

# INTERNATIONAL STANDARD



# 4106

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

## Road vehicles — Motorcycles — Engine test code — Net power

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

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## FOREWORD

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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 4106 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in September 1977.

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

|                |                        |                       |
|----------------|------------------------|-----------------------|
| Austria        | Korea, Dem. P. Rep. of | South Africa, Rep. of |
| Czechoslovakia | Korea, Rep. of         | Spain                 |
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| Iran           | New Zealand            | Turkey                |
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| Japan          | Romania                | U.S.S.R.              |

The member body of the following country expressed disapproval of the document on technical grounds :

Belgium

# Road vehicles — Motorcycles — Engine test code — Net power

## 1 SCOPE

This International Standard specifies a method for testing engines designed for motorcycles, as defined in ISO 3833 (item 3.5), 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 engine 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 mass production motorcycles (excluding racing motorcycles) 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.

Engines fitted with a supercharging device using a mechanical supercharger or a turbo-charger are not covered by this International Standard.

## 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 (generally after having been transmitted through the reduction gear, clutch and top gear of the transmission) on a test bed at the power take-off shaft or its equivalent, at the engine 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 torque :** The crankshaft torque, calculated after measurement under the same conditions as specified in 4.1.

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

**4.4 auxiliaries :** The equipment and devices listed in table 1.

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

## 5 ACCURACY OF MEASUREMENTS

### 5.1 Torque

The dynamometer must be such that the first one-eighth of its scale is not used. It must give an accuracy within  $\pm 0,5 \%$  of the maximum scale value.

### 5.2 Engine rotational frequency

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

### 5.3 Fuel consumption

$\pm 1 \%$  overall for the apparatus used.

### 5.4 Engine inlet air temperature

$\pm 1 ^\circ\text{C}$ .

### 5.5 Barometric pressure

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

### 5.6 Pressure in exhaust extraction duct

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

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

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

| No. | Auxiliaries                                                                                                                     | Fitted for net power test                                                                     |
|-----|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1   | Intake system<br>Intake manifold<br>Air filter<br>Intake silencer<br>Crankcase emission control system<br>Speed limiting device | Yes, standard production equipment                                                            |
| 2   | Induction heating device of intake manifold                                                                                     | Yes, standard production equipment<br>If possible, to be set in the most favourable condition |
| 3   | Exhaust system<br>Manifold<br>Connecting pipes<br>Silencer<br>Tail pipe                                                         | Yes, standard production equipment                                                            |
| 4   | Fuel supply pump                                                                                                                | Yes, standard production equipment                                                            |
| 5   | Carburettor                                                                                                                     | Yes, standard production equipment                                                            |
| 6   | Fuel injection equipment<br>Prefilter<br>Filter<br>Pump<br>High pressure pipe<br>Injector                                       | Yes, standard production equipment                                                            |
| 7   | Liquid cooling equipment<br>Engine cowl<br>Radiator<br>Fan<br>Fan cowl<br>Water pump<br>Thermostat                              | No<br><br>Yes, standard production equipment                                                  |
| 8   | Air cooling<br>Cowl<br>Fan<br>Temperature regulating device                                                                     | Yes, standard production equipment                                                            |
| 9   | Electrical equipment                                                                                                            | Yes, standard production equipment                                                            |
| 10  | Anti-pollution device                                                                                                           | Yes, standard production equipment                                                            |

6 TESTS

6.1 Auxiliaries

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

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                      | In accordance with the manufacturer's production specifications for the approval of the maximum output of the engine |
| 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 be made at full throttle, the engine being equipped as specified in 4.4.

**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  $\pm 1\%$ .

**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  $-20^\circ\text{C}$  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 case of the fuel being disputed, tests shall be made with CEC reference fuel CEC RF-01-T-69 (see annex).

