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COMMISSION DIRECTIVE 93/116/EC

of 17 December 1993

adapting to technical progress Council Directive 80/1268/EEC relating to the fuel consumption of motor vehicles

(OJ L 329, 30.12.1993, p. 39)

Corrected by:

► C1 Corrigendum, OJ L 42, 15.2.1994, p. 27 (93/116/EC)

▼B**COMMISSION DIRECTIVE 93/116/EC****of 17 December 1993****adapting to technical progress Council Directive 80/1268/EEC
relating to the fuel consumption of motor vehicles**

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Council Directive 70/156/EEC of 6 February 1970 relating to the type-approval of motor vehicles and their trailers ⁽¹⁾, as last amended by Commission Directive 93/81/EEC ⁽²⁾, and in particular Article 13 (2) thereof,

Having regard to Council Directive 80/1268/EEC of 16 December 1980 on the approximation of the laws of the Member States relating to the fuel consumption of motor vehicles ⁽³⁾, as amended by Directive 89/491/EEC ⁽⁴⁾, and in particular Article 3 thereof,

Whereas Directive 80/1268/EEC is one of the separate directives of the EC type-approval procedure which has been established by Directive 70/156/EEC; whereas, consequently, the provisions laid down in Directive 70/156/EEC relating to vehicle systems, components and separate technical units apply to this Directive;

Whereas, in particular, Articles 3 (4) and 4 (3) of Directive 70/156/EEC require each separate Directive to have attached to it an information document incorporating the relevant items of Annex I to that Directive and also a type-approval certificate based on Annex VI thereto in order that type-approval may be computerized;

Whereas reference should be made to Council Directive 70/220/EEC ⁽⁵⁾, as last amended by Directive 93/59/EEC ⁽⁶⁾, relating to measures to be taken against air pollution by emissions from motor vehicles, because that Directive establishes technical and administrative provisions which apply also to this Directive;

Whereas, in view of the increasing concern about the environmental effects of carbon dioxide emissions, the fifth programme of action of the European Communities on the protection of the environment approved by the Council on 16 December 1992 provides for a stabilization target of these emissions; whereas it is necessary to determine the carbon dioxide emissions of light motor vehicles in the framework of the EC type-approval; whereas it is appropriate to base the measurement of carbon dioxide on the test procedure established by Directive 70/220/EEC for the measurement of the air-polluting substances of motor vehicles, and consequently to calculate fuel consumption on the basis of the results of these measurements;

Whereas the measures provided for in this Directive are in accordance with the opinion of the Committee for Adaptation to Technical Progress established by Directive 70/156/EEC,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Directive 80/1268/EEC shall be amended as follows:

1. the title shall be replaced by the following:

‘Council Directive 80/1268/EEC relating to the carbon dioxide emissions and the fuel consumption of motor vehicles.’;

⁽¹⁾ OJ No L 42, 23. 2. 1970, p. 1.⁽²⁾ OJ No L 264, 23. 10. 1993, p. 49.⁽³⁾ OJ No L 375, 31. 12. 1980, p. 36.⁽⁴⁾ OJ No L 238, 15. 8. 1989, p. 43.⁽⁵⁾ OJ No L 76, 6. 4. 1970, p. 1.⁽⁶⁾ OJ No L 186, 28. 7. 1993, p. 21.

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2. Article 2 shall be replaced by the following:

'Article 2

No Member State may refuse to grant EC type-approval or national type-approval in respect of a vehicle, or refuse or prohibit the sale, registration, entry into service or use of a vehicle, on grounds relating to its carbon dioxide emissions or its fuel consumption if the emission and consumption figures have been determined in accordance with Annexes I and II and are set out in a document given to the vehicle owner at the time of purchase in the manner and form decided by each Member State.';

3. the Annexes shall be replaced by the Annexes to this Directive.

Article 2

1. With effect from 1 April 1994, Member States may not on grounds relating to the emission of carbon dioxide or to fuel consumption:

- refuse, in respect of any given type of motor vehicle, to grant EC type-approval or national type-approval; or
- prohibit the registration, sale or entry into service of vehicles,

if the emission and consumption figures have been determined to be in accordance with the requirements of Directive 80/1268/EEC as amended by this Directive.

2. With effect from 1 January 1996, Member States:

- shall no longer grant EC type-approval, and
- may refuse to grant national type-approval,

for a type of vehicle on grounds relating to the emission of carbon dioxide and to the fuel consumption if the emission and consumption figures have not been determined in accordance with the requirements of Directive 80/1268/EEC, as amended by this Directive.

