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(Acts whose publication is not obligatory)

COUNCIL

COUNCIL DIRECTIVE

of 16 June 1988

amending Directive 70/220/EEC on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from engines of motor vehicles (Restriction of particulate pollutant emissions from diesel engines)

(88/436/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

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

Having regard to the proposal from the Commission ⁽¹⁾,

In cooperation with the European Parliament ⁽²⁾,

Having regard to the opinion of the Economic and Social Committee ⁽³⁾,

Whereas it is important to adopt measures with the aim of progressively establishing the internal market over a period expiring on 31 December 1992; whereas the internal market shall comprise an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured;

Whereas the first programme of action of the European Communities on the environment, which was adopted by the Council on 22 November 1973, calls for account to be taken of the latest scientific progress in combating air pollution caused by exhaust gases from motor vehicles and for Directives adopted previously to be amended accordingly; whereas the third programme of action provides for further efforts to reduce considerably the present level of emissions of pollutants from motor vehicles;

Whereas differences which may emerge in national legislation concerning limits for particulate pollutant

emissions from compression ignition ('diesel') engines used as criteria for the type-approval of vehicles equipped with such engines, are liable to constitute a restriction on the free movement of these products in the Community; whereas it therefore seems necessary to fix common standards in this area;

Whereas Directive 70/220/EEC ⁽⁴⁾ lays down limit values for emissions of carbon monoxide and unburnt hydrocarbons from such engines; whereas these limit values were lowered for the first time by Directive 74/290/EEC ⁽⁵⁾ and supplemented, pursuant to Commission Directive 77/102/EEC ⁽⁶⁾, by limit values for permissible emissions of nitrogen oxides; whereas the limit values for these three pollutants were successively reduced by Commission Directive 78/665/EEC ⁽⁷⁾ and Directives 83/351/EEC ⁽⁸⁾ and 88/76/EEC ⁽⁹⁾;

Whereas the scope of Directive 70/220/EEC was expanded by Directive 83/351/EEC in order to cover certain categories of vehicle equipped with compression ignition ('diesel') engines, without, however, laying down specific emission requirements for those engines; whereas only soot emissions are covered by Directive 72/306/EEC ⁽¹⁰⁾; whereas, however, with a view to improved protection of public health, it is necessary to restrict the overall particulate pollutant emissions from engines of this type; whereas it is appropriate to lay down limit values for particulate pollutant emissions which correspond to the state of the art with regard to diesel engines in the Community and to amplify the test procedure set out in Directive 70/220/EEC by adding the

⁽¹⁾ OJ No C 174, 12. 7. 1986, p. 3.

⁽²⁾ OJ No C 190, 20. 7. 1987, p. 178 and OJ No C 167, 27. 6. 1988.

⁽³⁾ OJ No C 333, 29. 12. 1986, p. 17.

⁽⁴⁾ OJ No L 76, 6. 4. 1970, p. 1.

⁽⁵⁾ OJ No L 159, 15. 6. 1974, p. 61.

⁽⁶⁾ OJ No L 32, 3. 2. 1977, p. 32.

⁽⁷⁾ OJ No L 223, 14. 8. 1978, p. 48.

⁽⁸⁾ OJ No L 197, 20. 7. 1983, p. 1.

⁽⁹⁾ OJ No L 36, 9. 2. 1988, p. 1.

⁽¹⁰⁾ OJ No L 190, 20. 8. 1972, p. 1.

provisions relating to the sampling and analysis of particulate emissions taken over from the relevant United States requirements;

Whereas the establishment of 1,1 g and 1,4 g/test as limit values for particulate pollutant emissions from vehicles fitted with diesel engines represents only a first step towards controlling these emissions;

Whereas, considering also the opinion of the European Parliament, a second stage in the reduction of particulate pollutant emissions must be implemented as quickly as possible and whereas levels of 0,8 g and 1,0 g/test should be achieved; whereas the levels adopted will have to take into account the technical/economic possibilities which exist at that time,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Directive 70/220/EEC is hereby amended as follows:

1. The title is replaced by the following:

'Council Directive of 20 March 1970 on the approximation of the laws of the Member States on measures to be taken against air pollution by emissions from motor vehicles'.

2. Annexes I, III and III A are amended in accordance with the Annex to this Directive.

Article 2

1. From 1 October 1988 no Member State may, on grounds relating to air pollution by particulate pollutant emissions from an engine:

- refuse to grant EEC type approval, to issue the document referred to in the last indent of Article 10 (1) of Directive 70/156/EEC ⁽¹⁾ or to grant national type approval for a type of motor vehicle equipped with a compression-ignition engine,
- prohibit the entry into service of vehicles equipped with compression-ignition engines,

where particulate pollutant emissions from this type of motor vehicle or from such vehicles meet the requirements set out in the Annexes to Directive 70/220/EEC, as amended by this Directive.

2. From 1 October 1989, Member States:

- may no longer issue the document provided for in the last indent of Article 10 (1) of Directive 70/156/EEC in respect of a type of motor vehicle, equipped with a compression-ignition engine,
- may refuse national type approval for a type of motor vehicle, whose emission levels do not meet the requirements set out in the Annexes to Directive 70/220/EEC, as amended by this Directive.

