

3.3.2. The OBD system must indicate the failure of an emission-related component or system when that failure results in an increase in emissions above the limits given below:

		Reference mass	**Mass of carbon monoxide**		**Mass of hydrocarbons**		**Mass of oxides of nitrogen**		**Mass of particulates[a]**
		(RW)	**(CO)L1**		**(HC)L2**		**(NO_x)L3**		**(PM)L4**
		(kg)	**(g/km)**		**(g/km)**		**(g/km)**		**(g/km)**
Category	**Class**		**Petrol**	**Diesel**	**Petrol**	**Diesel**	**Petrol**	**Diesel**	**Diesel**
M[b]	—	all	3,2	3,2	0,4	0,4	0,6	1,2	0,18

a For compression ignition engines.

b Except vehicles the maximum mass of which exceeds 2 500 kg.

c And those Category M vehicles which are specified in note 2.

d The Commission proposal referred to in Article 3(1) of this Directive shall contain the threshold limit values for OBD for 2005/6 for M_1 and N_1 vehicles.

N_1[cd]	I	RW ≤ 1305	3,2	3,2	0,4	0,4	0,6	1,2	0,18
	II	1305 < RW ≤ 1760	5,8	4,0	0,5	0,5	0,7	1,6	0,23
	III	1760 < RW	7,3	4,8	0,6	0,6	0,8	1,9	0,28

a	For compression ignition engines.
b	Except vehicles the maximum mass of which exceeds 2 500 kg.
c	And those Category M vehicles which are specified in note 2.
d	The Commission proposal referred to in Article 3(1) of this Directive shall contain the threshold limit values for OBD for 2005/6 for M_1 and N_1 vehicles.

3.3.3. *Monitoring requirements for vehicles equipped with positive-ignition engines*

In satisfying the requirements of 3.3.2 the OBD system must, at a minimum, monitor for:

3.3.3.1. reduction in the efficiency of the catalytic converter with respect to the emissions of HC only;

3.3.3.2. the presence of engine misfire in the engine operating region bounded by the following lines:

(a) a maximum speed of 4 500min^{-1} or 1 000 min^{-1} greater than the highest speed occurring during a Type 1 test cycle, whichever is the lower;

(b) the positive torque line (i. e. engine load with the transmission in neutral);

(c) a line joining the following engine operating points: the positive torque line at 3 000 min^{-1} and a point on the maximum speed line defined in (a) above with the engine's manifold vacuum at 13,33 kPa lower than that at the positive torque line.

3.3.3.3. oxygen sensor deterioration

3.3.3.4. other emission control system components or systems, or emission-related powertrain components or systems which are connected to a computer, the failure of which may result in tailpipe emissions exceeding the limits given in 3.3.2;

3.3.3.5. any other emission-related powertrain component connected to a computer must be monitored for circuit continuity;

3.3.3.6. the electronic evaporative emission purge control must, at a minimum, be monitored for circuit continuity.

3.3.4. *Monitoring requirements for vehicles equipped with compression-ignition engines*

In satisfying the requirements of 3.3.2 the OBD system must monitor:

3.3.4.1. Where fitted, reduction in the efficiency of the catalytic converter;

3.3.4.2. Where fitted, the functionality and integrity of the paniculate trap;

3.3.4.3. The fuel-injection system electronic fuel quantity and timing actuator(s) is/are monitored for circuit continuity and total functional failure;

3.3.4.4. Other emission control system components or systems, or emission-related powertrain components or systems, which are connected to a computer, the failure of which may result in tailpipe emissions exceeding the limits given in 3.3.2. Examples of such systems or components are those for monitoring and control of air mass-flow, air volumetric flow (and temperature), boost pressure and inlet manifold pressure (and relevant sensors to enable these functions to be carried out).

3.3.4.5. Any other emission-related powertrain component connected to a computer must be monitored for circuit continuity.

3.3.5. Manufacturers may demonstrate to the approval authority that certain components or systems need not be monitored if, in the event of their total failure or removal, emissions do not exceed the emission limits given in 3.3.2.

3.4. A sequence of diagnostic checks must be initiated at each engine start and completed at least once provided that the correct test conditions are met. The test conditions must be selected in such a way that they all occur under normal driving as represented by the Type I test.

