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ISO 1585

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Road vehicles — Engine test code — Net power

Véhicules routiers — Code d'essai des moteurs — Puissance nette

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 1585 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Sub-Committee SC 5, *Engine tests.*

This third edition cancels and replaces the second edition (ISO 1585 : 1982), of which it constitutes a technical revision.

NOTE — This International Standard is also the basis for the following parallel documents:

ISO 2288 : 1989, *Agricultural tractors and machines — Engine test code (bench test) — Net power.*

ISO 4106 : 1978, *Road vehicles — Motorcycles — Engine test code — Net power.*

ISO 4164 : 1978, *Road vehicles — Mopeds — Engine test code — Net power.*

ISO 9249 : 1989, *Earth-moving machinery — Engine test code — Net power.*

ISO 2534 : 1974, *Road vehicles — Engine test code — Gross power,* provides a similar test code for gross power.

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Road vehicles — Engine test code — Net power

1 Scope

This International Standard specifies a method for testing engines designed for automotive vehicles. It applies to the evaluation of their performance with a view, in particular, to presenting curves of power and specific fuel consumption at full load as a function of engine speed.

It applies only to net power assessment.

This International Standard concerns internal combustion engines used for propulsion of passenger cars and other motor vehicles, excluding motorcycles, mopeds and agricultural tractors (see the note in the foreword), normally travelling on roads and included in one of the following categories:

— reciprocating internal combustion engines (spark-ignition or compression-ignition) but excluding free piston engines;

— rotary piston engines.

These engines may be naturally aspirated or pressure-charged, either using a mechanical supercharger or turbocharger.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2710 : 1978, *Reciprocating internal combustion engines — Vocabulary.*

ISO 3104 : 1976, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity.*

ISO 3173 : 1974, *Road vehicles — Apparatus for measurement of the opacity of exhaust gas from diesel engines operating under steady state conditions.*

ISO 3675 : —[1], *Crude petroleum and liquid petroleum products — Laboratory determination of density or relative density — Hydrometer method.*

ISO 5163 : 1990, *Motor and aviation-type fuels — Determination of knock characteristics — Motor method.*

ISO 5164 : 1990, *Motor fuels — Determination of knock characteristics — Research method.*

ISO 5165 : 1992, *Diesel fuels — Determination of ignition quality — Cetane method.*

ISO 7967-1 : 1987, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 1: Structure and external covers.*

ISO 7967-2 : 1987, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 2: Main running gear.*

ISO 7967-3 : 1987, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 3: Valves, camshaft drive and actuating mechanisms.*

ISO 7967-4 : 1988, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 4: Pressure charging and air/exhaust gas ducting systems.*

ISO 7967-5 : 1992, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 5: Cooling systems.*

ISO 7967-8 : 1990, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 8: Starting systems.*

ASTM D 240-87, *Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter.*

ASTM D 3338-88, *Standard test method for estimation of heat of combustion of aviation fuels.*

1) To be published. (Revision of ISO 3675 : 1976.)

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 2710, ISO 7967-1, ISO 7967-2, ISO 7967-3, ISO 7967-4, ISO 7967-5 and ISO 7967-8, and the following definitions apply.

3.1 net power: Power obtained on a test bed at the end of the crankshaft or its equivalent[1)] at the corresponding engine speed with the equipment and auxiliaries listed in table 1.

3.2 standard production equipment: Any equipment provided by the manufacturer for a particular engine application.

4 Accuracy of measuring equipment and instruments

4.1 Torque

The dynamometer torque-measuring system shall have an accuracy within ± 1 % in the range of scale values required for the test.

4.2 Engine speed (rotational frequency)

The engine speed (rotational frequency) measuring system shall have an accuracy of ± 0,5 %.

4.3 Fuel flow

The fuel flow measuring system shall have an accuracy of ± 1 %.

4.4 Fuel temperature

The fuel temperature measuring system shall have an accuracy of ± 2 K.

4.5 Air temperature

The air temperature measuring system shall have an accuracy of ± 2 K.