However, in respect of types of vehicle equipped with a direct-injection compression-ignition engine, that date shall be postponed until 1 October 1994.

3. From 1 October 1990, Member States may prohibit the entry into service of motor vehicles equipped with compression-ignition engines whose particulate pollutant emissions do not meet the requirements set out in the Annexes to Directive 70/220/EEC, as amended by this Directive.

However, in respect of vehicles equipped with a direct-injection compression-ignition engine, that date shall be postponed until 1 October 1996.

Article 3

Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive not later than 1 October 1988. They shall forthwith inform the Commission thereof.

Article 4

Before the end of 1989, the Council shall decide, on the basis of a proposal from the Commission, the implementation of a second stage for further reduction in the limit values for particulate pollutant emissions.

Article 5

This Directive is addressed to the Member States.

Done at Luxembourg, 16 June 1988.

For the Council
The President
K. TÖPFER

⁽¹⁾ OJ No L 42, 23. 2. 1970, p. 1.

ANNEX

Amendments to the Annexes to Directive 70/220/EEC

ANNEX 1

SCOPE, DEFINITIONS, APPLICATION FOR EEC TYPE APPROVAL, EEC TYPE APPROVAL, TEST SPECIFICATIONS, EXTENSION OF EEC TYPE APPROVAL, CONFORMITY OF PRODUCTION, TRANSITIONAL ARRANGEMENTS

1 now reads as follows:

'1. SCOPE

This Directive applies to the emission of gaseous pollutants from all motor vehicles equipped with spark-ignition engines and to the emission of gaseous and particulate pollutants from vehicles of categories M₁ and N₁, equipped with compression-ignition engines covered by Article 1.'

2.1 now reads as follows:

'2.1. "Vehicle type" with regard to the emission of gaseous and particulate pollutants from the engine, means a category of power-driven vehicles which do not differ in such essential respects as:'

2.4 is expanded as follows:

'Particulate pollutants" means components of the exhaust gas which are removed from the diluted exhaust gas at a maximum temperature of 52 °C by means of the filters covered by Annex III.'

3.1 now reads as follows:

'3.1. The application for approval of a vehicle type with regard to the emission of gaseous and particulate pollutants from its engine is submitted by the vehicle manufacturer or by his authorized representative.'

5.1.1. The first sentence now reads as follows:

'The components liable to effect the emission of gaseous and particulate pollutants must be so designed, constructed and assembled as to enable the vehicle, in normal use, to comply with the requirements of this Directive, despite the vibration to which they may be subjected.'

5.2.1.1 now reads as follows:

'5.2.1.1. Type 1 test (verifying the average emission of gaseous and particulate pollutants after a cold start).'

5.2.1.1.2 is expanded as follows:

'Not only the carbon monoxide, hydrocarbon and nitrogen oxide emissions, but also the particulate pollutant emissions from vehicles equipped with compression-ignition engines will be plotted.'

5.2.1.1.3. The second sentence now reads as follows:

'The methods used to collect and analyse the gases and also to remove and weigh the particulates must be those prescribed.'

5.2.1.1.4 now reads as follows:

'5.2.1.1.4. Subject to the requirements of 5.2.1.1.4.2 and 5.2.1.1.5 the test is repeated three times. For a vehicle of a given category the mass of the carbon monoxide, the combined mass of the hydrocarbons and the nitrogen oxides, the mass of the nitrogen oxides, and — in the case of vehicles equipped with compression-ignition engines — the mass of the particulates obtained in the test must be less than the amounts shown in the table below:

Engine capacity C (in cm ³)	Mass of carbon monoxide L ₁ (g/test)	Combined mass of hydrocarbons and nitrogen oxides L ₂ (g/test)	Mass of nitrogen oxides L ₃ (g/test)	Mass of particulates ⁽¹⁾ L ₄ (g/test)
C > 2 000	25	6,5	3,5	1,1
1 400 ≤ C ≤ 2 000	30	8		
C < 1 400	45	15	6	

(¹) In the case of vehicles equipped with compression-ignition engines.

Vehicles equipped with compression-ignition engines whose engine capacity exceeds 2 000 cm³ must comply with the limit values for the emission of pollutant gases, corresponding to the category of engine capacities ranging from 1 400 cm³ to 2 000 cm³.

5.2.1.1.4.1. The phrase in brackets is deleted.

5.2.1.1.4.2 now reads as follows:

'5.2.1.1.4.2. The number of tests prescribed in 5.2.1.1.4 may, at the request of the manufacturer, be increased to 10 tests provided that «the arithmetical mean ($\bar{x}_1$) of the three results obtained for each pollutant or combined total of two pollutants subject to limitation falls between 100 and 110 % of the limit. In this case, the decision, after testing, depends exclusively on the average results obtained from all ten tests ($\bar{x} < L$)».