3.5. **Activation of malfunction indicator (MI)**

3.5.1. The OBD system must incorporate a malfunction indicator readily perceivable to the vehicle operator. The MI must not be used for any other purpose except to indicate emergency start-up or limp-home routines to the driver. The MI must be visible in all reasonable lighting conditions. When activated, it must display a symbol in conformity with ISO 2575[(10)]. A vehicle must not be equipped with more than one general purpose MI for emission-related problems. Separate specific purpose telltales (e. g. brake system, fasten seat belt, oil pressure, etc.) are permitted. The use of red for an MI is prohibited.

3.5.2. For strategies requiring more than two preconditioning cycles for MI activation, the manufacturer must provide data and/or an engineering evaluation which adequately demonstrates that the monitoring system is equally effective and timely in detecting component deterioration. Strategies requiring on average more than 10 driving cycles for MI activation are not accepted. The MI must also activate whenever the engine control enters a permanent emission default mode of operation if the emission limits given in 3.3.2 are exceeded. The MI must operate in a distinct warning mode, e. g. a flashing light, under any period during which engine misfire occurs at a level likely to cause catalyst damage, as specified by the manufacturer. The MI must also activate when the vehicle's ignition is in the ‘key-on’ position before engine starting or cranking and de-activate after engine starting if no malfunction has previously been detected.

3.6. **Fault code storage**

The OBD system must record code(s) indicating the status of the emission-control system. Separate status codes must be used to identify correctly functioning emission control systems and those emission control systems which need further vehicle operation to be fully evaluated. Fault codes that cause MI activation due to deterioration or malfunction or permanent emission default modes of operation must be stored and that fault code must identify the type of malfunction.

3.6.1. The distance travelled by the vehicle since the MI was activated must be available at any instant through the serial port on the standard link connector[11].'

3.6.2. In the case of vehicles equipped with positive-ignition engines, misfiring cylinders need not be uniquely identified if a distinct single or multiple cylinder misfire fault code is stored.

3.7. **Extinguishing the MI**

3.7.1. For misfire malfunctions at levels likely to cause catalyst damage (as specified by the manufacturer), the MI may be switched to the normal mode of activation if the misfire is not present any more, or if the engine is operated after changes to speed and load conditions where the level of misfire will not cause catalyst damage.

3.7.2. For all other malfunctions, the MI may be de-activated after three subsequent sequential driving cycles during which the monitoring system responsible for activating the MI ceases to detect the malfunction and if no other malfunction has been identified that would independently activate the MI.

3.8. **Erasing a fault code**

3.8.1. The OBD system may erase a fault code and the distance travelled and freeze-frame information if the same fault is not re-registered in at least 40 engine warm-up cycles.

Appendix 1

FUNCTIONAL ASPECTS OF ON-BOARD DIAGNOSTIC (OBD) SYSTEMS

1. INTRODUCTION

This Appendix describes the procedure of the test according to section 5 of this Annex. The procedure describes a method for checking the function of the on-board diagnostic (OBD) system installed on the vehicle by failure simulation of relevant systems in the engine management or emission control system. It also sets procedures for determining the durability of OBD systems.

The manufacturer must make available the defective components and/or electrical devices which would be used to simulate failures. When measured over the Type I test cycle, such defective components or devices must not cause the vehicle emissions to exceed the limits of section 3.3.2 by more than 20 %.

When the vehicle is tested with the defective component or device fitted, the OBD system is approved if the MI is activated.

2. DESCRIPTION OF TEST

2.1. The testing of OBD systems consists of the following phases:

— simulation of malfunction of a component of the engine management or emission control system,

— preconditioning of the vehicle with a simulated malfunction over preconditioning specified in section 6.2.1,

— driving the vehicle with a simulated malfunction over the Type I test cycle and measuring the emissions of the vehicle,

— determining whether the OBD system reacts to the simulated malfunction and indicates malfunction in an appropriate manner to the vehicle driver.

2.2. Alternatively, at the request of the manufacturer, malfunction of one or more components may be electronically simulated according to the requirements of section 6.

2.3. Manufacturers may request that monitoring take place outside the Type I test cycle if it can be demonstrated to the authority that monitoring during conditions encountered during the Type I test cycle would impose restrictive monitoring conditions when the vehicle is used in service.

