
INTERNATIONAL STANDARD



4164

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Road vehicles — Mopeds — Engine test code — Net power

Véhicules routiers — Cyclomoteurs — 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 institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4164 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in December 1977.

It has been approved by the member bodies of the following countries :

Australia	Korea, Dem. P. Rep. of	Spain
Austria	Korea, Rep. of	Sweden
Belgium	Mexico	Switzerland
Czechoslovakia	Netherlands	Turkey
France	New Zealand	United Kingdom
Iran	Poland	U.S.S.R.
Italy	Romania	Yugoslavia
Japan	South Africa, Rep. of	

No member body expressed disapproval of the document.

Road vehicles – Mopeds – Engine test code – Net power

1 SCOPE

This International Standard specifies a method for testing engines designed for mopeds, applicable to the evaluation of their performances with a view, in particular, to presenting curves of power and specific fuel consumption at full load as a function of rotational frequency.

It applies only to the net power study.

2 FIELD OF APPLICATION

This International Standard concerns internal combustion engines used for propulsion of mopeds, as defined in ISO 3833, normally travelling on roads and included in one of the following categories :

- internal combustion engines (spark ignition) but excluding free piston engines;
- rotary piston engines.

3 REFERENCES

ISO 1585, *Road vehicles – Engine test code – Net power.*

ISO 3833, *Road vehicles – Types – Terms and definitions.*

4 DEFINITIONS

4.1 net power : The power obtained on a test bed at the crankshaft or its equivalent¹⁾, at the rotational frequency specified by the manufacturer, the engine being equipped with the standard production auxiliaries necessary to its operation for the particular application.

4.2 specific fuel consumption : The amount of fuel consumed per output and per hour. The amount of lubricants must be excluded when they are used with a mixture of fuels.

4.3 auxiliaries : The equipment and devices listed in table 1.

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

4.5 compression ratio : The volume swept by a piston plus the volume of the combustion chamber divided by the volume of the combustion chamber.

5 ACCURACY OF MEASUREMENTS

5.1 Torque

The accuracy of the measured value shall be $\pm 2\%$.

5.2 Rotational frequency

The accuracy of the measured value shall be $\pm 0,5\%$.

5.3 Fuel consumption

$\pm 2\%$ overall for the apparatus used.

5.4 Engine inlet air temperature

$\pm 2\text{ }^{\circ}\text{C}$.

5.5 Barometric pressure

$\pm 70\text{ Pa}$ ($0,70\text{ mbar}^2$).

5.6 Pressure in exhaust extraction duct

$\pm 25\text{ Pa}$ ($0,25\text{ mbar}$).

6 TESTS

6.1 Auxiliaries

During the test, the auxiliaries specified below shall be installed on the test bed, as far as possible, in the same position as the intended application.

The engine shall be equipped only with the auxiliaries necessary to make it acceptable for service in the vehicle (see table 1).

1) If the construction of the engine does not permit direct connection of the test dynamometer to the crankshaft, the test dynamometer is connected to the engine power take-off shaft, the power being transmitted through the reduction gear, clutch and top gear of the transmission.

2) $1\text{ bar} = 10^5\text{ Pa}$

TABLE 1 – Installation of auxiliaries during test for determination of net power of engine

No.	Auxiliaries	Fitted for net power test
1	Intake system Intake manifold Air filter Intake silencer Crankcase emission control system Speed limiting device	Yes, standard production equipment
2	Exhaust system Exhaust purifier Manifold Connecting pipes ¹⁾ Silencer ¹⁾ Tail pipe ¹⁾	Yes, standard production equipment
3	Carburettor	Yes, standard production equipment
4	Fuel injection equipment Prefilter Filter Pump High pressure pipe Injector Air intake valve, if fitted ²⁾ Governor (if fitted)	Yes, standard production equipment
5	Liquid cooling equipment Radiator Fan ⁴⁾⁵⁾ Water pump Thermostat ⁶⁾	Yes, ³⁾ standard production equipment
6	Air cooling Cowl Fan ⁴⁾⁵⁾ Auxiliary test bed fan Temperature regulating device	Yes, standard production equipment Yes, if necessary Yes, standard production equipment
7	Electrical equipment	Yes, ⁷⁾ standard production equipment
8	Anti-pollution devices	Yes, standard production equipment

1) If it is impracticable to fit the standard exhaust system, a system of equivalent restriction may be fitted for the test, provided that this is acceptable to the manufacturer.