5.2.1.1.5.1 now reads as follows:

'5.2.1.1.5.1. Only one test is performed if the values obtained for each pollutant or for the combined emission of two pollutants, subject to limitation, are $\leq 0,70 L$.'

5.2.1.1.5.2 now reads as follows:

'5.2.1.1.5.2. Only two tests are performed if the result for all pollutants or combined emissions of pollutants is $V_1 \leq 0,85 L$, and if, at the same time, at least one of these values or combined values for pollutants is $V_1 > 0,70 L$. In addition the requirement that $V_1 + V_2 \leq 1,70 L$ and $V_2 \leq L$ must be satisfied.'

7.1 now reads as follows:

'7.1. As a general rule, conformity of production models, with regard to limitation of the emission of gaseous and particulate pollutants from the engine, is checked on the basis of the description set out in Annex VII and, where necessary, of all or some of the tests of Types I, II and III described in 5.2.'

7.1.1.1. The table is replaced by the following:

Engine capacity C (cm ³)	Mass of carbon monoxide L ₁ (g/test)	Combined mass of hydrocarbons and nitrogen oxides L ₂ (g/test)	Mass of nitrogen oxides L ₃ (g/test)	Mass of particulates ⁽¹⁾ L ₄ (g/test)
C > 2 000	30	8,1	4,4	1,4
1 400 ≤ C ≤ 2 000	36	10		
C < 1 400	54	19	7,5	

⁽¹⁾ In the case of vehicles equipped with compression-ignition engines.

Vehicles equipped with a compression-ignition engine having an engine capacity of more than 2 000 cm³ shall not exceed the limit values for pollutant gas emissions from the engine capacity class ranging from 1 400 cm³ to 2 000 cm³.

7.1.1.2. The second paragraph now reads as follows:

'The result to be taken into consideration for the vehicle tested originally is the arithmetical mean of the results obtained from the three Type-I tests carried out on that vehicle. The arithmetical mean ($\bar{x}$) of the results obtained from the random sample and the standard deviation S ⁽¹⁾ are then plotted for the carbon monoxide emissions, the combined hydrocarbon and nitrogen oxide emissions, the nitrogen oxide emissions and the particulate emissions. Production models are then deemed to conform if the following condition is met:

$$\bar{x} + k \cdot S \leq L$$

where:

L is the limit value laid down in 7.1.1.1,

k is the statistical factor depending upon n and given in the following table:

8.3.1.1 now reads as follows:

'8.3.1.1. For vehicle type approval, the limit values specified in the table set out in 5.2.1.1.4 shall be replaced by the following:

- Mass of carbon monoxide: 2,11 g/km,
- Mass of hydrocarbons: 0,25 g/km,
- Mass of nitrogen oxides: 0,62 g/km,
- Mass of particulates ⁽¹⁾: 0,124 g/km.

These limit values are deemed to be met if they are not exceeded by the results of tests on a vehicle type in which the individual masses of pollutants are multiplied by the relevant deterioration factor set out in the table below:

Exhaust gas clean-up system	Deterioration factor			
	CO	HC	NO _x	Particulates ⁽¹⁾
1. Spark-ignition engine with oxidizing catalytic converter	1,2	1,3	1,0	—
2. Spark-ignition engine without catalytic converter	1,2	1,3	1,0	—
3. Spark-ignition engine with 3-way catalytic converter	1,2	1,3	1,1	—
4. Compression-ignition engine	1,1	1,0	1,0	1,2

⁽¹⁾ In the case of vehicles equipped with a compression-ignition engine.

Where the certification process for the Community export markets has provided a manufacturer with confirmation of deterioration factors which are specific to a vehicle type these factors may be used as an alternative to the abovementioned factor to establish whether the limit values referred to in this section are complied with.

ANNEX III

TYPE-I TEST

(Verifying the average emission of gaseous and particulate pollutants in a congested urban area after a cold start)

4.2.1 now reads as follows:

‘4.2.1. The exhaust gas sampling system must be able to measure the actual quantities of pollutants emitted in the exhaust gases to be measured. The system to be used is the constant volume sampler (CVS) system. This requires that the vehicle exhaust be continuously diluted with ambient air under controlled conditions. In the constant volume sampler concept of measuring two conditions must be satisfied: the total volume of the mixture of exhaust gases and dilution air must be measured and a continuously proportional sample of the volume must be collected for analysis.

The quantities of pollutants emitted are determined from the sample concentrations, corrected for the pollutant content of the ambient air and the totalized flow over the test period.

The particulate pollutant emission level is determined by using suitable filters to collect the particulates from a proportional part flow throughout the test and determining the quantity thereof gravimetrically in accordance with 4.3.2.’

4.3.1.1 is expanded as follows:

‘Particulates:

Gravimetric determination of the particulates collected. These particulates are in each case collected by two series-mounted filters in the sample gas flow. The quantity of particulates collected by each pair of filters should be as follows:

- V_{ep} : flow through filters,
- V_{mix} : flow through tunnel,
- M : particulates mass (g/test)
- M_{limit} : limit mass of particulates (limit mass in force, g/test),
- m : mass of particulates collected by filters (g).

$$M = \frac{V_{mix}}{V_{ep}} m \rightarrow m = \frac{V_{ep}}{V_{mix}} M$$

The particulates sample rate (V_{ep}/V_{mix}) will be adjusted so that for $M = M_{limit}$, $1 \leq m \leq 5$ mg.

