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COMMISSION DIRECTIVE

of 24 March 1988

adapting to technical progress Council Directive 80/1269/EEC on the approximation of the laws of the Member States relating to the engine power of motor vehicles

(88/195/EEC)

(OJ L 92, 9.4.1988, p. 50)

Corrected by:

►**C1** Corrigendum, OJ L 105, 26.4.1988, p. 34 (88/195)

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COMMISSION DIRECTIVE

of 24 March 1988

adapting to technical progress Council Directive 80/1269/EEC on the approximation of the laws of the Member States relating to the engine power of motor vehicles

(88/195/EEC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community,

Having regard to Council Directive 80/1269/EEC of 16 December 1980 on the approximation of the laws of the Member States relating to the engine power of motor vehicles ([1]), and in particular Article 3 thereof,

whereas, in view of experience gained and of the state of the art, it is now appropriate to render more precise the test procedures laid down in Directive 80/1269/EEC, and in particular to align them with the latest developments made by the United Nations Economic Commission for Europe and the International Organization for Standardization (ISO);

Whereas the provisions of this Directive were in accordance with the opinion of the Committee for the Adaptation to Technical Progress of the Directives on Motor Vehicles,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Annexes I and II to Directive 80/1269/EEC are hereby amended in accordance with the Annex to this Directive.

Article 2

1. As from 1 April 1988 no Member State may, on grounds relating to engine power:

— refuse, in respect of a type of vehicle, to grant EEC type-approval, or to issue the copy of the certificate provided for in the last indent of Article 10 (1) of Council Directive 70/156/EEC ([2]), or to grant national type-approval, or

— prohibit the entry into service of vehicles

where the engine power of such type of vehicle or of such vehicles has been determined in accordance with Directive 80/1269/EEC as last amended by this Directive.

2. As from 1 October 1988 Member States:

— shall no longer issue the copy of the certificate provided for in the last indent of Article 10 (1) of Directive 70/156/EEC in respect of a type of vehicle of which the engine power has not been determined in accordance with Directive 80/1269/EEC as last amended by this Directive,

— may refuse to grant national type-approval of a type of vehicle of which the engine power has not been determined in accordance with Directive 80/1269/EEC, as last amended by this Directive.

3. As from 1 October 1992 Member States may prohibit the entry into service of vehicles of which the engine power has not been determined in accordance with Directive 80/1269/EEC, as last amended by this Directive.

([1]) OJ No L 375, 31. 12. 1980, p. 46.
([2]) OJ No L 42, 23. 2. 1970, p. 1.

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Article 3

Before 1 April 1988, Member States shall bring into force the provisions necessary in order to comply with this Directive. They shall forthwith inform the Commission thereof.

Article 4

This Directive is addressed to the Member States.

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ANNEX

Annex I to Directive 80/1269/EECis replaced by the following:

'ANNEX 1

DETERMINATION OF ENGINE POWER

1. EEC TYPE-APPROVAL

1.1. **Application for EEC type-approval**

The application for EEC type-approval for a vehicle type in respect of the engine power is submitted by the vehicle manufacturer or his authorized representative.

1.1.1. It must be accompanied by three copies of the document mentioned below and of the following:

1.1.1.1. Information sheet duly completed,

1.1.1.2. Information required in Appendix 1 or 2.

1.1.2. If the technical service responsible for the type-approval tests carries out the tests itself, a vehicle representative of the vehicle type to be approved must be provided.

1.2. **Documents**

Where an application within the meaning of 1.1 is accepted, the competent authority must prepare the document, the model for which is contained in Annex II. In order to draw up this document, the competent authority of the Member State conducting the EEC type-approval tests may use the report prepared by an approved or recognized laboratory pursuant to the provisions of this Directive.

2. SCOPE

2.1. This method applies to internal-combustion engines used for the propulsion of category M and N vehicles as defined in Annex I to Directive 70/156/EEC, belonging to either of the following types.