3. With effect from 1 January 1997, Member States:

- shall consider certificates of conformity which accompany new vehicles in accordance with the provisions of Directive 70/156/EEC to be no longer valid for the purposes of Article 7 (1) of that Directive, and
- may refuse the registration, sale and entry into service of new vehicles which are not accompanied by a certificate of conformity in accordance with Directive 70/156/EEC,

on grounds relating to the emission of carbon dioxide and to fuel consumption if the emission and consumption figures have not been determined in accordance with the requirements of Directive 80/1268/EEC, as amended by this Directive.

Article 3

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 March 1994. They shall forthwith inform the Commission thereof.

When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted by Member States.

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

Article 4

This Directive shall enter into force on the third day following its publication in the *Official Journal of the European Communities*.



ANNEX I

DETERMINATION OF CO₂ EMISSIONS AND FUEL CONSUMPTION

1. SCOPE

This Directive applies to the carbon dioxide (CO₂) emissions and the fuel consumption of all motor vehicles of category M1.
2. APPLICATION FOR EC TYPE-APPROVAL
 - 2.1. The application for EC type-approval pursuant to Article 3 (4) of Directive 70/156/EEC for a vehicle type with regard to CO₂ emissions and fuel consumption shall be submitted by the manufacturer.
 - 2.2. A model for the information document is given in Annex II to Directive 70/220/EEC. When already available, the type-approval number will also be reported. When appropriate, copies of other type-approvals with the relevant data are provided to enable extension of approvals in accordance with point 11. At the request of the technical service in charge of the tests or the manufacturer, complementary technical information could be considered for specific vehicles which are particularly fuel efficient.
 - 2.3. For the test described in point 6 of this Annex, a vehicle representative of the vehicle type to be approved will be submitted when the technical service responsible for the type-approval tests carries out the tests itself. During the test, the technical service will check that this vehicle conforms to the limit values applicable to that type, as described in Directive 70/220/EEC, as modified according to its last amendment.
3. GRANTING OF EC TYPE-APPROVAL
 - 3.1. If the relevant requirements are satisfied, EC type-approval pursuant to Article 4 (3) of Directive 70/156/EEC shall be granted.
 - 3.2. A model for the EC type-approval certificate is given in Annex II.
 - 3.3. An approval number in accordance with Annex VII to Directive 70/156/EEC shall be assigned to each vehicle type approved. The same Member State shall not assign the same number to another vehicle type.
4. GENERAL REQUIREMENTS
 - 4.1. The CO₂ emissions are measured during the test cycle simulating the urban and extra-urban driving patterns as described in Appendix 1 of Annex III to Council Directive 91/441/EEC⁽¹⁾.
 - 4.2. The results of the test must be expressed as carbon dioxide emissions in g/km rounded to the nearest whole number.
 - 4.3. Fuel consumptions are calculated according to point 7 by the carbon balance method using the measured emissions of CO₂ and the other carbon related emissions (CO and HC). The results will be rounded to the first decimal place.
 - 4.4. **Test fuel**

The appropriate reference fuels as defined in Annex VIII to Directive 91/441/EEC must be used for testing.

For the purpose of calculation mentioned in point 4.3, the following fuel characteristics will be used:

 - (a) density: measured on the test fuel according to ISO 3675 or an equivalent method;
 - (b) hydrogen — carbon ratio: fixed values will be used which are 1,85 for gasoline and 1,86 for diesel.

⁽¹⁾ OJ No L 242, 30. 8. 1991, p. 1.

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5. TEST CONDITIONS

5.1. **Test vehicle**

5.1.1. The vehicle must be presented in good mechanical condition. It must have been run in and driven at least 3 000 kilometres, but less than 15 000 kilometres, before the test.

5.1.2. The settings of the engine and of the vehicle controls must be those prescribed by the manufacturer. This requirement also applies, in particular to the idle settings, to the cold start device and to the exhaust gas pollutant emission control system.

5.1.3. The laboratory may check that vehicle performance is as specified by the manufacturer and that it is possible to use it in normal driving conditions, particularly cold and hot start.

5.1.4. Before the test, the vehicle must be stored in a room where the temperature remains between 293 and 303 K (20 and 30 °C). This conditioning period will last at least six hours and to a point where the temperature of the engine lube oil and the engine coolant are within ± 2 K of the room temperature. At the request of the manufacturer, the test may be conducted within a maximum of 30 hours after the vehicle has been used at normal temperature.

At the manufacturer's request, gasoline engined vehicles may be preconditioned according to the procedure prescribed in point 5.1.11 of Annex VI to Directive 91/441/EEC; compression-ignition engined vehicles may be preconditioned according to the procedure described in point 5.3 of Annex III to the same Directive.