**6.3.13** If it is impracticable to fit the standard exhaust system, a system permitting the normal engine running characteristics in accordance with the manufacturer's specification shall be fitted for the test. In particular 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  $\pm 740\text{ Pa}$  (7,4 mbar), unless the manufacturer has specifically prescribed the back pressure prior to the test, in which case the lower of the two pressures shall be used.

### 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

$25^\circ\text{C}$  (298 K).

#### 7.2.2 Total pressure

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

NOTE — With the temperature range 10 to  $35^\circ\text{C}$ , 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 test conditions (temperature and pressure) precisely stated in the test report.

NOTE — The test 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 :

$$K = \left( \frac{100}{p} \right) \left( \frac{T}{298} \right)^{0,5}$$

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.

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**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 : ..... cm<sup>3</sup>

Number of cylinders : .....

Arrangement of cylinders : .....

Total swept volume of the cylinders : ..... cm<sup>3</sup>

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 : ..... cm<sup>3</sup>

Number of rotors : ..... Firing order : .....

Compression ratio : ..... Cycle : 2\* or 4\* strokes : .....

**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 supply**

Pump : Make : ..... Type : ..... Serial No. : .....

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

\* Delete where inapplicable.

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 (mbar) Injection high pressure pipes { lengths : ..... mm  
inside diameter : ..... mm

8.6 Ignition distributor

Make : ..... Type : ..... Serial No. : .....  
Static timing : ..... Advance device : .....  
Timing at ..... min<sup>-1</sup> : ..... (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. : .....

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 clearances (hot\* or cold\*) : ..... mm

**8.12 Crankcase emission control system**

Brief description : .....

Make : ..... Type : ..... Serial No. : .....

**8.13 Exhaust system**

Pipes : standard\* or not\* ..... Brief description if not : .....

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 : .....

Fan : Make : ..... Type : ..... Serial No. : .....

Fan drive system : ..... Drive ratio : .....

Fan cowl : yes\* or no\*

**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. : .....

\* Delete where inapplicable

### 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

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) or  
of the exhaust port(s)) recommended by the manufacturer : . . . . . °C

Idling rotational frequency : . . . . . min<sup>-1</sup> (for information)

Laboratory extraction system for the exhaust gases : . . . . .

Over-pressure or maximum depression : . . . . . ± . . . . . Pa, at full load

Dynamometer : Make : . . . . . Type : . . . . . Serial No. : . . . . .

Constant : . . . . .

Fuel consumption measuring apparatus : gravimetric\* or volumetric\*

\* Delete where inapplicable.

**8.20 Fuels and lubricants****Liquid fuel**

Make : ..... Type : ..... Octane RON\* No. : .....

Lead content : ..... g/dm<sup>3</sup>

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

Density : ..... g/cm<sup>3</sup> at ... °C

Lower calorific value : ..... kJ/kg

Other fuels : Characteristics : .....

Lubricant : Make : ..... Type : ..... SAE viscosity : .....

Mixture-ratio of fuels to lubricants : .....

**8.21 Results**Maximum net power : ..... kW at ... min<sup>-1</sup>Maximum net torque : ..... N·m at ... min<sup>-1</sup>**Specific fuel consumption**

— at maximum net power : ..... g/kW·h

— at maximum net torque : ..... g/kW·h

\* 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-<br>mometer rotational frequency | Dyna-<br>mometer load | Crank-<br>shaft torque | Observed power | Test conditions     |                          | Correction factor | Correc-<br>ted crank-<br>shaft torque | Correc-<br>ted power | Specific fuel consumption <sup>1)</sup> | 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 <sup>-1</sup>           | min <sup>-1</sup>                     | N                     | N·m                    | kW             | kPa                 | °C                       |                   | N·m                                   | kW                   | g/kW·h                                  | °C                                             | °C                                    | °C                  | °C                                                            |
|                             |                                       |                       |                        |                |                     |                          |                   |                                       |                      |                                         |                                                |                                       |                     |                                                               |

1) Without correction of power.