2.1.1. Internal-combustion piston engines (positive ignition or compression ignition), excluding free-piston engines;

2.1.2. Rotary-piston engines.

2.2. This method applies to naturally aspirated or supercharged engines.

3. DEFINITIONS

For the purposes of this Directive,

3.1. "Net power" means the power obtained on the test-bed at the end of the crankshaft or its equivalent at the corresponding engine speed with the auxiliaries listed in Table 1. If the power measurement can be carried out with a mounted gearbox only, the efficiency of the gearbox is to be taken into account.

3.2. "Maximum net power" means the maximum value of the net power measured at full engine load.

3.3. "Standard-production equipment" means equipment provided by the manufacturer for a particular application.

4. ACCURACY OF THE MEASUREMENTS OF FULL LOAD POWER

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4.1. **Torque:** ± 1 % of measured torque (1).

4.2. **Engine speed**

The measurement must be accurate to within ± 0,5 %. Engine speed must be measured preferably with an automatically synchronized revolution counter and chronometer (or counter-timer).

4.3. **Fuel consumption:** ± 1 % of measured consumption.

4.4. **Fuel temperature:** ± 2 K.

4.5. **Engine inlet air temperature:** ± 2 K.

4.6. **Barometric pressure:** ± 100 Pa.

4.7. **Pressure in inlet manifold:** ± 50 Pa (see note 1a to Table 1).

4.8. ►C1 **Pressure in vehicle exhaust pipe:** ± 200 Pa ◄ (see note 1b to Table 1).

5. TEST FOR MEASURING NET ENGINE POWER

5.1. **Auxiliaries**

5.1.1. *Auxiliary equipment to be fitted*

During the test, the auxiliary equipment necessary for the engine operation in the intended application (as listed in Table 1) shall be installed on the test bench as far as possible in the same position as the intended application.

5.1.2. *Auxiliary equipment to be removed*

Certain vehicle accessories necessary only for the operation of the vehicle and which may be mounted on the engine shall be removed for the test.

The following non-exhaustive list is given as a sample:

— air compressor for brakes,
— power-steering compressor,
— suspension compressor,
— air-conditioning system.

Where accessories cannot be removed, the power absorbed by them in the unloaded condition may be determined and added to the measured engine power.

TABLE 1

Auxiliary equipment to be included for the test to determine net power of engine

No	Auxiliary equipment	Fitted for net power test
1	Intake system	
	Intake manifold	Yes, standard-production equipment
	Air filter 1a	
	Intake silencer 1a	
	Crankcase emission control system	
	Speed-limiting device (1a)	
2	Induction-heating device of intake manifold	Yes, standard-production equipment (if possible it shall be set in the most favourable position)

(1) The torque measuring system shall be calibrated to take friction losses into account. The accuracy in the lower half of the measuring range of the dynamometer bench may be ± 2 % of measured torque.

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No	Auxiliary equipment	Fitted for net power test
3	Exhaust system	
	Exhaust purifier	Yes, standard-production equipment
	Exhaust manifold	
	Connecting pipes ([1b])	
	Silencer ([1b])	
	Tail pipe ([1b])	
	Exhaust brake ([2])	
	Supercharging device	
4	Fuel supply pump ([3])	Yes, standard-production equipment
5	Carburettor	
	Electronic control system, air flow meter etc. (if fitted)	Yes, standard-production equipment
	Pressure reducer	Equipment for gas engines
	Evaporator	
	Mixer	
6	Fuel-injection equipment (petrol and diesel)	
	Prefilter	Yes, standard-production equipment
	Filter	
	Pump	
	High-pressure pipe	
	Injector	
	Air intake valve, if fitted ([4])	
	Electronic control system, air flow meter etc. (if fitted)	
	Governor/control system	
	Automatic full-load stop for the control rack depending on atmospheric conditions	
7	Liquid-cooling equipment	
	Engine bonnet	No
	Bonnet air outlet	
	Radiator	Yes, standard-production equipment 5
	Fan ([5]) ([6])	
	Fan cowl	
	Water pump	
	Thermostat ([7])	
8	Air cooling	
	Cowl	Yes, standard-production equipment
	Blower ([5]) ([6])	
	Temperature-regulating device	
9	Electrical equipment	Yes, standard-production equipment 8