5.1.5. Only the equipment necessary for the functioning of the vehicle during the test shall be in operation. If there is a manually controlled device on the carburettor inlet for air heating, it must be in the 'summer' position. In general, the auxiliary equipment required for the normal running of the vehicle must be in operation.

5.1.6. If the radiator fan is temperature controlled, it must be operating as it would normally on the vehicle. The passenger compartment heating system must not be operating, nor must the air conditioning system, although its compressor must be operating normally.

5.1.7. If a pressure charging device is fitted, it must be operating as it would normally.

5.2. **Lubricants**

All lubricants must be those recommended by the manufacturer of the vehicle and must be indicated on the test report.

5.3. **Tyres**

The tyres must be of one of the types specified as original equipment by the vehicle manufacturer, inflated to the pressure recommended for the test load and speeds (adjusted, where necessary, for test-bed operation under test conditions). The pressures used must be indicated in the test report.

6. MEASUREMENT OF CO₂ AND CARBON-RELATED EMISSIONS6.1. **Test cycle**

The test cycle is described in Appendix 1 of Annex III to Directive 91/441/EEC including both Part One (urban driving) and Part Two (extra-urban driving). All driving prescriptions contained in this Appendix will be applied for the CO₂ measurement.

6.2. **Definition**

6.2.1. Reference mass

Mass of the vehicle in running order less the uniform mass of the driver of 75 kg and increased by a uniform mass of 100 kg.

6.3. **Dynamometer adjustments**

6.3.1. The load and inertia adjustments of the dynamometer are determined as defined in Annex III to Directive 91/441/EEC with the exception of point 5.1 and Appendix II, point 3.3.1.

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- 6.3.2. For the purpose of the determination of CO₂ emissions and the related fuel consumption, the inertia weight used to adjust the dynamometer will be chosen as follows:

Reference mass of vehicle RW (kg)	Power absorbed by the dynamometer Pa (kW)	Equivalent inertia I (kg)
RW ≤ 480	3,8	455
480 < RW ≤ 540	4,1	510
540 < RW ≤ 595	4,3	570
595 < RW ≤ 650	4,5	625
650 < RW ≤ 710	4,7	680
710 < RW ≤ 765	4,9	740
765 < RW ≤ 850	5,1	800
850 < RW ≤ 965	5,6	910
965 < RW ≤ 1 080	6,0	1 020
1 080 < RW ≤ 1 190	6,3	1 130
1 190 < RW ≤ 1 305	6,7	1 250
1 305 < RW ≤ 1 420	7,0	1 360
1 420 < RW ≤ 1 530	7,3	1 470
1 530 < RW ≤ 1 640	7,5	1 590
1 640 < RW ≤ 1 760	7,8	1 700
1 760 < RW ≤ 1 870	8,1	1 810
1 870 < RW ≤ 1 980	8,4	1 930
1 980 < RW ≤ 2 100	8,6	2 040
2 100 < RW ≤ 2 210	8,8	2 150
2 210 < RW ≤ 2 380	9,0	2 270
2 380 < RW ≤ 2 610	9,4	2 270
2 610 < RW	9,8	2 270

If the corresponding equivalent inertia is not available on the dynamometer, the bigger value closest to the vehicle reference mass will be used.

- 6.3.3. When using the alternative method for the setting of the dynamometer, the brake is adjusted in accordance with the values of Pa listed in the above table.

6.4. Calculation of emissions

6.4.1. General provisions

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

$$M_i = \frac{V_{\text{mix}} \cdot Q_i \cdot C_i \cdot 10^{-6}}{d} \quad (1)$$

where:

- M_i = mass emission of the pollutant i in grams per kilometre;
 V_{mix} = volume of the diluted exhaust gas expressed in litres per test and corrected to standard conditions (273,2 K and 101,33 kPa);
 Q_i = density of the pollutant i in grams per litre at normal temperature and pressure (273,2 K and 101,33 kPa);
 C_i = concentration of the pollutant i in the diluted exhaust gas expressed in ppm and corrected by the amount of the pollutant i contained in the dilution air. If C_i is expressed in % volume, 10^{-6} factor is replaced by 10^{-2} ;
 d = driven distance during the operating cycle in km.