3. TEST VEHICLE AND FUEL

3.1. **Vehicle**

The test vehicle must meet the requirements of section 3.1 of Annex III.

3.2. **Fuel**

The appropriate reference fuel as described in Annex IX must be used for testing.

4. TEST TEMPERATURE AND PRESSURE

4.1. The test temperature and pressure must meet the requirements of the Type I test as described in Annex III.

5. TEST EQUIPMENT

5.1. **Chassis dynamometer**

The chassis dynamometer must meet the requirements of Annex III.

6. OBD TEST PROCEDURE

6.1. The operating cycle on the chassis dynamometer must meet the requirements of Annex III.

6.2. **Vehicle preconditioning**

6.2.1. According to the engine type and after introduction of one of the failure modes given in 6.3, the vehicle must be preconditioned by driving at least two consecutive Type I tests (Parts One and Two). For compression-ignition engined vehicles an additional preconditioning of two Part Two cycles is permitted.

6.2.2. At the request of the manufacturer, alternative preconditioning methods may be used.

6.3. **Failure modes to be tested**

6.3.1. *Positive-ignition engined vehicles:*

6.3.1.1. Replacement of the catalyst with a deteriorated or defective catalyst or electronic simulation of such a failure.

6.3.1.2. Engine misfire conditions according to the conditions for misfire monitoring given in section 3.3.3.2 of this Annex.

6.3.1.3. Replacement of the oxygen sensor with a deteriorated or defective oxygen sensor or electronic simulation of such a failure.

6.3.1.4. Electrical disconnection of any other emission-related component connected to a powertrain management computer.

6.3.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped). For this specific failure mode, the Type I test must not be performed.

6.3.2. *Compression-ignition engined vehicles:*

6.3.2.1. Where fitted, replacement of the catalyst with a deteriorated or defective catalyst or electronic simulation of such a failure.

6.3.2.2. Where fitted, total removal of the particulate trap or, where sensors are an integral part of the trap, a defective trap assembly.

6.3.2.3. Electrical disconnection of any fuelling system electronic fuel quantity and timing actuator.

6.3.2.4. Electrical disconnection of any other emission-related component connected to a powertrain management computer.

6.3.2.5. In meeting the requirements of 6.3.2.3 and 6.3.2.4, and with the agreement of the approval authority, the manufacturer must take appropriate steps to demonstrate that the OBD system will indicate a fault when disconnection occurs.

6.4. **OBD system test**

6.4.1. *Vehicles fitted with positive-ignition engines:*

6.4.1.1. After vehicle preconditioning according to 6.2, the test vehicle is driven over a Type I test (Parts One and Two). The MI must activate before the end of this test under any of the conditions given in 6.4.1.2 to 6.4.1.5. The technical service may substitute those conditions by others in accordance with 6.4.1.6. However, the total number of failures simulated must not exceed 4 for the purpose of type-approval.

6.4.1.2. Replacement of a catalyst with a deteriorated or defective catalyst or electronic simulation of a deteriorated or defective catalyst that results in emissions exceeding the HC limit given in section 3.3.2 of this Annex.

6.4.1.3. An induced misfire condition according to the conditions for misfire monitoring given in section 3.3.3.2 of this Annex that results in emissions exceeding any of the limits given in 3.3.2.

6.4.1.4. Replacement of an oxygen sensor with a deteriorated or defective oxygen sensor or electronic simulation of a deteriorated or defective oxygen sensor that results in emissions exceeding any of the limits given in section 3.3.2 of this Annex.

6.4.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped).

6.4.1.6. Electrical disconnection of any other emission-related powertrain component connected to a computer that results in emissions exceeding any of the limits given in section 3.3.2 of this Annex.

6.4.2. *Vehicles fitted with compression-ignition engines:*

6.4.2.1. After vehicle preconditioning according to 6.2, the test vehicle is driven over a Type I test (Parts One and Two). The MI must activate before the end of this test under any of the conditions given in 6.4.2.2 to 6.4.2.5. The technical service may substitute those

conditions by others in accordance with 6.4.2.5. However, the total number of failures simulated must not exceed four for the purposes of type approval.

6.4.2.2. Where fitted, replacement of a catalyst with a deteriorated or defective catalyst or electronic simulation of a deteriorated or defective catalyst that results in emissions exceeding limits given in section 3.3.2 of this Annex.