4.6 Barometric pressure

The barometric pressure measuring system shall have an accuracy of ± 100 Pa[2)].

4.7 Back pressure in exhaust system

The system used to measure the back pressure in the exhaust system shall have an accuracy of ± 200 Pa. The measurement shall be made subject to footnote 1b) of table 1.

4.8 Depression in inlet system

The system used to measure the depression in the inlet system shall have an accuracy of ± 50 Pa. The measurement shall be made subject to footnote 1a) of table 1.

4.9 Absolute pressure in inlet duct

The system used to measure the absolute pressure in the inlet duct shall have an accuracy of ± 2 % of the measured pressure.

1) If the power measurement can only be carried out with a mounted gear-box, the losses in the gear-box should be added to the measured power to give the engine power.

2) 1 Pa = 1 N/m^2

Table 1 — Installation of equipment and auxiliaries during test

No.	Auxiliaries	Fitted for net power test
1	Inlet system Inlet manifold Crankcase emission control system Control devices for dual induction inlet manifold system Air flow meter Air inlet ductwork [1a)] Air filter [1a)] Inlet silencer [1a)] Speed-limiting device [1a)]	Yes, standard production equipment
2	Induction heating device of inlet manifold	Yes, standard production equipment. If possible, to be set in the most favourable position
3	Exhaust system Exhaust purifier Exhaust manifold Pressure-charging devices Connecting pipes [1b)] Silencer [1b)] Tail pipe [1b)] Exhaust brake [2)]	Yes, standard production equipment
4	Fuel supply pump [3)]	Yes, standard production equipment
5	Carburation equipment Carburettor Electronic control system, air-flow meter, etc. (if fitted) Equipment for gaseous fuel engines Pressure reducer Evaporator Mixer	Yes, standard production equipment
6	Fuel injection equipment [Spark-ignition and compression-ignition (diesel)] Prefilter Filter Pump High-pressure pipe Injector Air inlet valve (if fitted) [4)] Electronic control system, etc. (if fitted) Governor/control system — automatic full-load stop for the control depending on atmospheric conditions	Yes, standard production equipment
7	Liquid cooling equipment Radiator Fan [5), 6)] Fan cowl Water pump Thermostat [7)]	Yes, [5)] standard production equipment
8	Air cooling Cowl Fan or blower [5)] [6)] Temperature regulating device	Yes, standard production equipment

Table 1 — Installation of equipment and auxiliaries during test (*concluded*)

No.	Auxiliaries	Fitted for net power test
9	Electrical or electronic ignition equipment Generator[8)] Spark distribution system Coil or coils Wiring Spark-plugs Electronic control system including knock sensor/spark-retard system[11)]	Yes, standard production equipment
10	Pressure-charging equipment (if fitted) Compressor driven either directly by the engine, and/or by the exhaust gases Boost control[12)] Charge-air-cooler[5), 6), 9)] Coolant pump or fan (engine-driven) Coolant flow control devices (if fitted)	Yes, standard production equipment
11	Auxiliary test bed fan	Yes, if necessary
12	Anti-pollution devices[10)]	Yes, standard production equipment

1 a) Except in the case where there is a risk of the system having a noticeable influence upon engine power, an equivalent system may be used. In this case, a check should be made to ascertain that inlet depression does not differ by more than 100 Pa from the limit specified by the manufacturer for a clean air filter.

1 b) Except in the case where there is a risk of the system having a noticeable influence upon engine power, an equivalent system may be used. In this case, a check should be made to ascertain that the back-pressure in the engine exhaust system does not differ by more than 1 000 Pa from that specified by the manufacturer.

2) If an exhaust brake is incorporated in the engine, the throttle valve shall be fixed fully open.

3) The fuel feed pressure may be adjusted, if necessary, to reproduce the inlet pump pressure conditions consistent with the particular engine application (particularly where a "fuel return" system, e.g. to tank or filter, is used).

4) The air inlet valve is the control valve for the pneumatic governor of the injection pump. The governor of the fuel injection equipment may contain other devices which may affect the amount of fuel injected.