The filter surface should consist of a material that is hydrophobic and inert towards the components of the exhaust gas (PTFE or equivalent material).’

4.3.1.2 is expanded as follows:

‘Measurement of the particulates collected shall be to a guaranteed accuracy of a 1 µg.’

4.3.2 is expanded as follows:

‘The particulate sampling unit shall consist of a dilution tunnel, a sampling probe, a filter unit, a partial-flow pump, and a flow rate regulator and measuring unit. The particulate-sampling part flow is drawn through two series-mounted filters. The sampling probe for the test gas flow for particulates shall be so arranged within the dilution tract that a representative sample gas flow can be taken from the homogeneous air/exhaust mixture and an air/exhaust gas mixture temperature of 52 °C is not exceeded at the sampling point. The temperature of the gas flow in the flow meter cannot fluctuate more than ± 3 K, nor can the mass flow rate fluctuate by more than ± 5 %. Should the volume of flow change unacceptably as a result of excessive filter loading, the test must be stopped. When it is repeated, the rate of flow must be decreased and/or a larger filter used. The filters must be removed from the chamber no earlier than an hour before the test begins.

The necessary particle filters shall be conditioned (as regards temperature and humidity) in an open dish which has been protected against dust ingress for at least eight and for not more than 56 hours before the test in an air-conditioned chamber. After this conditioning the uncontaminated filters will be weighed and stored until they are used.’

5.3. Preconditioning of the car

5.3.1 is amended as follows:

‘For compression-ignition engine vehicles for the purpose of measuring particulates at most 36 hours and at least six hours before testing, the preconditioning described in Appendix 9 has to be completed.

After this preconditioning and before testing, compression-ignition and positive ignition engine vehicles must be kept in a room in which the temperature remains relatively constant between 20 and 30 °C. This conditioning must be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within $\pm 2^\circ\text{C}$ of the temperature of the room.

If the manufacturer so requests, the test must be carried out not later than 30 hours after the vehicle has been run at its normal temperature.'

7 now reads as follows:

'7. GAS AND PARTICULATE SAMPLING AND ANALYSIS'

7.1 now reads as follows:

'7.1. Sampling

Sampling begins at the beginning of the first test cycle as defined in 6.6.2 and ends on conclusion of the final idling period in the fourth cycle.'

7.2.1 is expanded as follows:

'The spent particulate filters must be taken to the chamber no later than one hour after conclusion of the test on the exhaust gases and must there be conditioned for between two and 56 hours and then be weighed.'

8 now reads as follows:

'8. DETERMINATION OF THE QUANTITY OF GASEOUS AND PARTICULATE POLLUTANTS EMITTED'

8.2 now reads as follows:

'8.2. Total mass of gaseous and particulate pollutants emitted

The mass M of each pollutant emitted by the vehicle during the test is determined by obtaining the product of the volumetric concentration and the volume of the gas in question, with due regard to the following densities under the abovementioned reference conditions:

- in the case of carbon monoxide (CO): $d = 1,25 \text{ g/l}$,
- in the case of hydrocarbons ($\text{CH}_{1,85}$): $d = 0,619 \text{ g/l}$,
- in the case of nitrogen oxides (NO_2): $d = 2,05 \text{ g/l}$.

The mass m of particulate pollutant emissions from the vehicle during the test is defined by weighing the mass of particulates collected by the two filters, m^1 by the first filter, m^2 by the second filter:

- if $0,95 (m^1 + m^2) \leq m^1$, $m = m^1$,
- if $0,85 (m^1 + m^2) \leq m^1 < 0,95 (m^1 + m^2)$, $m = m^1 + m^2$,
- if $m^1 < 0,85 (m^1 + m^2)$, the test is cancelled.

Appendix 8 gives the calculations, followed by examples, used in determining the mass emissions of gaseous and particulate pollutants.'

APPENDIX 5

The title of the appendix now reads as follows:

'DESCRIPTION OF GAS-SAMPLING SYSTEMS'

2.1.3 now reads as follows:

- '2.1.3. A continuously proportional sample of the diluted exhaust gases and the dilution air must be collected for analysis.

The quantity of gaseous pollutants emitted is determined from the proportional sample concentrations and the total volume measured during the test. The sample concentrations are corrected to take account of the pollutant content of the ambient air. In addition, where vehicles are equipped with compression-ignition engines, their particulate emissions are plotted.'

2.2.2 now reads as follows:

- 2.2.2 'The exhaust-gas sampling system must be so designed as to make it possible to measure the average volume concentrations of the CO_2 , CO, HC and NO_x , and, in addition, in the case of vehicles equipped with compression-ignition engines, of the particulate emissions, contained in the exhaust gases emitted during the vehicle testing cycle.'

2.4 now reads as follows:

'2.4. Additional sampling unit for the testing of vehicles equipped with a compression-ignition engine.