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No	Auxiliary equipment	Fitted for net power test
10	Supercharging equipment (if fitted) Compressor driven either directly by the engine and/or by the exhaust gases Charge air cooler ([9]) Coolant pump or fan (engine-driven) Coolant flow control device (if fitted)	Yes, standard-production equipment
11	Auxiliary test-bench fan	Yes, if necessary
12	Anti-pollution device ([10])	Yes, standard-production equipment

([1a]) The complete intake system shall be fitted as provided for the intended application:

where there is a risk of an appreciable effect on the engine power; in the case of two-stroke and positive-ignition engines; when the manufacturer requests that this should be done. In other cases, an equivalent system may be used and a check should be made to ascertain that the intake pressure does not differ by more than 100 Pa from the limit specified by the manufacturer for a clean air filter.

([1b]) The complete exhaust system shall be fitted as provided for the intended application:

where there is a risk of an appreciable effect on the engine power; in the case of two-stroke and positive-ignition engines; when the manufacturer requests that this should be done.

In other cases an equivalent system may be installed provided the pressure measured at the exit of the engine exhaust system does not differ by more than 1 000 Pa from that specified by the manufacturer. The exit of the engine exhaust system is defined as a point 150 mm downstream from the termination of the part of the exhaust system mounted on the engine.

([2]) If an exhaust brake is incorporated in the engine, the throttle valve must be fixed in the fully open position.

([3]) The fuel feed pressure may be adjusted, if necessary, to reproduce the pressures existing in the particular engine application (particularly when a "fuel return" system is used).

([4]) The air intake valve is the control valve for the pneumatic governor of the injection pump. The governor or the fuel-injection equipment may contain other devices which may affect the amount of injected fuel.

([5]) The radiator, the fan, the fan cowl, the water pump and the thermostat shall be located on the test bench in the same relative positions as on the vehicle. The cooling-liquid circulation shall be operated by the engine water pump only. Cooling of the liquid may be produced either by the engine radiator or by an external circuit, provided that the pressure loss of this circuit and the pressure at the pump inlet remain substantially the same as those of the engine cooling system. The radiator shutter, if incorporated, shall be in the open position. Where the fan, radiator and cowl system cannot conveniently be fitted to the engine, the power absorbed by the fan when separately moutned in its correct position in relation to the radiator and cowl (if used), shall be determined at the speeds corresponding to the engine speeds used for measurement of the engine power either by calculation from standard characteristics or by practical tests. This power, corrected to the standard atmospheric conditions defined in 6.2, should be deducted from the corrected power.

([6]) Where a disconnectable or progressive fan or blower is incorporated, the test shall be made with the disconnectable fan (or blower) disconnected or with the progressive fan or blower running at maximum slip.

([7]) The thermostat may be fixed in the fully open position.

([8]) Minimum power of the generator: the power of the generator shall be limited to that necessary for the operation of accessories which are indispensable for the operation of the engine. If the connection of a battery is necessary, a fully charged battery in good order must be used.

([9]) Charge air-cooled engines shall be tested with charge air cooling, whether liquid or air cooled, but if the manufacturer prefers, a test-bench system may replace the air-cooled cooler. In either case, the measurement of power at each speed shall be made with the same pressure drop and temperature drop of the engine air across the charge air-cooler on the test-bench system as those specified by the manufacturer for the system on the complete vehicle.

([10]) They may include, for example, Exhaust-gas recirculation (EGR)-system, catalytic converter, thermal reactor, secondary air-supply system and fuel evaporation protecting system.

5.1.3. *Compression-ignition engine starting auxiliaries*

For the auxiliary equipment used in starting compression-ignition engines, the two following cases shall be considered:

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(a) Electrical starting: The generator is fitted and supplies, where necessary, the auxiliary equipment indispensable to the operation of the engine.

(b) Starting other than electrical: If there are any electrically operated accessories indispensable to the operation of the engine, the generator is fitted to supply these accessories. Otherwise it is removed.