6.4.1.2. Volume determination

- 6.4.1.2.1. Calculation of the volume when a variable dilution device with constant flow control by orifice or venturi is used. Record continuously the parameters showing the volumetric flow, and calculate the total volume for the duration of the test.
- 6.4.1.2.2. Calculation of volume when a positive displacement pump is used. The volume of diluted exhaust gas in systems comprising a positive displacement pump is calculated with the following formula:

$$V = V_o \cdot N$$

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where:

V = volume of the diluted exhaust gas expressed in litres per test (prior to correction);

V_o = volume of gas delivered by the positive displacement pump on testing conditions in litres per revolution;

N = number of revolutions per test.

- 6.4.1.2.3. Correction of the diluted exhaust-gas volume to standard conditions. The diluted exhaust-gas volume is corrected by means of the following formula:

$$V_{\text{mix}} = V \cdot K_1 \cdot \frac{P_p}{T_p} \quad (2)$$

in which:

$$K_1 = \frac{273,2}{101,33} = 2,6961 \quad (K \cdot \text{kPa}^{-1}) \quad (3)$$

where:

P_p = absolute pressure at the inlet to the positive displacement pump in kPa;

T_p = average temperature of the diluted exhaust gas entering the positive displacement pump during the test (K).

- 6.4.1.3. Calculation of the corrected concentration of pollutants in the sampling bag

$$C_i = C_e - C_d \left(1 - \frac{1}{DF} \right) \quad (4)$$

where:

C_i = concentration of the pollutant i in the diluted exhaust gas, expressed in ppm or % volume and corrected by the amount of i contained in the dilution air;

C_e = measured concentration of pollutant i in the diluted exhaust gas, expressed in ppm, or % volume;

C_d = measured concentration of pollutant i in the air used for dilution, expressed in ppm, or % volume;

DF = dilution factor.

The dilution factor is calculated as follows:

$$DF = \frac{13,4}{C_{\text{CO}_2} + (C_{\text{HC}} + C_{\text{CO}})10^{-4}} \quad (5)$$

where:

C_{CO_2} = concentration of CO_2 in the diluted exhaust gas contained in the sampling bag, expressed in % volume;

C_{HC} = concentration of HC in the diluted exhaust gas contained in the sampling bag, expressed in ppm carbon equivalent;

C_{CO} = concentration of CO in the diluted exhaust gas contained in the sampling bag, expressed in ppm.

- 6.4.1.4. Example

- 6.4.1.4.1. Data

- 6.4.1.4.1.1. Ambient conditions:

ambient temperature: $23 \text{ }^\circ\text{C} = 296,2 \text{ }^\circ\text{K}$,

barometric pressure: $P_b = 101,33 \text{ kPa}$.

- 6.4.1.4.1.2. Volume measured and reduced to standard conditions

$$V = 51961 \text{ l}$$

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6.4.1.4.1.3. Analyser readings:

	Diluted exhaust	Dilution air
HC ⁽¹⁾	92 ppm	3,0 ppm
CO	470 ppm	0 ppm
CO ₂	1,6 % volume	0,03 % volume

⁽¹⁾ In ppm carbon equivalent.

6.4.1.4.2. Calculation

6.4.1.4.2.1. Dilution factor (DF) (see formula 5)

$$DF = \frac{13,4}{C_{CO_2} + (C_{CH} + C_{CO})10^{-4}}$$

$$DF = \frac{13,4}{1,6 + (92 + 470)10^{-4}}$$

$$DF = 8,091$$

6.4.1.4.2.2. Calculation of the corrected concentration of pollutants in the sampling bag:

HC mass emissions (see formulae 4 and 1)

$$C_i = C_e - C_d \left(1 - \frac{1}{DF}\right) \quad (4)$$

$$C_{HC} = 92 - 3 \left(1 - \frac{1}{8,091}\right)$$

$$C_{HC} = 89,371 \text{ ppm}$$

$$M_{HC} = C_{HC} \cdot V_{mix} \cdot Q_{HC} \cdot \frac{1}{d} \cdot 10^{-6} \quad (1)$$

$$Q_{HC} = 0,619$$

$$M_{HC} = 89,371 \cdot 51\,961 \cdot 0,619 \cdot 10^{-6} \cdot \frac{1}{d}$$

$$M_{HC} = \frac{2,88}{d} \text{ g/km}$$

CO mass emissions (see formula 1)

$$M_{CO} = C_{CO} \cdot V_{mix} \cdot Q_{CO} \cdot \frac{1}{d} \cdot 10^{-6} \quad (1)$$

$$Q_{CO} = 1,25$$

$$M_{CO} = 470 \cdot 51\,961 \cdot 1,25 \cdot 10^{-6} \cdot \frac{1}{d}$$

$$M_{CO} = \frac{30,5}{d} \text{ g/km}$$

CO₂ mass emissions (see formula 1)