- 2.4.1. By way of a departure from the taking of gas samples from vehicles equipped with spark-ignition engines, the hydrocarbon and particulate sampling points are located in a dilution tunnel.
- 2.4.2. In order to reduce heat losses in the exhaust gases between the exhaust tail pipe and the dilution tunnel inlet, the pipe may not be more than 3,6 m long, or 6,1 m long if heat insulated. Its internal diameter may not exceed 105 mm.
- 2.4.3. Predominantly turbulent flow conditions (Reynolds number $\geq 4\,000$) must apply in the dilution tunnel, which consists of a straight tube of electrically-conductive material, in order to guarantee that the diluted exhaust gas is homogeneous at the sampling points and that the samples consist of representative gases and particulates. The dilution tunnel must be at least 200 mm in diameter and the system must be earthed.
- 2.4.4. The particulate sampling system consists of a sampling probe in the dilution tunnel and two series-mounted filters. Quick-acting valves are located both up and downstream of the two filters in the direction of flow.
- 2.4.5. The particulate sampling probe shall be arranged as follows:
It must be installed in the vicinity of the tunnel centreline, roughly ten tunnel diameters downstream of the gas inlet, and have an internal diameter of at least 12 mm.
The distance from the sampling tip to the filter mount must be at least five probe diameters, but must not exceed 1 020 mm.
- 2.4.6. The sample gas flow measuring unit consists of pumps, gas flow regulators and flow measuring units.
- 2.4.7. The hydrocarbon sampling system consists of a heated sampling probe, line, filter and pump. The sampling probe must be installed in such a way at the same distance from the exhaust gas inlet as the particulate sampling probe, that neither interferes with samples taken by the other. It must have a minimum internal diameter of 4 mm.
- 2.4.8. All heated parts must be maintained at a temperature of $190^{\circ}\text{C} \pm 10^{\circ}\text{C}$ by the heating system.
- 2.4.9. If it is not possible to compensate for variations in the flow rate there must be a heat exchanger and a temperature control device as specified in 2.3.3.1 so as to ensure that the flow rate in the system is constant and the sampling rate is accordingly proportional.'

3.1.4 is expanded as follows:

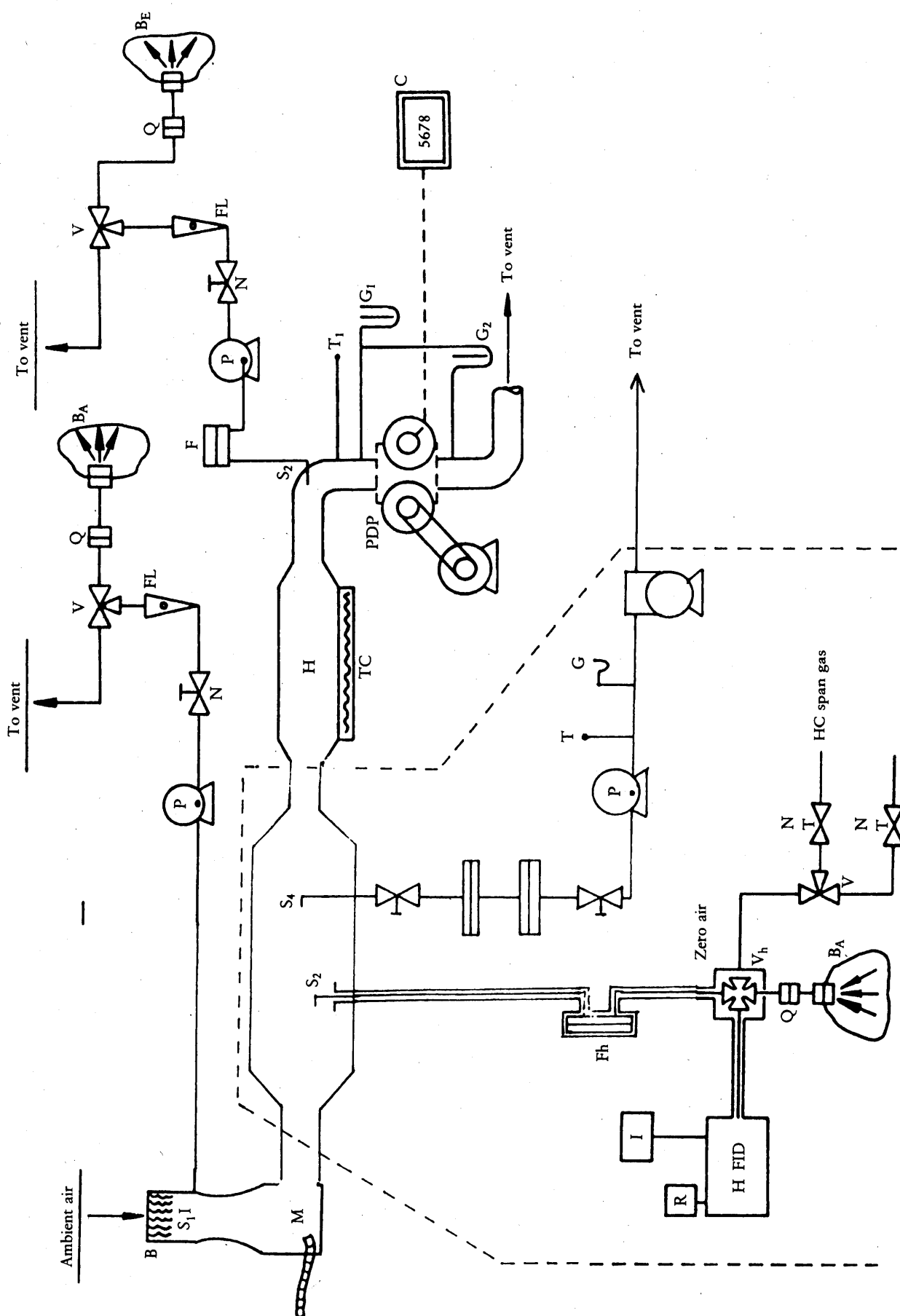
'Particulate sampling system

- S₄: Sampling probe in the dilution tunnel,
- F_p: Filter unit consisting of two series-mounted filters; switching arrangement for further parallel-mounted pairs of filters,
- Sampling line,
- Pumps, flow regulators, flow measuring units.'

Figure 1 is replaced by the following:

Figure 1

Constant volume sampler with positive displacement pump (PDP-CVS)



Required for diesel testing only

3.2.4. is expanded as follows:

Particulate sampling system

- S₄: Sampling probe in dilution tunnel,
- F_p: Filter unit, consisting of two series-mounted filters; Switching unit for further parallel-mounted pairs of filters,
- Sampling line,
- Pumps, flow regulators, flow measuring units.'

Figure 2 is replaced by the following:

3.3 is replaced as follows:

'(only for spark-ignition engines)'

APPENDIX 8

This appendix now reads as follows:

'APPENDIX 8

CALCULATION OF THE EMISSION OF POLLUTANTS

1. GENERAL

1.1. Emissions of gaseous pollutants are calculated by means of the following equation:

$$M_i = V_{\text{mix}} \cdot Q_i \cdot k_H \cdot C_i \cdot 10^{-6}$$

where:

M_i : Pollutant i emissions in g/test;

V_{mix} : Volume of the diluted exhaust gas expressed in l/test and corrected to standard conditions (273,2 K and 101,33 kPa);

Q_i : Density of the pollutant i in g/l at normal temperature and pressure (273,2 K and 101,33 kPa);

k_H : Humidity correction factor used for the calculation of the emissions of nitrogen oxides (there is no humidity correction for HC and CO);

C_i : Concentration of the pollutant i in the diluted exhaust gas, expressed in ppm and corrected by the concentration of the pollutant i in the dilution air.

1.2. Volume determination

The wording of former Section 1 is adopted without change.

1.3. Calculation of the corrected concentration of pollutants in the sampling bag

The wording of former Section 2 is adopted without change.

1.4. Determination of the NO humidity correction factor

The wording of former Section 3 is adopted without change.

1.5. Example

The wording of former Section 4 is adopted without change up to 4.2 while 4.3 and 4.4 are deleted.

2. SPECIAL PROVISION RELATING TO VEHICLES EQUIPPED WITH COMPRESSION-IGNITION ENGINES

2.1. HC measurement for compression-ignition engines

The average HC concentration used in determining the HC mass emissions from compression-ignition engines is calculated with the aid of the following formula:

$$c_e = \frac{\int_{t_1}^{t_2} c_{\text{HC}} \cdot dt}{t_2 - t_1}$$

where:

$\int_{t_1}^{t_2} c_{\text{HC}} \cdot dt$: Integral of the recording of the heated HFID throughout the test ($t_2 - t_1$),

c_e : Concentration of HC measured in the diluted exhaust, in ppm,

c_e : is substituted directly for C_{hc} in all relevant equations.

2.2. Determination of particulates

Particulate emission M_p (g/test) is calculated by means of the following equation:

$$M_p = \frac{(V_{\text{mix}} + V_{\text{ep}}) \times P_e}{V_{\text{ep}}}$$

where exhaust gases are vented outside tunnel,

$$M_p = \frac{V_{\text{mix}} + P_e}{V_{\text{ep}}}$$

where exhaust gases are returned to the tunnel,

where:

V_{mix} : Volume of diluted exhaust gases (see 1.1.3), under standard conditions,

V_{ep} : Volume of exhaust gas flowing through particulate filter under standard conditions,

P_e : Particulate mass collected by filter,

M_p : particulate emission in g/test for use in this Appendix

or

M_p : particulate emission in g/phase for use in Appendix 8 of Annex III A.'

