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Measurement methods of maximum torque and maximum net power of engines for motorcycles and mopeds

摩托车和轻便摩托车发动机 最大扭矩和最大净功率测量方法

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Measurement methods of maximum torque and maximum net power of engines for motorcycles and mopeds

1 Scope

This Standard describes the measurement methods of maximum torque and maximum net power of engines for motorcycles and mopeds.

This Standard is applicable to engines for motorcycles and mopeds (hereinafter referred to as "engines").

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 14622, *Limits and Measurement Methods for Motorcycle Pollutant Discharge (China stage IV)*

GB 18176, *Limits and measurement methods for emissions of pollutants from mopeds(CHINA IV)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 net power

engine with the accessories listed in Table 2, at the speed specified by the manufacturer, the power obtained from the end of the engine crankshaft on the test bench

NOTE: If the power can only be measured by the gearbox of the engine, the transmission efficiency of the gearbox is also considered.

3.2 maximum net power

the maximum power output measured by the engine at full load

3.3 maximum torque

2) If V_2<120km/h and/or ϕ<0.25m^2, the minimum test conditions cannot be met. The test stand cooling system shall be improved. In this case, the test shall be carried out in accordance with the method in Annex A and approved by the manufacturer.

The method specified in this clause is not used for the moped engines and compression ignition engines.

4.3.5 The engine intake air temperature (ambient air) shall be measured within 0.15m of the front end of the air filter intake direction. If there is no air filter, measure within 0.15m from the air inlet. Thermometers and thermocouples are protected against radiation and fuel vapors and inserted directly into the air flow. To obtain a representative average intake air temperature, an appropriate number of measurement points shall be set.

4.3.6 The torque, speed and temperature shall remain stable for at least 30s before starting the measurement.

4.3.7 The speed variation of each measurement point of spark ignition engine for mopeds shall not exceed ±2%. The deviation between the measured speed of the motorcycle engine and the selected speed shall not exceed ±1% or ±10r/min. Take the higher of the two.

4.3.8 Dynamometer load and intake air temperature shall be recorded simultaneously. Its value shall be the average of two stable recordings taken consecutively. The difference between the two values of the dynamometer load shall not exceed 2%.

4.3.9 The coolant temperature at the engine coolant outlet shall be maintained within ±5K of the upper limit temperature of the thermostat given by the manufacturer. If there is no factory given value, the temperature is 353K ± 5K. For air-cooled engines, the temperature at the manufacturer's specified point shall be maintained between $^{0}_{-20}$K of the maximum manufacturer's specified temperature under standard conditions.

4.3.10 The fuel temperature shall be measured at the carburetor inlet or the fuel injection system inlet and the fuel consumption meter. Its value shall be within the range given by the manufacturer.

4.3.11 The lube oil temperature shall be measured at the crankcase or oil cooler outlet. Its value shall be within the range given by the manufacturer.

4.3.12 The compression ignition engine temperature shall be maintained within the limits of 4.3.8 ~ 4.3.10, otherwise an additional adjustment device shall be used.

4.3.13 The exhaust temperature shall be measured at an angle perpendicular to the airflow at the exhaust manifold, exhaust manifold, or exhaust pipe vent.

4.3.14 If an automatic trigger device is used to measure speed and fuel consumption, the measurement duration is at least 10s. If using manual device, the duration is at least 20s.

4.3.15 During the type test, the reference fuel that meets the requirements of GB 14622 and GB 18176 shall be used.

4.3.16 During the test, parameters such as torque, rotational speed, intake air temperature, atmospheric pressure, humidity, oil temperature, fuel temperature, and exhaust temperature shall be collected and recorded in the original record.

4.4 Tests

Tests shall be carried out at multiple speed points between the manufacturer's recommended minimum and maximum speeds in order to correctly define the power curve. The distribution of RPM points shall include the corresponding RPMs for maximum net engine power and maximum torque. The determination of each rotational speed shall be the average of at least two stable measurements.

5 Correction factors for spark ignition engine power and torque

5.1 Meaning of correction factor (α_1) for standard ambient conditions and correction factor (α_2) for transmission efficiency

The correction factor (α_1) for standard ambient conditions and the correction factor (α_2) for transmission efficiency are multiplied by the measured power and torque to determine the power and torque obtained under standard ambient conditions. At the same time ensure that the transmission efficiency is considered during the test.

The corrected power formula is shown in formula (1):

$$P_0 = \alpha_1 \cdot \alpha_2 \cdot P \qquad \cdots\cdots (1)$$

Where,

P0 - Corrected power (crankshaft output power);

α_1 - Correction factor for standard ambient conditions;

α_2 - Correction coefficient of transmission efficiency;

P - Measured power.