5) The radiator, fan, fan cowl, water pump and thermostat shall be located on the test bed in the same relative positions that they will occupy 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 mounted 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 shall 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 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 engine operation. If the connection of a battery is necessary, a fully charged battery in good order shall be used.

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

If a test bed system is used on a compression-ignition engine without a wastegate, or with the wastegate not operating, the correction factor given in 6.3.2.1 b) is to be used. If a wastegate is both fitted and operating, then the correction factor in 6.3.2.1 a) is to be used.

10) They may include for example EGR system, catalytic convertor, thermal reactor, secondary air supply system and fuel evaporation protecting system.

11) The spark advance shall be representative of in-use conditions established with the minimum octane fuel recommended by the manufacturer.

12) For engines equipped with variable boost as a function of charge or inlet air temperature, octane rating and/or engine speed, the boost pressure shall be representative of in-vehicle conditions established with the minimum octane fuel as recommended by the manufacturer.

5 Tests

5.1 Auxiliaries

5.1.1 Auxiliaries to be fitted

During the test auxiliaries necessary to make engine acceptable for service in the intended application (as listed in table 1) shall be installed on the test bed as far as possible in the same position as in the intended application.

5.1.2 Auxiliaries 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 an example:

- air compressor for brakes;
- power steering pump;
- 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.

5.1.3 Compression-ignition engine starting auxiliaries

For auxiliaries used to start compression-ignition engines, the two following cases shall be considered:

a) Electrical starting. The generator is fitted and supplies, where necessary, the auxiliaries 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 for determination of net power are indicated in table 2.

Table 2 — Setting conditions

1	Setting of carburettor(s)	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	
6	Boost control	

5.3 Test conditions

5.3.1 The net power test shall consist of a run at full throttle for spark-ignition engines and at the 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.

Engines shall have been run-in, started and warmed up in accordance with the manufacturer's recommendations. Combustion chambers may contain deposits, but in limited quantity. Test conditions such as inlet air temperature shall be selected as near to reference conditions (see 6.2) as possible in order to minimize 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 air inlet ductwork.

The thermometer or thermocouple shall be shielded from radiant heat and located directly in the airstream. It shall also be shielded from fuel sprayback. A sufficient number of locations shall be used to give a representative average inlet temperature.

5.3.4 The inlet depression shall be measured downstream of the entry ducts, air filter, inlet silencer, speed-limiting device (if they are fitted) or their equivalents.

5.3.5 The absolute pressure at the entry to the engine, downstream of the compressor and heat exchanger if they are fitted, shall be measured in the inlet manifold and at any other point where pressure has to be measured to calculate correction factors.

5.3.6 The exhaust back pressure shall be measured at a point at least three pipe diameters from the outlet flange(s) of the exhaust manifold(s) and downstream of the turbocharger(s), if fitted. The location shall be specified.

5.3.7 No data shall be taken until torque, speed and temperature have been maintained substantially constant for at least 1 min.

5.3.8 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.

5.3.9 Observed brake load, fuel flow and inlet air temperature data shall be taken virtually simultaneously and shall, in each case, be the average of two stabilized consecutive readings which do not vary more than 2 % for the brake load and fuel consumption. The second reading shall be determined without any adjustment of the engine, approximately 1 min after the first.

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

5.3.11 Fuel temperatures shall be as follows:

a) For spark-ignition engines, the fuel temperature shall be measured as near as possible to the inlet of the carburettor or assembly of fuel injectors. Fuel temperature shall be maintained within ± 5 K of the temperature specified by the manufacturer. However, the minimum test fuel temperature allowed shall be the ambient air temperature. If the test fuel temperature is not specified by the manufacturer, it shall be 298 K ± 5 K.

b) For compression-ignition engines, the fuel temperature shall be measured at the inlet to the fuel-injection pump. At the manufacturer's request the fuel temperature measurement can be made at another point in the pump representative of the engine operating condition. Fuel temperature shall be maintained within ± 3 K of the temperature specified by the manufacturer. In all cases, the minimum allowable fuel temperature at the pump entrance is 303 K. If the test fuel temperature is not specified by the manufacturer, it shall be 313 K ± 3 K.