Appendix 9 is added as follows:

APPENDIX 9

PRECONDITIONING CYCLE

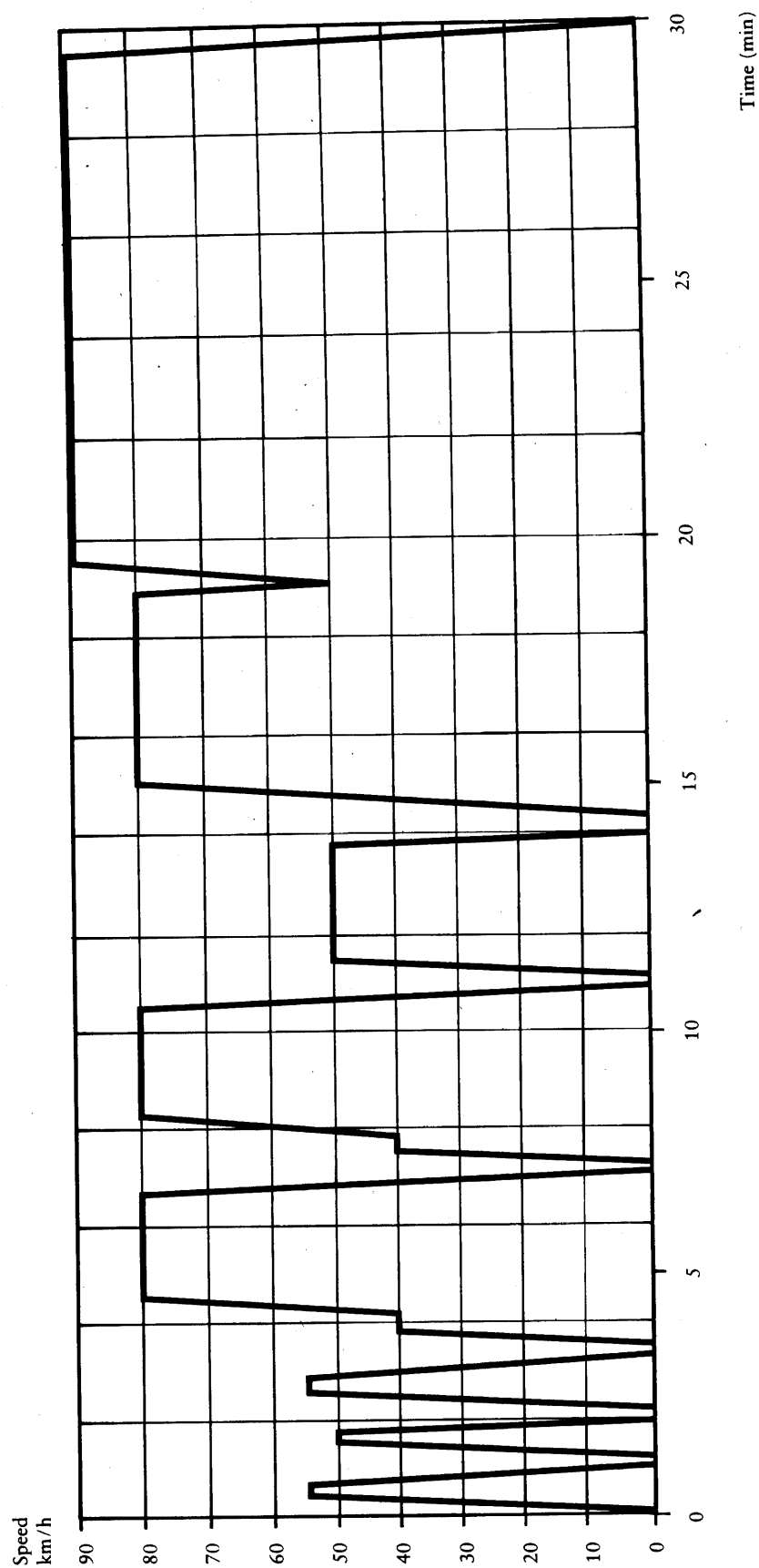
CEC CF-11/3

Gear shifting

1/2 25 km/h
2/3 40 km/h
3/4 50 km/h
4/5 70 km/h

Dyno brake power setting:

Procedure prescribed by ECE Dir. 83/351



Time (sec)	Speed (km/h)	Time (sec)	Speed (km/h)
0	0	840	0
20	55	850	0
45	55	880	80
65	0	1110	80
75	0	1130	50
92	50	1150	90
108	50	1760	90
125	0	1800	0'
135	0		
155	55		
180	55		
200	0		
210	0		
225	40		
255	40		
270	80		
400	80		
420	0		
430	0		
445	40		
485	40		
500	80		
630	80		
650	0		
660	0		
680	50		
820	50		

ANNEX III A

TEST EQUIVALENT TO THE TYPE-I TEST INTENDED TO CHECK EMISSIONS FOLLOWING A COLD START

- 4.2.1
4.3.1.1
4.3.1.2
4.3.2
- } are amended in the same way as the corresponding items in Annex III.

6.2.2.7 now reads as follows:

- '6.2.2.7. Start the gas flow measuring device, position the sample-selector valves to direct the sample flow into the "transient" exhaust sample bag and the "transient" dilution-air sample bag (turn on the diesel hydrocarbon analyser system integrator and mark the recorder chart, if applicable), position the valves during sampling in such a way that the transient phase is directed onto the particulate filters, turn the key and start the engines.'

