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**Limits and Measurement Methods for Emissions from Motorcycles
(CHINA IV)**

摩托车污染物排放限值及测量方法（中国第四阶段）

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the People's Republic of China.**

Limits and Measurement Methods for Emissions from Motorcycles (CHINA IV)

1 Application Scope

This standard specifies the limits and measurement methods for tailpipe emissions and evaporative emissions of the motorcycle with spark-ignition engine, as well as the emission requirements for crankcase, endurance requirements for emission-control devices and technical requirements for on-board diagnostic (OBD) system.

This standard specifies the limits and measurement methods for tailpipe emissions of the three-wheeled motorcycle with compression-ignition engine, as well as the endurance requirements for emission-control devices and technical requirements for on-board diagnostic (OBD) system.

This standard specifies the type test requirements, production conformity inspection, and judgment methods for motorcycles.

This standard is applicable to the motorcycles driven by spark-ignition engine, with maximum design speed greater than 50km/h or displacement greater than 50ml; and the three-wheeled motorcycles driven by compression-ignition engine, with maximum design speed greater than 50km/h or displacement greater than 50ml.

2 Normative References

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. For undated references, the latest edition of the referenced document applies

GB/T 15089-2001	<i>Classification of Power - Driven Vehicles and Trailers</i>
HJ/T 289	<i>Equipment Specifications and Quality Control Requirements for Gasoline Vehicles in Two-Speed Idle Exhaust Emission Test</i>
QC/T 1003	<i>Determination of Precious Metal in Metal Support Catalytic Converter for Motorcycles</i>
ISO 2575: 2010	<i>Road Vehicles - Symbols For Controls, Indicators and Tell-tales</i>
ISO 9141-2	<i>Road Vehicles - Diagnostic Systems - Part 2: CARB Requirements for Interchange of Digital Information</i>
ISO 14229-3	<i>Road Vehicles - Unified Diagnostic Services (UDS) - Part 3: Unified Diagnostic Services on CAN Implementation (UDSonCAN)</i>

3.13**crankcase emissions**

the gaseous pollutants exhausted to the atmosphere through the vent hole of the crankcase or the opening of the lubrication system

3.14**evaporative emissions**

the hydrocarbon compound vapor discharged from the fuel (gasoline) system of motorcycle except that from motorcycle tailpipe, including:

diurnal breathing loss: the hydrocarbon compounds (expressed by $C_1H_{2.33}$ equivalent) exhausted due to temperature change in fuel storage tank. Hot-soak loss: the hydrocarbon compounds (expressed by $C_1H_{2.20}$ equivalent) exhausted from the fuel system of static motorcycle after running for a certain duration

3.15**volume of the carbon in canister**

the volume of activated carbon in the canister

3.16**weight of carbon in canister**

the filling weight of activated carbon in canister

3.17**efficient loading quality of canister**

the difference between the total mass of canister after adsorbing vapor and that after desorption

3.18**bed volume of canister**

the design volume of activated carbon contained in canister

3.19**initial butane working capacity of canister**

the efficient loading quality of unit volume of the carbon in canister after being tested for 13 times

3.20**breakthrough point**

the moment when the accumulated evaporative emission amount of fuel is equivalent to 2g

3.21**non-exposed type of fuel storage tank**

the fuel storage tank which is not directly exposed to sunlight except its cap

3.22**on-board diagnostic (OBD) system**

the on-board diagnostic system (hereinafter referred to as "OBD system") used for emission control, which must possess the function of distinguishing the area with potential malfunction and storing this information in the memory of electronic control unit in the form of malfunction code

3.23**defeat device**

a kind of device that can activate, adjust, delay or stop the operation of a component or the function of the emission control system through measuring, inducing and responding operating parameters (such as speed, engine rotation speed, gearbox position, temperature, air inlet branch vacuum degree and other parameters) so as to decrease the efficiency of the emission control system under normal service conditions of the motorcycle

The following devices are not regarded as defeat devices:

- (1) the device required for preventing the engine from damage or accident or for the driving safety of motorcycle;
- (2) the device only acts at the start of engine;
- (3) the device acts indeed during Type I or Type IV test.

3.24**irrational emission control strategy**

the measures and methods that can decrease the efficiency of the emission control system of the motorcycle under normal service conditions to a level not complying with the emission level required by the type test

3.25

5.1 The parts and components having an impact on tailpipe emissions, crankcase emissions and evaporative emissions shall be such designed, manufactured and assembled as to enable the motorcycle under normal service condition, to comply with the requirements of this standard despite the vibration to which it may be subject.