6.4.2.3. Where fitted, total removal of the particulate trap or replacement of the particulate trap with a defective particulate trap meeting the conditions of 6.3.2.2 that results in emissions exceeding the limits given in section 3.3.2 of this Annex.

6.4.2.4. With reference to 6.3.2.5, disconnection of any fuelling system electronic fuel quantity and timing actuator that results in emissions exceeding any of the limits given in section 3.3.2 of this Annex.

6.4.2.5. With reference to 6.3.2.5, disconnection of any other emission-related powertrain component connected to a computer that results in emissions exceeding any of the limits given in section 3.3.2 of this Annex.

6.5. **Diagnostic signals**

6.5.1.1. Upon determination of the first malfunction of any component or system, 'freeze-frame' engine conditions present at the time must be stored in computer memory. Should a subsequent fuel system or misfire malfunction occur, any previously stored freeze-frame conditions must be replaced by the fuel system or misfire conditions (whichever occurs first). Stored engine conditions must include, but are not limited to calculated load value, engine speed, fuel trim value(s) (if available), fuel pressure (if available), vehicle speed (if available), coolant temperature, intake manifold pressure (if available), closed- or open-loop operation (if available) and the fault code which caused the data to be stored. The manufacturer must choose the most appropriate set of conditions facilitating effective repairs for freeze-frame storage. Only one frame of data is required. Manufacturers may choose to store additional frames provided that at least the required frame can be read by a generic scan tool meeting the specifications of 6.5.3.2 and 6.5.3.3. If the fault code causing the conditions to be stored is erased in accordance with section 3.7 of this Annex, the stored engine conditions may also be erased.

6.5.1.2. If available, the following signals in addition to the required freeze-frame information must be made available on demand through the serial port on the standardized data link connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: diagnostic trouble codes, engine coolant temperature, fuel control system status (closed-loop, open-loop, other), fuel trim, ignition timing advance, intake air temperature, manifold air pressure, air flow rate, engine speed, throttle position sensor output value, secondary air status (upstream, downstream or atmosphere), calculated load value, vehicle speed and fuel pressure.

The signals must be provided in standard units based on the specifications given in 6.5.3. Actual signals must be clearly identified separately from default value or limp-home signals. In addition, the capability to perform bi-directional diagnostic control based on the specifications given in 6.5.3 must be made available on demand through the serial port on the standardized data link connector according to the specifications given in 6.5.3.

6.5.1.3. For all emission control systems for which specific on-board evaluation tests are conducted (catalyst, oxygen sensor, etc.), except misfire detection, fuel system monitoring and comprehensive component monitoring, the results of the most recent

test performed by the vehicle and the limits to which the system is compared must be made available through the serial data port on the standardized data link connector according to the specifications given in 6.5.3. For the monitored components and systems excepted above, a pass/fail indication for the most recent test results must be available through the data link connector.

6.5.1.4. The OBD requirements to which the vehicle is certified (i. e. this Annex or the alternative requirements specified in section 5 of Annex I) and the major emission control systems monitored by the OBD system consistent with 6.5.3.3 must be available through the serial data port on the standardized data link connector according to the specifications given in 6.5.3.

6.5.2. The emission control diagnostic system is not required to evaluate components during malfunction if such evaluation would result in a risk to safety or component failure.

6.5.3. The emission control diagnostic system must provide for standardised and unrestricted access and conform with the following ISO and/or SAE standards. Some of the ISO standards have been derived from Society of Automotive Engineers Standards and Recommended Practices. Where this is the case, the appropriate SAE reference appears in parentheses.

6.5.3.1. One of the following standards with the restrictions as described must be used as the on-board to off-board communications link:

ISO 9141-2 ‘Road Vehicles — Diagnostic Systems — CARB Requirements for the Interchange of Digital Information’;

ISO 11519-4 ‘Road Vehicles — Low Speed Serial Data Communication — Part 4: Class B Data Communication Interface (SAE J1850)’. Emission-related messages must use the cyclic redundancy check and the three-byte header and not use inter-byte separation or checksums.

ISO DIS 14230 — Part 4 ‘Road Vehicles — Diagnostic Systems — Keyword Protocol 2000’.