6.2.2.11. The first sentence now reads as follows:

'At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously switch the sample flows from the "transient" to the "stabilized" bags, in such a way that they pass through the particulate filters for the stabilized flows, switch off gas-flow measuring device No 1 (and diesel hydrocarbon integrator No 1) (mark the diesel-hydrocarbon recorder chart) and start gas-flow measuring device No 2 (and diesel-hydrocarbon integrator No 2).'

6.2.2.13. The first sentence now reads as follows:

'Five seconds after the engine stops running, simultaneously turn off gas-flow measuring device No 2 (and diesel-hydrocarbon integrator No 2) (mark the hydrocarbon recorder chart, if applicable) close the valves for the stabilized-phase particulate filters and place the sample selector valves in the "standby" position.'

6.2.2.16. The following new sentence is inserted after the first sentence:

'In the case of vehicles equipped with a compression-ignition engine similarly only one pair of particulate filters is needed for the hot-start test.'

6.2.2.17. The first sentence now reads as follows:

'At the end of the deceleration, which is scheduled to occur at 505 seconds, simultaneously turn off gas-flow measuring device No 1 (and diesel hydrocarbon integrator No 1) (mark the diesel hydrocarbon recorder chart, if applicable) close the valves for the particulate filter and place the sample selector valve in the "standby" position (engine shutdown does not form part of the hot-start test sampling period).'

The following new point is inserted after 7.7:

- '7.8. The spent particulate filters must be taken to the chamber no later than one hour after conclusion of the test on the exhaust gases and must there be conditioned for between two and 56 hours, and then be weighed.'

8 and 8.2 are amended in the same way as the corresponding items in Annex III.

APPENDIX 5: the title is the same as that of Appendix 5 to Annex III.

- 2.1.3
2.2.2
2.4.1
2.4.2
2.4.3
- } are amended in the same way as the corresponding items in Appendix 5 to Annex III.

2.4.4 now reads as follows:

- '2.4.4. The particulate sampling system consists of a sampling probe in the dilution tunnel, three filter units consisting in each case of two series-mounted filters to which the sample gas flows within a test phase can be directed. The sample gas flows from the phases "transient after cold start", "stabilized after cold start" and "transient after hot start" will in turn flow through the filter units.'

- 2.4.5
2.4.6
2.4.7
2.4.8
2.4.9
- } are amended in the same way as the corresponding items in Appendix 5 to Annex III.

3. Add the following under the Title.

'The systems coincide with those described in item 3 in Appendix 5 to Annex III, with the exception that in each case three sample bags for exhaust gas samples and ambient air samples are arranged in parallel in such a way that they can in turn have the sample gas flow directed towards them via quick-acting valves.

Accordingly, in the tests on vehicles equipped with diesel engines, three pairs of particulate-measurement filters are arranged in parallel.'

APPENDIX 8: This appendix now reads as follows:

'APPENDIX 8

CALCULATION OF THE EMISSION OF POLLUTANTS

1. Pollutant emissions are calculated by means of the following equation:

$$M_s = 0,43 \frac{M_{icT} + M_{is}}{S_{cT} + S_s} + 0,57 \frac{M_{iHT} + M_{is}}{S_{HT} + S_s}$$

where:

- M_s : pollutant emissions in g/km for the complete test;
 M_{icT} : pollutant emissions in grams during the first phase (transient cold);
 M_{iHT} : pollutant emissions in grams during the final phase (transient hot);
 M_{is} : pollutant emissions in grams during the second phase (stabilized);
 S_{cT} : distance covered (in km) during the final phase;
 S_{HT} : distance covered (in km) during the final phase;
 S_s : distance covered (in km) during the second phase.

2. The emissions of pollutants in the individual phases are calculated by means of the following formula:

$$M_{ij} = V_{mix} \times Q_i \times k_H \times C_i \times 10^{-6}$$

where:

- M_{ij} : pollutant emission in g/phase i (ie. M_{icT} , M_{iHT} , etc.);
 V_{mix} : volume of the diluted exhaust: gas expressed in l/phase and correction to standard conditions (273,2 K and 101,33 kPa);
 Q_i : density of the pollutant in g/l at normal temperature and pressure (273,2 K and 101,33 kPa);
 k_H : humidity correction factor used in calculating the emissions of nitrogen oxides (there is no humidity correction for HC and CO);
 C_i : concentration of the pollutant in the diluted exhaust gas, expressed in ppm and corrected for the concentration of the pollutant i in the dilution air.

3. SPECIAL PROVISIONS RELATING TO VEHICLES EQUIPPED WITH COMPRESSION-IGNITION ENGINES

3.1 HC measurement

The HC emissions in the individual phases shall be determined in accordance with 2.1 in Appendix 8 to Annex III.

3.2 Particulate measurement

The particulate emissions in the individual phases shall be determined in accordance with 2.2 in Appendix 8 to Annex III.
 The total emission is calculated in accordance with paragraph 1 of this Appendix.'