5.2 Technical measures must be taken by the motorcycle manufacturer to ensure that the motorcycle meets the requirements of Chapters 6 and 7. Thus, it is regarded as able to effectively control its tailpipe emissions and evaporative emissions within the limits specified in this standard under normal service condition and within service life.

5.3 Any of the following measures must be taken by the motorcycle manufacturer so as to avoid excess evaporative emissions and fuel overflow due to loss of fuel storage tank cap.

- (1) Adopt the automatic opening and closing fuel storage tank cap which cannot be taken off;
- (2) Avoid the excess evaporative emissions caused by loss of fuel storage tank cap from the design structure;
- (3) Other measures leading to similar effects, e.g. adopt the fastened fuel storage tank cap, or lock the fuel storage tank cap with the key firing the motorcycle, which can only be pulled out when the fuel storage tank cap is locked.

5.4 All motorcycles shall be equipped with OBD systems that shall be such designed, manufactured and installed as to identify and record the malfunction types of motorcycles throughout the service life. Without type test, any change in the technical measures taken by the manufacturer and the OBD system equipped on motorcycle, which may affect the emissions of motorcycle, cannot be made. The OBD system shall be equipped with a malfunction indicator (MI) which may be perceived by the driver quickly.

5.5 The safety of electronic control system shall meet the following requirements:

- (1) Unless being authorized by the manufacturer, any motorcycle adopting electronic control unit to control the emissions shall be able to prevent being-changed. Any pluggable chip used for storing calibration data shall be put into a sealed container or protected by electronic algorithm; moreover, the stored data shall not be changed unless with special tool and specific program. Only the functions directly related to the emission calibration or those related to anti-burglary of motorcycle are required to meet such protection requirement.
- (2) The operating parameters of engine expressed by code of electronic control unit shall not be changed unless with special tool and specific specification [e.g. the parts and components of electronic control unit are completely welded or sealed, or the electronic control unit box is enclosed (or sealed)].

6.2.2.2 Test of smoke intensity at free acceleration

6.2.2.2.1 All motorcycles with compression-ignition engine shall be subject to this test.

6.2.2.2.2 This test is conducted immediately after Type I test and its method shall meet the requirements of Attachment DA.

6.2.2.2.3 The value of the measured light absorption coefficient plus 0.5m^{-1} is regarded as the result of type test on exhaust smoke intensity at free acceleration of this motorcycle type.

6.2.3 Type III test (test for crankcase emissions)

Any crankcase emission shall not be exhausted into atmosphere. Where necessary, the manufacturer shall disclose detailed technical information and drawings to the competent department so as to prove that the engine structure will not exhaust any fuel, lubricating oil or crankcase gas into atmosphere from crankcase ventilation system.

6.2.4 Type IV test (test for evaporative emissions)

6.2.4.1 All motorcycles with spark-ignition engine, except mono fuel gas motorcycles, shall be subject to this test. As for bi-fuel motorcycle, only gasoline is used to conduct this test.

6.2.4.2 The test is conducted according to Annex E, and the evaporative emission amount shall not exceed 2.0g/test.

6.2.4.3 Before the test, the motorcycle manufacturer shall separately provide two same canisters, one is equipped on motorcycle for Type IV test; the other one is subject to initial working capacity testing according to the test method in Attachment EB, and the measurement result shall not be higher than 1.15 times the declared value of the manufacturer.

6.2.5 Type V test (endurance test for emission-control devices)

6.2.5.1 Before the test, the motorcycle manufacturer shall separately provide two same catalytic converters, one is subject to endurance test; the other one is subject to noble metal content testing according to the requirements of QC/T 1003, and the measurement result shall not be higher than 1.2 times the declared value of the manufacturer.

6.2.5.2 All motorcycles subject to type test shall be subject to emission deterioration endurance test with the method complying with the requirements of Annex F.

required by the manufacturer, running-in less than 1 000km may be conducted according to the running-in specification of the manufacturer; however, such motorcycles shall not be adjusted in any way.

7.1.4 Commercially available vehicle fuel complying with the requirements of relevant standard shall be adopted for test. Where required by the manufacturer, reference fuels specified in Annex H may be adopted.