In the test laboratory, the exhaust extraction system at the point where the test bed exhaust system is connected shall not, with the engine in operation, create at the exhaust extraction duct a pressure differing from the atmospheric pressure by more than ± 740 Pa (7,40 mbar), unless the manufacturer has accepted a higher back pressure prior to the test.

2) The air intake valve is the control valve for the pneumatic governor of the injection pump.

3) The radiator, the fan, the water pump and the 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 may be produced either by the engine radiator or by an external circuit, provided that pressure loss of this circuit remains substantially the same as that of the engine cooling system. The radiator shutter, if incorporated, shall be in the open position.

4) Where a disconnectable fan is incorporated, the net power shall be determined first with the fan disconnected, then with the fan connected.

5) Where a fixed fan, electrically or mechanically operated, cannot be fitted on the test bed, the power absorbed by the fan should be determined at the same engine rotational frequencies as those used for the measurement of the engine power. This power shall be deducted from the corrected power to obtain the net power.

6) The thermostat may be fixed in the fully open position.

7) 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. There shall be no charging of the battery during the test.

6.2 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)	

6.3 Test conditions

6.3.1 The net power test shall consist of a run at full throttle for spark ignition engines, the engine being equipped as specified in table 1.

6.3.2 Performance data shall be obtained under stabilized normal 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 of spark ignition engines may contain deposits, but in limited quantity. Test conditions such as inlet air temperature shall be selected as near to reference conditions (see 7.2) as possible in order to minimize the magnitude of the correction factor.

6.3.3 The temperature of the inlet air to the engine (ambient air), shall be measured within 0,15 m maximum of the point of entry to the air cleaner, or if no air cleaner is used, within 0,15 m of the air inlet horn. The thermometer or thermocouple shall be shielded from radiant heat and located 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.

6.3.4 No data shall be taken until torque, rotational frequency and temperature have been maintained substantially constant for at least 30 s.

6.3.5 The engine rotational frequency during a run or reading shall not deviate from the selected rotational frequency by more than $\pm 2\%$.

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

6.3.7 A time of measurement of not less than 10 s shall be used when measuring rotational frequency and fuel

consumption with an automatically synchronized counter timer combination; for hand operation, the time of measurement shall be not less than 20 s.

6.3.8 The coolant outlet temperature in liquid-cooled engines shall be controlled at $80 \pm 5^\circ\text{C}$ unless otherwise specified by the manufacturer.

For air-cooled engines, the temperature at a point indicated by the manufacturer shall be kept within -20°C of the maximum value specified by the manufacturer.

6.3.9 The fuel temperature at the inlet of the injection pump or carburettor shall be maintained within the limits established by the engine manufacturer.

6.3.10 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.

6.3.11 The exhaust temperature shall be measured at a point in the exhaust pipe(s) adjacent to the outlet flange(s) of the exhaust manifold(s) or ports.

6.3.12 In cases of dispute, tests shall be carried out using CEC reference fuel CEC RF-05-T-76 (see annex).

6.4 Test procedure

Record data at a sufficient number of operating rotational frequencies to define completely the power curve between the lowest and the maximum engine rotational frequencies recommended by the manufacturer.

6.5 Data to be recorded

Data to be recorded are those indicated in clause 8.

7 CORRECTION FACTORS

7.1 Definition of factor K

A factor by which the observed power must be multiplied to determine the engine power under the reference atmospheric conditions specified in 7.2.

7.2 Reference atmospheric conditions

7.2.1 Temperature

25°C (298 K)

7.2.2 Total pressure

100 kPa (1 000 mbar), humidity being neglected.