In either case, the system for producing and accumulating the energy necessary for starting is fitted and operates in the unloaded condition.

5.2. **Setting conditions**

The setting conditions for the test to determine the net power are indicated in Table 2.

TABLE 2

Setting conditions

1	Setting of carburettor(s)	Set in accordance with the manufacturer's production specifications and used without further alteration for the particular application
2	Setting of injection-pump delivery system	
3	Ignition or injection timing (timing curve)	
4	Governor setting	
5	Anti-pollution devices	

5.3. **Test conditions**

5.3.1. The net power test shall consist of a run at full throttle for positive-ignition engines and at fixed full load fuel-injection-pump setting for compression-ignition engines, the engine being equipped as specified in Table 1.

5.3.2. Performance data shall be obtained under stabilized operating conditions, with an adequate fresh-air supply to the engine. The engine must have been run-in in accordance with the manufacturer's recommendations. Combustion chambers may contain deposits, but in limited quantity.

Testconditions such as inlet air temperature shall be selected as near to reference conditions (see 6.2) as possible in order to minimize the magnitude of the correction factor.

5.3.3. The temperature of the inlet air to the engine (ambient air) shall be measured within 0,15 m upstream of the point of entry of the air cleaner, or, if no air cleaner is used, within 0,15 m to the air inlet horn. The thermometer or thermocouple shall be shielded from radiant heat and placed directly in the air stream. It shall also be shielded from fuel spray-back. A sufficient number of locations shall be used to give a representative average inlet temperature.

5.3.4. No data shall be taken until torque, speed and temperatures have been maintained substantially constant for at least one minute.

5.3.5. The engine speed during a run or reading shall not deviate from the selected speed by more than ± 1 % or ± 10 min^{-1}, whichever is greater.

5.3.6. Observed brake load, fuel consumption and inlet air temperature data shall be taken simultaneously and shall be the average of two stabilized consecutive values which do not vary more than 2 % for the brake load and fuel consumption.

5.3.7. The temperature of the coolant at the outlet from the engine shall be kept within ± 5 K from the upper thermostatically controlled temperature specified by the manufacturer. If no temperature is specified by the manufacturer, the temperature shall be 353 K ± 5 K.

For air-cooled engines, the temperature at a point indicated by the manufacturer shall be kept within + 0/− 20 K of the maximum value specified by the manufacturer in the reference conditions.

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5.3.8. The fuel temperature shall be measured at the inlet to the carburettor or at the fuel-injection system and maintained within the limits established by the engine manufacturer.

5.3.9. The temperature of the lubricating oil measured in the oil sump or at the outlet from the oil cooler, if fitted, shall be maintained within the limits established by the engine manufacturer.

5.3.10. An auxiliary regulating system may be used if necessary to maintain the temperature within the limits specified in 5.3.7, 5.3.8 and 5.3.9.

5.3.11. *Fuel*

The fuel shall be one available on the market without any supplementary smoke suppressant additives. In any case of dispute, the reference fuel shall be:

(a) for positive-ignition engines as defined by Annex VI, paragraph 1, and

(b) for compression-ignition engines, as defined by Annex VI, paragraph 2

of Council Directive 70/220/EEC of 20 March 1970 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from motor vehicles [1], as last amended by Directive 83/351/EEC [2].

As an alternative, instead of the above reference fuels, reference fuels as defined by CEC [3] as CEC-RF-08-A-85 (positive-ignition engines for operation on unleaded fuel) or CEC-RF-03-A-84 (compression-ignition engines) may also be used at the discretion of the manufacturer.

5.4. **Test procedure**

Measurements shall be taken at a sufficient number of engine speeds to define correctly the power curve completely between the lowest and the highest engine speeds recommended by the manufacturer. This range of speeds shall include the speed of revolution at which the engine produces its maximum power. For each speed, the average of at least two stabilized measurements is to be determined.

5.5. **Measurement of smoke index**

In the case of compression-ignition engines, the exhaust gases shall be examined during the test for compliance with the conditions set out in Annex VI to Council Directive 72/306/EEC [4].