6.5.3.2. Test equipment and diagnostic tools needed to communicate with OBD systems must meet or exceed the functional specification given in ISO DIS 15031-4.

6.5.3.3. Basic diagnostic data, (as specified in 6.5.1) and bi-directional control information must be provided using the format and units described in ISO DIS 15031-5 and must be available using a diagnostic tool meeting the requirements of ISO DIS 15031-4.

6.5.3.4. When a fault is registered, the manufacturer must identify the fault using the most appropriate fault code consistent with those given in section 6.3 of ISO DIS 15031-6 (SAE J2012 — dated July 1996), relating to ‘... Powertrain system diagnostic trouble codes’. The fault codes must be fully accessible by standardized diagnostic equipment complying with the provisions of 6.5.3.2.

The note in section 6.3 of ISO DIS 15031-6 (SAE J2012 — dated July 1996) immediately preceding the list of fault codes in the same section does not apply.

6.5.3.5. The connection interface between the vehicle and the diagnostic tester must meet all the requirements of ISO DIS 15031-3. The installation position must be subject to agreement of the approval authority such that it is readily accessible by service personnel but protected from tampering by non-qualified personnel.

6.5.3.6. The manufacturer must also make accessible, where appropriate upon payment, to repairers who are not undertakings within the distribution system, the technical information required for the repair or maintenance of motor vehicles unless that

information is covered by an intellectual property right or constitutes essential, secret know-how which is identified in an appropriate form; in such case, the necessary technical information must not be withheld improperly.

Appendix 2

ESSENTIAL CHARACTERISTICS OF THE VEHICLE FAMILY

1. PARAMETERS DEFINING THE OBD FAMILY

The OBD family may be defined by basic design parameters which must be common to vehicles within the family. In some cases there may be interaction of parameters. These effects must also be taken into consideration to ensure that only vehicles with similar exhaust emission characteristics are included within an OBD family.

2. To this end, those vehicle types whose parameters described below are identical are considered to belong to the same engine-emission control/OBD system combination.

Engine:

— combustion process (i. e. positive-ignition, compression-ignition, two-stroke, four-stroke),

— method of engine fuelling (i. e. carburettor or fuel injection).

Emission control system:

— type of catalytic converter (i. e. oxidation, three-way, heated catalyst, other),

— type of particulate trap,

— secondary air injection (i. e. with or without),

— exhaust gas recirculation (i. e. with or without)

OBD parts and functioning:

— the methods of OBD functional monitoring, malfunction detection and malfunction indication to the vehicle driver.

(**1**) As defined in Part A of Annex II to Directive 70/156/EEC.

(**2**) OJ L 36, 9.2.1998, p. 33.

(**3**) This section is applicable to new types from 1 January 2002.

(**4**) The Commission will, as soon as possible, but not later than 31 December 1999, propose limit values for Classes II and III, in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC. These limit values shall be applied no later than 2003.

(**5**) The Lambda value must be calculated using the simplified Brettschneider equation as follows:
Where:

[ ]	=	Concentration in % vol.
K1	=	Conversion factor for NDIR measurement to FID measurement (provided by manufacturer of measurement equipment)
Hcv	=	Atomic ratio of hydrogen to carbon [1,7261]
Ocv	=	Atomic ratio of oxygen to carbon [0,0175].

(**6**) Sections 7.1.1 and 7.1.2 will be re-examined and completed without delay in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC while taking into account the particular problems associated with vehicles in Category N_1 and with the vehicles in Category M referred to in footnote 2 to the table in section 5.3.1.4. Proposals must be submitted in good time for their adoption before the dates laid down in Article 2(3).

(**7**) Delete where inapplicable.

(**8**) The provisions laid down in Appendix 4 must be re-examined and completed without delay in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC.

(**9**) The provisions concerning “forced cool down methods” must be re-examined without delay in accordance with the procedure laid down in Article 13 of Directive 70/156/EEC.

(**10**) International Standard ISO 2575-1982 (E), entitled ‘Road vehicles — Symbols for controls indicators and tell-tales’, Symbol Number 4.36.

(**11**) This requirement is only applicable to vehicles with an electronic speed input to the engine management provided the ISO standards are completed within a lead time compatible with the application of the technology. It applies to all vehicles entering into service from 1 January 2005.