5.3.12 The lubricant temperature shall be measured at the oil gallery inlet or the oil cooler outlet if fitted, unless some other measuring location is specified by the manufacturer. The temperature shall be maintained within the limits specified by the manufacturer.

5.3.13 An auxiliary regulation system may be used if necessary to maintain temperature within limits specified in 5.3.10, 5.3.11 and 5.3.12.

5.3.14 It is recommended that a reference fuel is used; a non-exhaustive list of such fuels includes:

CEC RF-01-A-80 [1)]

CEC RF-08-A-85

CEC RF-03-A-84

JIS K 2202 [2)]

JIS K 2204

40 CFR, Part 86.113-87 [3)] for spark-ignition engines

40 CFR, Part 86.1313-87 for compression-ignition engines

A commercially available fuel may be used, providing its characteristics are specified in 8.3 and that it does not contain any supplementary smoke-suppressant or additive.

5.4 Test procedure

Measurements shall be taken at a sufficient number of engine speeds to define the power curve completely between the lowest and the highest engine speeds recommended by the manufacturer. This range of speeds shall include the revolution speed at which the engine produces its maximum power.

5.5 Data to be recorded

Data to be recorded shall be those indicated in clause 8.

6 Power correction factors

6.1 Definition of factor α for power correction

This is factor by which the observed power shall be multiplied to determine the engine power at the reference atmospheric conditions specified in 6.2. The corrected power (i.e. power at reference conditions), P_{ref}, is given by

$$P_{ref} = \alpha P_y$$

where

α is the correction factor (α_a being the correction factor for spark-ignition engines and α_c the correction factor for compression-ignition engines);

P_y is the measured (observed) power.

6.2 Atmospheric conditions

6.2.1 Reference atmospheric conditions

The reference atmospheric conditions shall be as given in 6.2.1.1 and 6.2.1.2.

6.2.1.1 Temperature

The reference temperature, T_{ref}, is 298 K (25 °C).

1) Co-ordinating European Council for the Development of Performance Tests for Lubricants and Engine Fuels.

2) Japan Industrial Standard.

3) Title 40, Code of Federal Regulations, USA.

6.2.1.2 Dry pressure

The reference dry pressure, $p_{d,ref}$, is 99 kPa.

NOTE — The dry pressure is based on a total pressure of 100 kPa and a vapour pressure of 1 kPa.

6.2.2 Test atmospheric conditions

The test atmospheric conditions shall be within the values given in 6.2.2.1 and 6.2.2.2 during the test.

6.2.2.1 Temperature, T

- for spark-ignition engines

  288 K $\leqslant T \leqslant$ 308 K

- for compression-ignition engines

  283 K $\leqslant T \leqslant$ 313 K

6.2.2.2 Dry pressure, p_d

For all engines

80 kPa $\leqslant p_d \leqslant$ 110 kPa

6.3 Determination of power correction factors

The test may be carried out in air-conditioned test rooms where the atmospheric conditions are controlled to equal the reference conditions.

Where an influencing parameter is controlled by an automatic device, no power correction for that parameter shall be applied, provided that the relevant parameter is within the relevant range of the device. This applies in particular to

a) automatic air temperature controls where the device is still operating at 25 °C;

b) automatic boost control, independent of atmospheric pressure, when the atmospheric pressure is such that the boost control is working;

c) automatic fuel control where the governor adjusts the fuel flow for constant power output (by compensating for the influence of ambient pressure and temperature).

However, in the case of a), if the automatic air temperature device is fully closed at full load at 25 °C (no heated air added to the intake air), the test shall be carried out with the device fully closed, and the normal correction factor applied. In the case of c), the fuel flow for compression-ignition engines shall be corrected by the reciprocal of the power correction factor.

6.3.1 Naturally aspirated and pressure-charged spark-ignition engines — Factor α_a

The correction factor, α_a, for spark-ignition engines shall be as calculated from the formula

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

where

T is the absolute temperature, in kelvins, at the engine air inlet;

p_d is the dry atmospheric pressure, in kilopascals, i.e. the total barometric pressure minus the water vapour pressure.