5.6. **Data to be recorded**

Data to be recorded are those indicated in Appendix I.

6. POWER CORRECTION FACTORS

6.1. **Definition**

The power correction factor is the coefficient to determine the engine power under the atmospheric reference conditions specified in 6.2:

$P_o = \alpha \cdot P$

where

P_o is the corrected power (i.e. power under reference atmospheric conditions);

(1) OJ No L 76, 6. 4. 1970, p. 1.
(2) OJ No L 197, 20. 7. 1983, p. 1.
(3) European Coordinating Council for the Development of Performance Tests for Lubricants and Engine Fuels.
(4) OJ No L 190, 20. 8. 1972, p. 1.

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α is the correction factor (α_a or α_d);

P is the measured power (test power).

6.2. **Reference atmospheric conditions**

6.2.1. *Temperature* (T_o): 298 K (25 °C)

6.2.2. *Dry pressure* (P_{so}): 99 kPa

Note: The dry pressure is based on a total pressure of 100 kPa and a water vapour pressure of 1 kPa.

6.3. **Test atmospheric conditions**

The atmospheric conditions during the test shall be the following:

6.3.1. *Temperature (T)*

For positive-ignition engines $288\ K \leq T \leq 308\ K$

For compression-ignition engines $283\ K \leq T \leq 313\ K$.

6.3.2. *Pressure (P_s)*

$80\ kPa \leq p_s \leq 110\ kPa$.

6.4. **Determination of correction factors α_a and α_d (1)**

6.4.1. *Naturally aspirated or supercharged positive-ignition engine — Factor α_a:*

$$\alpha_a = \left(\frac{99}{Ps}\right)^{1,2} \cdot \left(\frac{T}{298}\right)^{0,6}$$ (2)

where

T is the absolute temperature in Kelvins (K) of the air drawn in by the engine;

P_s is the total dry atmospheric pressure in kilopascals (kPa), that is, the total barometric pressure minus water vapour pressure.

Conditions to be complied with in the laboratory.

For a test to be valid, the correction factor α_a must be such that:

$0,93 \leq \alpha_a \leq 1,07$

If these limits are exceeded, the correct value obtained shall be given and the test conditions (temperature and pressure) precisely stated in the test report.

6.4.2. *Compression-ignition engine — Factor α_d*

The power correction factor (α_d) for compression-ignition engines at constant fuel rate is obtained by applying the formula:

$\alpha_d = (f_a)\ f_m$

where

f_a is the atmospheric factor;

f_m is the characteristic parameter for each type of engine and adjustment.

6.4.2.1. Atmospheric factor f_a

This factor indicates the effects of environmental conditions (pressure, temperature and humidity) on the air drawn in by the engine.

The atmospheric factor formula differs according to the type of engine.

6.4.2.1.1. Naturally aspirated and mechanically supercharged engines.

$$f_a = \left(\frac{99}{Ps}\right) \cdot \left(\frac{T}{298}\right)^{0,7}$$

(1) The tests may be carried out in air-conditioned test rooms where the atmospheric conditions may be controlled.

(2) In the case of engines fitted with automatic air temperature control, if the device is such that at full load at 25 °C no heated air is added, the test shall be carried out with the device fully closed. If the device is still operating at 25 °C then the test is made with the device operating normally and the exponent of the temperature term in the correction factor shall be taken as zero (no temperature correction).