NOTE – With the temperature range 10 to 35°C , the effects of humidity on the correction factor value may be neglected (though in some cases these effects may not be negligible), taking into account the accuracy of the measurements.

7.3 Limitations in use of correction formula

The correction formula is only applicable where the correction factor is between 0,96 and 1,04.

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

NOTE — These tests may be carried out in air-conditioned test rooms where the atmospheric conditions may be controlled.

7.4 Determination of correction factors

Within the limits defined in 7.3, the correction factor is obtained by applying the formula

$$K_a = \left(\frac{100}{P}\right) \left(\frac{T}{298}\right)^{0,5} \dots (1)$$

where

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

P is the total atmospheric pressure, in kilopascals.

This formula is applied to the observed brake power, without taking into account the mechanical efficiency of the engine.

8 TEST REPORT

(State "NONE" where not applicable, or delete).

8.1 Engine data

8.1.1 Reciprocating engines

Make : Type : Serial No. :
 Bore : mm Stroke : mm Swept volume of one cylinder : cm³
 Number of cylinders : Arrangement of cylinders :
 Total swept volume of the cylinders : cm³ Ignition : firing order :
 Compression ratio : Cycle : 2* or 4* strokes :

8.1.2 Rotary trochoidal engines

Make : Type : Serial No. :
 Epitrochoidal* or Hypotrochoidal*
 Envelope : internal* or external*
 Number of gas-tight chambers between the rotor and the stator, i.e. number of peripheral sealing devices per rotor or stator :
 Eccentricity : mm Generating radius : mm
 Operating width : mm Swept volume of one gas-tight chamber : cm³
 Number of rotors : Ignition : spark* or compression*
 firing or injection order :
 Compression ratio : Cycle : 2* or 4* strokes :

* Delete where inapplicable.

8.1.3 Transmission gear ratio

$$\text{Reduction gear ratio} = \frac{\text{Crankshaft rotational frequency}}{\text{Power take-off shaft rotational frequency}}$$

8.2 Fuel apply

Pump : Make : Type : Serial No. :

Prefilter : yes* or no* Filter : yes* or no*

8.3 Carburettor

Make : Type : Serial No. :

Number : Detailed specifications :

8.4 Injection pumps or devices

Make : Type : Serial No. :

Static timing : Advance device :

Manufacturer's code :

8.5 Injection nozzles and nozzle holders

Make : Type : Serial No. :

Setting pressure : kPa (bar) Injection high pressure pipes { lengths : mm
inside diameter : mm

8.6 Ignition distributor

Make : Type : Serial No. :

Static timing : Advance device :

Timing at : min⁻¹ (as specified by the manufacturer)

Maximum range of advance device :

Distributor contact breaker gap : mm

8.7 Spark plugs

Make : Type : Serial No. :

Number per cylinder : Electrodes gap : mm

8.8 Ignition coils

Make : Type : Serial No. :

Number :

8.9 Interference suppressor

Make : Type : Serial No. :

* Delete where inapplicable.

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8.10 Intake system

Intake manifold : Description :

Air filter : Make : Type : Serial No. :

Intake silencer : Make : Type : Serial No. :

Inlet maximum depression at full flow recommended by the manufacturer : kPa (mbar)

8.11 Valve gear

Type of valve gear : Brief description :

Valve timing : Tappet clearance (hot* or cold*) : mm

8.12 Crankcase emission control system

Brief description :

Make : Type : Serial No. :

8.13 Exhaust system

Pipes and other components : standard* or not* Brief description if not :

Exhaust brake : Make : Type : Serial No. :

Silencer : Make : Type : Serial No. :

8.14 Cooling system

8.14.1 Liquid

Nature of the liquid :

Circulating pump : Make : Type : Serial No. :

Drive ratio :

Thermostat : Make : Type : Serial No. :

Setting :

Radiator : Make : Type : Serial No. :

Pressurizing valve : Make : Type :

Pressure setting : kPa (bar)

Fan : Make : Type : Serial No. :

Fan drive system : Drive ratio :

Fan cowl : yes* or no*

* Delete where inapplicable.