This formula applies to carburettored engines and to other engines where the management system is designed to maintain a relatively constant fuel/air ratio as ambient conditions change. For other engine types see 6.3.3.

This formula only applies if

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

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.

6.3.2 Compression-ignition engines — Factor α_c

The power correction factor, α_c, for compression-ignition engines at constant fuel delivery setting is obtained by applying the formula

$$\alpha_c = (f_a)^{f_m}$$

where

f_a is the atmospheric factor (see 6.3.2.1);

f_m is the characteristic parameter for each type of engine and adjustment (see 6.3.2.2).

6.3.2.1 Atmospheric factor, f_a

The atmospheric factor, f_a, which indicates the effect of environmental conditions (pressure, temperature and humidity) on the air drawn in by the engine shall be as calculated from the formula in a), b) or c):

a) naturally aspirated engines, mechanically pressure-charged engines and turbocharged engines with wastegates operating:[1)]

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

1) For engine speeds when the wastegate of a turbocharged engine is not operating, formula a) or b) is used, depending on the type of charge cooling, if any.

b) turbocharged engines without charge air cooling or with charge cooling by air/air cooler:

$$f_a = \left(\frac{99}{p_d}\right)^{0,7} \left(\frac{T}{298}\right)^{1,2}$$

c) turbocharged engines with charge air cooling by engine coolant:

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

where T and p_d are as defined in 6.3.1.

6.3.2.2 Engine factor, f_m

Within the limits established for α_c in 6.3.2, the engine factor, f_m, is a function of the corrected fuel delivery parameter, q_c, and is calculated from the formula

$$f_m = 0{,}036\, q_c - 1{,}14$$

where

$$q_c = \frac{q}{r}$$

in which

q is the fuel delivery parameter, in milligrams per cycle per litre of engine swept volume [mg/(l·cycle)], and is equal to

$$\frac{(Z) \times (\text{fuel flow in g/s})}{(\text{displacement in l}) \times (\text{engine speed in min}^{-1})}$$

where

Z = 120 000 for 4-stroke cycle engines and Z = 60 000 for 2-stroke cycle engines;

r is the ratio between the absolute static pressure at the outlet of the pressure charger, or charge air cooler if fitted, and the ambient pressure (r = 1 for naturally aspirated engines).

The formula for the engine factor, f_m, is only valid for a q_c value between 37,2 mg/(l·cycle) $\leqslant q_c \leqslant$ 65 mg/(l·cycle). For values less than 37,2 mg/(l·cycle), a constant value of 0,2 shall be taken for f_m, while for q_c values greater than 65 mg/(l·cycle), a constant value of 1,2 shall be taken for f_m (see figure 1).

6.3.2.3 Limitation in use of correction formula

This correction formula only applies if

$$0{,}9 \leqslant \alpha_c \leqslant 1{,}1$$

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.

6.3.3 Other types of engine

For engines not covered by 6.3.1 and 6.3.2, a correction factor equal to 1 shall be applied when the ambient air density does not vary by more than ± 2 % from the density at the reference conditions (298 K and 99 kPa). When the ambient air density is beyond these limits, no correction shall be applied, but the test conditions shall be stated in the test report.