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6.4.2.1.2. Turbocharged engines with or without cooling of inlet air.

$$f_a = \left(\frac{99}{Ps}\right)^{0,7} \cdot \left(\frac{T}{298}\right)^{1,5}$$

6.4.2.2. Engine factor f_m

f_m is a function of q_c (fuel flow corrected) as follows:

$f_m = 0,036 \cdot q_c - 1,14$

where

$q_c = q/r$

where

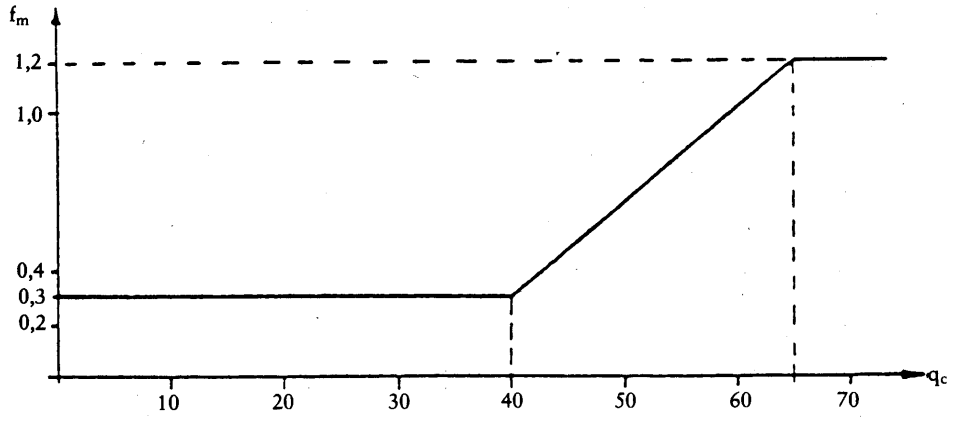
q is the fuel flow in milligramms per cycle per litre of total swept volume (mg/(litre · cycle)).

r is the pressure ratio of compressor outlet and compressor inlet (r = 1 for naturally aspirated engines).

This formula is valid for a value interval of q_c included between 40 mg/(litre · cycle) and 65 mg/(litre · cycle).

For q_c values lower than 40 mg/(litre · cycle), a constant value of f_m equal to 0,3 ($f^m = 0,3$) will be taken.

For q_c values higher than 65 mg/(litre · cycle), a constant value of f_m equal to 1,2 ($f^m = 1,2$) will be taken (see figure):



6.4.2.3. Conditions to be complied with in the laboratory.

For a test to be valid, the correction factor α_d must be such that

$0,9 \leq \alpha_d \leq 1,1$

If these limits are exceeded, the corrected value obtained shall be given and the test conditions (temperature and pressure) precisely stated in the test report.

7. TEST REPORT

The test report shall contain the results and all the calculations required to find the net power, as listed in Annex II, together with the characteristics of the engine listed in Appendix I or Appendix 2 to this Annex.

8. MODIFICATION OF ENGINE TYPE

Any modification of the engine with regard to the characteristics listed in Appendix 1 or Appendix 2 to this Annex shall be reported to the competent authority. That authority may then either:

8.1. consider that the modifications made are not likely to have any substantial effect on the power of the engine, or

8.2. request a futher determination of the engine power through the carrying-out of such tests as are deemed necessary.

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9. TOLERANCES FOR MEASURING THE NET POWER

9.1. The net power of the engine measured by the technical service may differ by ± 2 % from the net power specified by the manufacturer, with a tolerance of 1,5 % for the engine speed.

9.2. The net power of an engine at a production conformity test may differ by ± 5 % from the net power at a type-approval test.'

Appendix 1 to Directive 80/1269/EEC is amended as follows:

The sub-heading'(Diesel engines)' is replaced by '(Compression-ignition engines)'.

In items 3.2.2.1.3, 3.2.2.4.3, 3.2.2.4.4 and 3.2.2.4.5, 'r/min' is replaced by 'min^{-1}'.

In item 3.2.2.3.3, 'bar' is replaced by 'kPa'.

Appendix 2 to Directive 80/1269/EEC is amended as follows:

In item 3.2.2.4, 'bar' is replaced by 'kPa'.

Annex II to Directive 80/1269/EEC is amended as follows:

In items 5.1.1, 5.1.2 and 5.1.3, 'mbar' is replaced by 'kPa'.

In items 5.3, 6.1, 6.2, 6.3 and 6.4, 'r/min' is replaced by 'min^{-1}'.

In items 5.6.3, 5.6.4, 6.1 and 6.2, 'diesel' is replaced by 'compression-ignition'.