$$C_i = C_e - C_d \left(1 - \frac{1}{DF}\right) \quad (4)$$

$$C_{CO_2} = 1,6 - 0,03 \left(1 - \frac{1}{8,091}\right)$$

$$C_{CO_2} = 1,573 \text{ % volume}$$

$$Q_{CO_2} = 1,964$$

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$$M_{\text{CO}_2} = C_{\text{CO}_2} \cdot V_{\text{mix}} \cdot Q_{\text{CO}_2} \cdot 10^{-2} \cdot \frac{1}{d} \quad (1)$$

$$M_{\text{CO}_2} = 1,573 \cdot 51\,961 \cdot 1,964 \cdot 10^{-2} \cdot \frac{1}{d}$$

$$M_{\text{CO}_2} = \frac{1\,605,27}{d} \text{ g/km}$$

- 6.4.2. Special provisions relating to vehicles equipped with compression ignition engines

HC measurements 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 FID over the test duration ($t_2 - t_1$);

C_e = HC concentration of the diluted exhaust sample as calculated from the integrated HC trace, in ppm carbon equivalent.

6.5. **Interpretation of the results**

- 6.5.1. The CO_2 value adopted as the type-approval value shall be the value declared by the manufacturer if the value measured by the technical service does not exceed the declared value by more than 4 %. The measured value can be lower without any limitations.

- 6.5.2. If the measured value of CO_2 exceeds the manufacturer's declared CO_2 value by more than 4 %, then another test is run on the same vehicle.

When the average of the two test results does not exceed the manufacturer's declared value by more than 4 %, then the value declared by the manufacturer is taken as the type-approval value.

- 6.5.3. If the average still exceeds the declared value by more than 4 %, a final test is run on the same vehicle.

The average of the three test results is taken as the type-approval value.

7. **CALCULATION OF FUEL CONSUMPTIONS**

- 7.1. The fuel consumptions are calculated from the emissions of hydrocarbons, carbon monoxide and carbon dioxide calculated in accordance with paragraph 6.

- 7.2. The fuel consumptions expressed in litres per 100 km are calculated using the following formulae:

(a) for petrol-engined vehicles:

$$FC = \frac{0,1154}{D} [(0,866 \cdot \text{HC}) + (0,429 \cdot \text{CO}) + (0,273 \cdot \text{CO}_2)]$$

(b) for diesel-engined vehicles:

$$FC = \frac{0,1155}{D} [(0,866 \cdot \text{HC}) + (0,429 \cdot \text{CO}) + (0,273 \cdot \text{CO}_2)]$$

where:

FC = fuel consumption in litres per 100 km;

HC = measured emission of hydrocarbon in g/km;

CO = measured emission of carbon monoxide in g/km;

CO_2 = measured emission of carbon dioxide in g/km;

D = density of the test fuel.

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8. AMENDMENTS TO APPROVALS

8.1. In the case of amendments to approvals granted pursuant to this Directive the provisions of Article 5 of Directive 70/156/EEC shall apply.

9. CONFORMITY OF PRODUCTION FOR CO₂ EMISSIONS

9.1. As a general rule, measures to ensure the conformity of production with regard to CO₂ emissions from vehicles is checked on the basis of the description in the type-approval certificate set out in Annex II to this Directive and in accordance with the provisions of Article 10 of Directive 70/156/EEC.

If the authority is not satisfied with the auditing procedure of the manufacturer, then points 2.4.2 and 2.4.3 of Annex X to Directive 70/156/EEC shall apply.

9.1.1. If a vehicle type has had one or several extensions, the tests will be carried out on the vehicle(s) described in the information package which accompanied the first type-approval application.