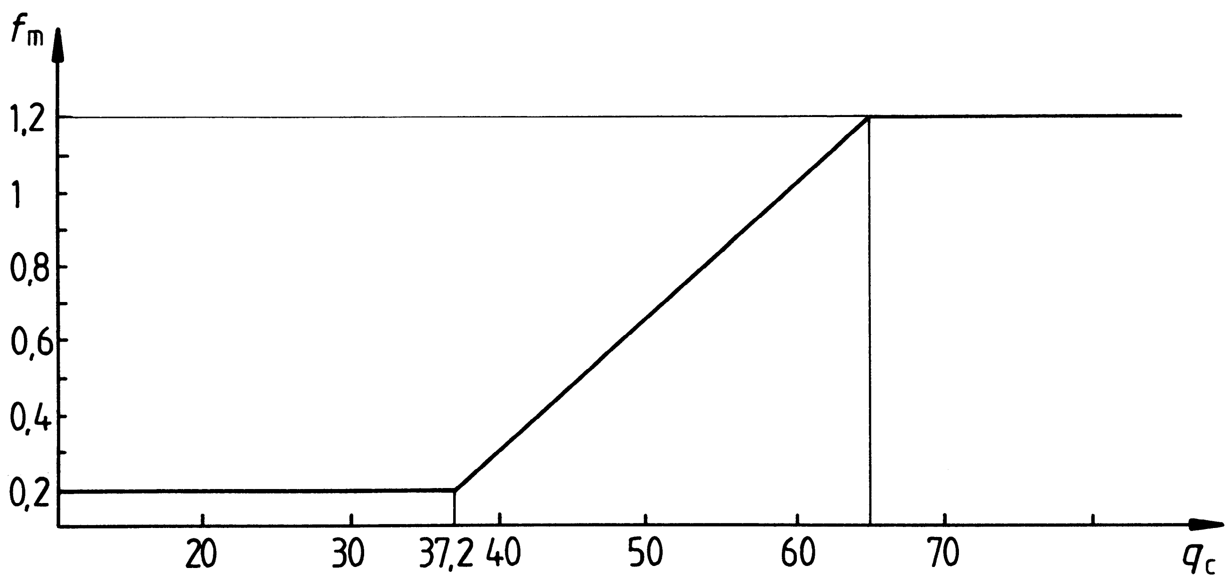

Figure 1 — Engine factor, f_m, as a function of corrected fuel delivery parameter, q_c

7 Measurement of and correction for smoke value for compression-ignition engines

The smoke value shall be measured and recorded at every test point. The opacimeter used, and its installation, shall meet the requirements of ISO 3173.

7.1 Correction factor for light absorption coefficient of smoke

This is the factor by which the light absorption coefficient of smoke, S_r, expressed in absolute units of metres to the power minus one, shall be multiplied to determine the engine light absorption coefficient of smoke at the reference atmospheric conditions specified in 6.2.1:

$$S_r = \alpha_s S$$

where

α_s is the correction factor (see 7.2);

S is the measured light absorption coefficient of smoke, in reciprocal metres (observed smoke).

7.2 Determination of correction factor for light absorption coefficient of smoke

The correction factor, α_s, for compression-ignition engines under a constant fuel delivery setting is obtained from the following formula

$$\alpha_s = 1 - 5\,(f_a - 1)$$

where f_a is the atmospheric factor (see 6.3.2.1).

7.3 Limits of application

This correction factor only applies when, for approval purposes,

$$0{,}92 \leqslant f_a \leqslant 1{,}08$$

$$283\ \text{K} \leqslant T \leqslant 313\ \text{K}$$

$$80\ \text{kPa} \leqslant p_d \leqslant 110\ \text{kPa}$$

8 Test report

(State "none" where inapplicable, or delete)

8.1 Compression-ignition engines — Essential characteristics [1)]

8.1.1 Description of engine

Make : ....

Type : ....

Cycle : four-stroke/two-stroke [2)]

Bore : .... mm

Stroke : .... mm

Number of cylinders : ....

Layout of cylinders : .... Firing order : ....

Engine swept volume : .... litres

Compression ratio [3)] : ....

Cooling system

a) Liquid

Nature of liquid : ....

Circulating pumps : yes/no [2)]

Characteristics or make(s) : .... Type(s) : ....

Drive ratio : ....

Thermostat : setting : ....

Radiator : drawing(s) or make(s) : .... Type(s) : ....

Relief valve : ....

Fan : characteristics or make(s) : .... Type(s) : ....

Fan drive system : ....

Drive ratio : ....

Fan cowl : ....

1) In the case of non-conventional engines and systems, particulars equivalent to those referred to here shall be supplied by the manufacturer.

2) Delete where inapplicable.

3) Specify the tolerance.