8.14.2 Air

8.14.2.1 Forced air cooling

Fan : Make : Type : Serial No. :

Drive ratio :

Air ducting (standard production) : yes* or no*

Auxiliary test bed fan : yes* or no*

Temperature regulating system : yes* or no*

Brief description :

8.14.2.2 Natural air cooling

Air ducting (standard production) : yes* or no*

8.15 Oil cooler yes* or no*

Make : Type : Serial No. :

8.16 Electrical equipment

Generator* or Alternator* : Make : ... Type : Serial No. :

8.17 Anti-pollution systems (brief description) :

8.18 Other test equipment

(Enumerate, with brief description if necessary.)

8.19 Specific test conditions

Barometric pressure : kPa (mbar)

Relative humidity : % (for information)

Temperature of the test laboratory : °C (for information)

Cooling liquid outlet temperature specified by the manufacturer : °C

Air-cooled engine temperature specified by the manufacturer : °C

Measuring point :

Oil temperature range specified by the manufacturer : °C min. °C max.

Fuel temperature range specified by the manufacturer at inlet of the carburettor or of the injection pump : °C min °C max.

Exhaust temperature (measured at a point in the exhaust pipe(s) adjacent to the outlet flange(s) of the exhaust manifold(s) recommended by the manufacturer : °C

Idling rotational frequency : min⁻¹ (for information)

* Delete where inapplicable.

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Laboratory extraction system for the exhaust gases :

Over-pressure or maximum depression : \pm Pa, at full load

Dynamometer : Make : Type : Serial No. :

Constant :

Fuel consumption measuring apparatus : gravimetric* or volumetric*

8.20 Fuels and lubricants

Liquid fuel

Make : Type : Octane RON** No. :

Cetane No. :

Distillation : Temperature at which the distillate volume is equal to : 10 % 50 % 90 % End point

Density : g/cm³ at °C

Lower calorific value : kJ/kg

Other fuels : Characteristics :

Lubricant : Make : Type : SAE viscosity :

Mixture-ratio fuel/lubricant :

8.21 Results

Maximum net power : kW at min⁻¹

Maximum net torque : N·m at min⁻¹

Specific fuel consumption

— at maximum net power : g/kW·h

— at maximum net torque : g/kW·h

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* Delete where inapplicable.

** RON : Research octane number.

8.22 Statement of results (net power)

The characteristic curves of the corrected torque and power and of the specific fuel consumption shall be drawn as a function of the engine rotational frequency.

Engine rotational frequency	Dyna-mometer rotational frequency	Dyna-mometer load	Crank shaft torque	Observed power	Test conditions		Correction factor	Corrected crank shaft torque	Corrected power	Specific fuel consumption ¹⁾	Temperature of engine cooling liquid at outlet	Temperature of oil at measuring point	Exhaust temperature	Temperature measured at a point indicated by the manufacturer
					Barometric pressure	Temperature of inlet air								
min ⁻¹	min ⁻¹	N	N·m	kW	kPa	°C		N·m	kW	g/kW·h	°C	°C	°C	°C

1) Spark ignition engine : without correction of power.

9 UNITS OF DESIGNATION

9.1 Units

Unit of mass : gram (g)

Unit of power : kilowatt (kW)

Unit of torque : newton metre (N·m)

9.2 Designation

When the performances (power curves, torque and specific fuel consumption) of a heat engine are measured according to the specification of this International Standard, reference shall be made to the method used by stating "measured according to International Standard ISO 4164".

9.2.1 Indication of net power

Qualify "net power" by the words "ISO method".

Example :

Net power (ISO method) : ... kW at ... min⁻¹
(measured according to International Standard ISO 4164).

9.2.2 Indication of net torque

Qualify "net torque" by the words "ISO method".

Example :

Net torque (ISO method) : ... N·m at ... min⁻¹
(measured according to International Standard ISO 4164).

9.2.3 Indication of specific fuel consumption

Mention "ISO net power" between parentheses after "specific fuel consumption".

Example :

Specific fuel consumption (Net power ISO method – International Standard ISO 4164) : ... g/kW·h.

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