9.1.1.1. Conformity of the vehicle for the CO₂ test.

9.1.1.1.1. Three vehicles are randomly taken in the series and are tested as described in paragraph 6 of this Annex.

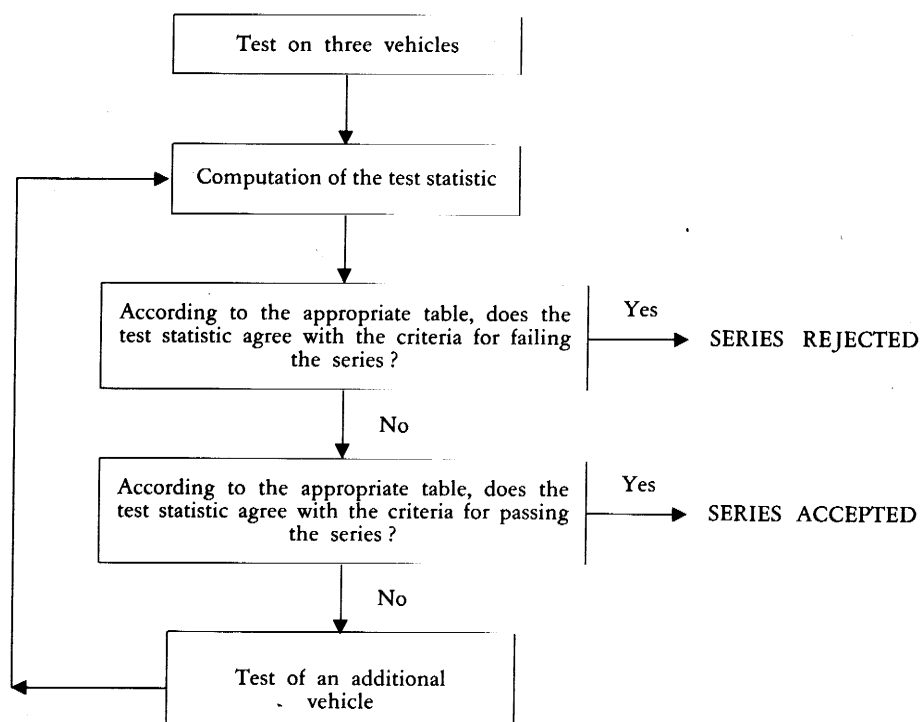
9.1.1.1.2. If the authority is satisfied with the production standard deviation given by the manufacturer, according to Annex X to Directive 70/156/EEC, the tests are carried out according to point 9.2 of this Annex.

If the authority is not satisfied with the production standard deviation given by the manufacturer according to Annex X to Directive 70/156/EEC, the tests are carried out according to point 9.3 of this Annex.

9.1.1.1.3. The production of a series is regarded as conforming or non-conforming, on the basis of tests on the three sampled vehicles, once a pass or fail decision is reached for CO₂, according to the test criteria applied in the appropriate table.

If no pass decision and/or no fail decision is reached for CO₂, a test is carried out on an additional vehicle (see Figure I/8).

FIGURE I/8



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- 9.1.1.2. Notwithstanding the requirements of point 5.1.1 of this Annex, the tests will be carried out on vehicles which have not travelled any distance.
- 9.1.1.2.1. However, at the request of the manufacturer, the tests will be carried out on vehicles which have been run-in a maximum of 15 000 km.
- In this case, the running-in procedure will be conducted by the manufacturer who shall undertake not to make any adjustments to those vehicles.
- 9.1.1.2.2. If the manufacturer asks to conduct a running-in procedure ('x' km, where $x \leq 15\,000$ km), it may be carried out as follows:
- the emission of CO₂ will be measured at zero and at 'x' km on the first tested vehicle (which can be the type-approval vehicle),
 - the evolution coefficient of the emission between zero and 'x' km will be calculated as follows:

$$EC = \frac{\text{Emissions 'x' km}}{\text{Emissions zero km}}$$

It may be less than one,

- the following vehicles will not be subjected to the running-in procedure, but their zero km emissions will be modified by the evolution coefficient, EC.

In this case, the values to be taken will be:

- the value at 'x' km for the first vehicle,
- the values at zero km multiplied by the evolution coefficient for the following vehicles.

- 9.1.1.2.3. As an alternative to this procedure, the car manufacturer can use a fixed evolution coefficient EC of 0,92 and multiply all values of CO₂ measured at zero km by this factor.
- 9.1.1.2.4. The reference fuels described in Annex VII to Directive 91/441/EEC shall be used for this test.

9.2. Conformity of production when manufacturer's statistical data is available

9.2.1. The following sections describe the procedure to be used to verify the CO₂ conformity of production requirements when the manufacturer's production standard deviation is satisfactory.

9.2.2. With a minimum sample size of three the sampling procedure is set so that the probability of a lot passing a test with 40 % of the production defective is 0,95 (producer's risk = 5 %), while the probability of a lot being accepted with 65 % of the production defective is 0,1 (consumer's risk = 10 %).

9.2.3. The following procedure is used (see Figure I/8).

Let L be the natural logarithm of the CO₂ type-approval value:

x_i = the natural logarithm of the measurement for the i-th vehicle of the sample;

s = an estimate of the production standard deviation (after taking the natural logarithm of the measurements);

n = the current sample number.