5.2 Ambient conditions

The power correction factor (α_d) for standard ambient conditions and the transmission efficiency correction factor (α_2) are multiplied by the measured power and torque, so as to determine the power and torque obtained under standard ambient conditions. At the same time ensure that the transmission efficiency is considered during the test.

The corrected power formula is shown in formula (6):

$$P_0 = \alpha_d \cdot \alpha_2 \cdot P \qquad \cdots\cdots(6)$$

Where,

P_0 - Corrected power (crankshaft output power);

α_d - Power correction factor for standard ambient conditions;

α_2 - Correction coefficient of transmission efficiency;

P - Measured power.

6.2 Standard ambient conditions

Standard ambient conditions require the following:

a) Standard temperature (T_o) is 298K (25°C);

b) Standard dry pressure (P_{so}) is 99kPa (990mbar).

6.3 Test ambient conditions

The ambient conditions during the test shall be within the ranges given below:

a) Test temperature (T): 283K~313K;

b) Atmospheric dry pressure (P_s): 80kPa~110kPa.

6.4 Power correction factor (α_d) for standard ambient conditions

6.4.1 Determination of power correction factor (α_d) for standard ambient conditions

Under a constant fuel supply rate, the power correction coefficient (α_d) of the compression ignition engine is obtained from formula (7):

$$\alpha_d = (f_a) f_m \qquad \cdots\cdots(7)$$

Where,

α_d - Power correction factor for standard ambient conditions;

f_α - Ambient factor;

f_m - Characteristic factor of the engine and regulator.

6.4.2 Ambient factor (f_α)

The ambient factor (f_α) refers to the effect of ambient conditions (pressure, temperature, humidity) on the intake air of the engine. Different engine types have different factors.

a) The ambient factor of a naturally aspirated or supercharged engine is calculated according to formula (8):

$$f_a = \left(\frac{99}{P_s}\right) \cdot \left(\frac{T}{298}\right)^{0.7} \quad \cdots\cdots (8)$$

Where,

f_α - Ambient factor;

T - Absolute temperature of the intake air of the engine, in Kelvin (K);

P_s - Atmospheric dry pressure, in kilopascals (kPa).

b) The ambient factor of turbocharged engine is calculated according to formula (9):

$$f_a = \left(\frac{99}{P_s}\right)^{0.7} \cdot \left(\frac{T}{298}\right)^{1.5} \quad \cdots\cdots (9)$$

Where,

f_α - Ambient factor;

T - Absolute temperature of the intake air of the engine, in Kelvin (K);

P_s - Atmospheric dry pressure, in kilopascals (kPa).

6.4.3 Characteristic factor of engine and regulator (f_m)

The characteristic factor (f_m) of the engine and regulator is a function of the corrected fuel flow (q_c), calculated according to formula (10):

$$f_m = 0.036 q_c - 1.14 \quad \cdots\cdots (10)$$

Where,

q_c - Corrected fuel flow, calculated according to formula (11):

Annex A

(normative)

Measurement of maximum torque and maximum net power of engine (by controlling engine temperature)

A.1 The test to determine the maximum torque and maximum net power of the engine shall be completed in the case of spark ignition engine with full throttle open and compression ignition engine under the condition of full load of fuel injection pump. The engine is mounted as listed in Table 2.

A.2 The engine operation during measurement shall be normal and stable, and the air supply shall be sufficient. The engine shall be run-in under the conditions recommended by the manufacturer. There can be carbon deposits in the combustion chamber, but it must be within the scope of the manufacturer's license. Test conditions (such as intake air temperature) shall be as close as possible to standard ambient conditions (see 5.2.1) to reduce the influence of the correction factor.

A.3 For the measurement of engine intake air temperature (ambient air), see 4.3.5.

A.4 In a measurement, the speed change of each measurement point shall not exceed ±1%.

A.5 The load reading of the measured engine shall be read from the dynamometer when the engine monitoring temperature reaches a predetermined value, and the engine speed remains basically constant.

A.6 For dynamometer load and intake air temperature measurements, see 4.3.8.

A.7 The measurement of fuel consumption can only be carried out when the engine reaches the specified speed. If using an automatic trigger device to measure speed and fuel consumption, the measurement duration is at least 10s. If using a manual device, the duration is at least 20s.

A.8 The coolant temperature at the engine coolant outlet shall be maintained within ±5K of the upper limit temperature of the thermostat given by the manufacturer. If there is no manufacturer given value, the temperature is 353K ± 5K. For air-cooled engines, the spark plug gasket temperature shall be maintained within ±10K of the maximum temperature specified by the manufacturer under standard conditions. If not specified by the manufacturer, the temperature is 483K±10K.

A.9 The temperature at the spark plug gasket of an air-cooled engine is measured by a thermometer in conjunction with a thermocouple seal.

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