9.2.4. Compute for the sample, the test statistic quantifying the sum of the standardized deviations to the limit and defined as:

$$\frac{1}{s} \sum_{i=1}^n (L - x_i)$$

9.2.5. Then:

- if the test statistic is greater than the pass decision number for the sample size given in Table I/ - /9.2.5, a pass decision is reached,
- if the test statistic is less than the fail decision number for the sample size given in Table I/ - /9.2.5, a fail decision is reached,
- otherwise, an additional vehicle is tested according to point 6 of this Annex and the procedure is applied to the sample with one unit more.

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TABLE I/ - /9.2.5

Sample size (cumulative number of vehicles tested)	Pass Decision No	Fail Decision No
(a)	(b)	(c)
3	3,327	- 4,724
4	3,261	- 4,790
5	3,195	- 4,856
6	3,129	- 4,922
7	3,063	- 4,988
8	2,997	- 5,054
9	2,931	- 5,120
10	2,865	- 5,185
11	2,799	- 5,251
12	2,733	- 5,317
13	2,667	- 5,383
14	2,601	- 5,449
15	2,535	- 5,515
16	2,469	- 5,581
17	2,403	- 5,647
18	2,337	- 5,713
19	2,271	- 5,779
20	2,205	- 5,845
21	2,139	- 5,911
22	2,073	- 5,977
23	2,007	- 6,043
24	1,941	- 6,109
25	1,875	- 6,175
26	1,809	- 6,241
27	1,743	- 6,307
28	1,677	- 6,373
29	1,611	- 6,439
30	1,545	- 6,505
31	1,479	- 6,571
32	- 2,112	- 2,112

9.3. **Conformity of production when manufacturer's statistical data is unsatisfactory or unavailable.**

9.3.1. The following sections describe the procedure to be used to verify the CO₂ conformity of production requirements when the manufacturer's evidence of production standard deviation is either unsatisfactory or unavailable.

9.3.2. With a minimum sample size of three the sampling procedure is set so that the probability of a lot passing a test with 40 % of the production defective is 0,95 (producer's risk = 5 %), while the probability of a lot being accepted with 65 % of the production defective is 0,1 (consumer's risk = 10 %).

9.3.3. The measurement of CO₂ is considered to be log normally distributed and should first be transformed by taking the natural logarithms. Let m₀ and m denote the minimum and maximum sample sizes respectively (m₀ = 3 and m = 32) and let n denote the current sample number.

9.3.4. If the natural logarithms of the measurements in the series are x₁, x₂, ..., x_j and L is the natural logarithm of the CO₂ type-approval value, then define:

$$d_j = x_j - L$$

$$\bar{d}_n = \frac{1}{n} \sum_{j=1}^n d_j$$

and:

▼**B**

$$V_n^2 = \frac{1}{n} \sum_{j=1}^n (d_j - \bar{d}_n)^2$$

9.3.5. Table I/ - /9.3.5 shows values of the pass (A_n) and fail (B_n) decision numbers against current sample number. The test statistic is the ratio \bar{d}_n/V_n and shall be used to determine whether the series has passed or failed as follows:

for $m_0 \leq n \leq m$:

- pass the series if $\bar{d}_n/V_n \leq A_n$,
- fail the series if $\bar{d}_n/V_n \geq B_n$,
- take another measurement if $A_n < \bar{d}_n/V_n < B_n$.

9.3.6. Remarks

The following recursive formulae are useful for computing successive values of the test statistic:

$$\bar{d}_n = \left(1 - \frac{1}{n}\right)\bar{d}_{n-1} + \frac{1}{n} d_n$$

$$V_n^2 = \left(1 - \frac{1}{n}\right)V_{n-1}^2 + \frac{(\bar{d}_{n-1} - d_n)^2}{n-1}$$

($n = 2, 3, \dots$; $\bar{d}_1 = d_1$; $V_1 = 0$)

TABLE I/ - /9.3.5

Sample size (cumulative number of vehicles tested) n	Pass Decision No A_n	Fail Decision No B_n
(a)	(b)	(c)
3	- 0,80381	16,64743
4	- 0,76339	7,68627
5	- 0,72982	4,67136
6	- 0,69962	3,25573
7	- 0,67129	2,45431
8	- 0,64406	1,94369
9	- 0,6175	1,59105
10	- 0,59135	1,33295
11	- 0,56542	1,13566
12	- 0,5396	0,9797
13	- 0,51379	0,85307
14	- 0,48791	0,74801
15	- 0,46191	0,65928
16	- 0,43573	0,58321
17	- 0,40933	0,51718
18	- 0,38266	0,45922
19	- 0,3557	0,40788
20	- 0,3284	0,36203
21	- 0,30072	0,32078
22	- 0,27263	0,28343
23	- 0,2441	0,24943
24	- 0,21509	0,21831
25	- 0,18557	0,1897
26	- 0,1555	0,16328
27	- 0,12483	0,1388
28	- 0,09354	0,11603
29	- 0,06159	0,0948
30	- 0,02892	0,07493
31	► C1 0,00449 ◀	0,05629
32	- 0,03876	► C1 0,03876 ◀

▼B

10. SPECIAL PROVISIONS
 - 10.1. In the future, vehicles with special fuel efficient technologies may be offered which could be submitted to complementary testing programmes. These would be specified at a later stage which can be claimed by the manufacturer in order to demonstrate the advantages of the solution.
11. EXTENSION OF APPROVAL
 - 11.1. The type-approval can be extended to vehicles from the same type or from a different type differing with regard to the following characteristics of Annex II if the CO₂ emissions measured by the technical service do not exceed by more than 4 % the type-approval value:
 - 11.1.1. Mass.
 - 11.1.2. Maximum authorized mass.
 - 11.1.3. Type of bodywork: saloon, estate, coupé.
 - 11.1.4. Overall gear ratios.
 - 11.1.5. Engine equipment and accessories.

▼B

ANNEX II

MODEL

(maximum format: A4 (210 × 297 mm))

EC TYPE-APPROVAL CERTIFICATE

STAMP OF ADMINISTRATION

Communication concerning the :

- type approval (1)
- extension of type approval (1)
- refusal of type approval (1)
- withdrawal of type approval (1)

of a type of vehicle / component / separate technical unit (1) with regard to Directive 80/1268/EEC, as last amended by Directive 93/116/EC.

Type-approval number :

Reason for extension :

Section I

- 0.1. Make (trade name of manufacturer) :
- 0.2. Type and general commercial description(s) :
- 0.3. Means of identification of type, if marked on the vehicle/component/separate technical unit (1) (2) :
- 0.3.1. Location of that marking :
- 0.4. Category of vehicle (1) :
- 0.5. Name and address of manufacturer :
- 0.6. In the case of components and separate technical units, location and method of affixing of the EC type-approval mark :
- 0.7. Address(es) of assembly plant(s) :

Section II

1. Additional information (where applicable) : see addendum
2. Technical service responsible for carrying out the tests :
3. Date of test report :
4. No of test report :
5. Remarks (if any) : see addendum
6. Place :
7. Date :
8. Signature :
9. The index to the information package lodged with the approval authority, which may be obtained on request, is attached.



Addendum

to EC type-approval certificate No :

concerning the type approval of a vehicle with regard to Directive 80/1268/EEC (CO₂ emissions and fuel consumption) as last amended by Directive 93/116/EC.

1. Additional information
 - 1.1. Mass of the vehicle in running order :
 - 1.2. Maximum mass :
 - 1.3. Type of bodywork : saloon, estate, coupé (¹)
 - 1.4. Drive wheels : front, rear, 4 x 4 (¹)
 - 1.5. Engine :
 - 1.5.1. Engine displacement :
 - 1.5.2. Fuel supply system : carburettor/injection (¹)
 - 1.5.3. Fuel recommended by the manufacturer :
 - 1.5.4. Maximum power : kW at min⁻¹
 - 1.5.5. Pressure charging device : yes/no (¹)
 - 1.5.6. Ignition system : diesel/conventional or electronic ignition (¹)
 - 1.6. Transmission :
 - 1.6.1. Type of gearbox : manual/automatic (¹)
 - 1.6.2. Number of gear ratios :
 - 1.6.3. Total gear ratios (including the rolling circumferences of the tyres under load) : road speeds per 1 000 min⁻¹ km/h

First gear :	Fourth gear :
Second gear :	Fifth gear :
Third gear :	Overdrive :
 - 1.6.4. Final drive ratio :
 - 1.6.5. Tyres :
 - Type : Dimensions :
 - Rolling circumference under load :
 - 1.7. Test results
 - 1.7.1. CO₂ mass emission : g/km
 - 1.7.2. Fuel consumptions
 - 1.7.2.1. Fuel consumption (urban conditions) : l/100 km
 - 1.7.2.2. Fuel consumption (extra-urban conditions) : l/100 km
 - 1.7.2.3. Fuel consumption (combined) : l/100 km
2. Remarks :

(¹) Delete where not applicable.

(²) If the means of identification of type contains characters not relevant to describe the vehicle, component or separate technical unit types covered by this type-approval certificate, such characters shall be represented in the documentation by the symbol '?' (e.g. ABC ? ?123 ? ?).

(³) As defined in Annex II A to Directive 70/156/EEC.