7.2 Production conformity inspection for Type II test

7.2.1 Production conformity inspection for test of motorcycle with spark-ignition engine at double idling speed

7.2.1.1 The manufacturer shall conduct random inspection for motorcycles passing off-production-line inspection through test at double idling speed.

7.2.1.2 The CO and HC emission values at double idling speed and the λ value at high idling speed of the motorcycle shall meet the requirements of 6.2.2.1.4.

7.2.2 Production conformity inspection for smoke intensity at free acceleration of three-wheeled motorcycle with compression-ignition engine

7.2.2.1 The manufacturer shall conduct random inspection for motorcycles passing off-production-line inspection through test of smoke intensity at free acceleration.

7.2.2.2 The measured light absorption coefficient shall not be greater than the type test result specified in 6.2.2.2 plus 0.5m^{-1} .

7.3 Production conformity inspection for Type III test

Shall meet the requirements of 6.2.3.

7.4 Production conformity inspection for Type IV test

Production conformity inspection shall be conducted according to the requirements in E.7, Annex E.

7.5 Production conformity inspection for OBD system

7.5.1 Three motorcycles are randomly taken from batch products to conduct tests specified in Annex G.

7.5.2 If the three motorcycles meet the test requirements specified in Annex G, it is regarded that the production conformity of OBD system meets relevant requirements, otherwise it will be

regarded as rejected.

7.6 Production conformity inspection for canister

7.6.1 Three motorcycles (or three canisters) are randomly taken from the assembling line or batch products to test the initial working capacity of canister according to the requirements of Attachment EB.

7.6.2 Judgment criteria for canister production conformity:

- if the measurement results of the initial working capacity of three canisters are not less than 0.85 times of the declared value, and their average is not less than 0.9 times of the declared value, the canister is judged as acceptable in production conformity inspection.
- if the measurement result of the initial working capacity of any of three canisters is less than 0.85 times of the declared value, or the average is less than 0.9 times of the declared value, the canister is judged as rejected in production conformity inspection.

7.7 Production conformity inspection for catalytic converter

7.7.1 Three motorcycles (or three catalytic converters) are randomly taken from the assembling line or batch products to test the content of each noble metal in the sampled catalytic converter according to the requirements of QC/T 1003.

7.7.2 Judgment criteria for catalytic converter production conformity:

- if the measurement results of the noble metal content in three catalytic converters are not less than 0.8 times of the declared value, and their average is not less than 0.85 times of the declared value, the catalytic converter is judged as acceptable in production conformity inspection.
- if the measurement result of certain noble metal content in any of the three catalytic converters is less than 0.8 times of the declared value, or the average is less than 0.85 times of the declared value, the catalytic converter is judged as rejected in production conformity inspection.

7.8 Others

In case that a certain motorcycle type fails to meet any of the production conformity inspection requirements specified in 7.1~7.7, the motorcycle manufacturer shall take all the necessary measures as soon as possible to reestablish the production conformity assurance system.

C.2.5.3.2 The requirements of test equipment are as follows, its components are expressed in the corresponding symbols in Figures C.2, C.3 and C.4. Where other different equipment is adopted, its equivalence shall be confirmed by the testing organization.

C.2.5.3.2.1 The collector collecting all the exhaust emitted during the test shall be closed type and may collect all exhaust at the motorcycle air outlet when the exhaust back pressure changes within $\pm 1.25\text{kPa}$, and the device shall be free from condensation phenomena changing exhaust composition when collecting gases at test temperature. If the ambient atmospheric pressure is able to be ensured at the motorcycle tailpipe outlet, all the exhaust can be collected and open type instrument may also be used.

C.2.5.3.2.2 The collector and gas sampling equipment are connected with connecting tube (T_U). The connecting tube and sampling equipment shall be made of stainless steel or other materials not affecting the collected gas composition and able to withstand its temperature.

C.2.5.3.2.3 In the whole test process, the heat exchanger (S_C) shall be able to control the temperature change of diluted gases at pump inlet within $\pm 5^\circ\text{C}$. The heat exchanger is equipped with preheating system which heats the gas to the required working temperature (deviation is $\pm 5^\circ\text{C}$) before the test.

C.2.5.3.2.4 The constant volume pump P_1 which sucks diluted exhaust is driven by multi-stage constant-speed motor and it shall have enough volume of constant flow to ensure that all the exhaust is sucked in. Critical flow venturi tube may also be adopted.

C.2.5.3.2.5 A device which may record the temperature of diluted gases into constant volume pump (or critical flow venturi tube) continuously.

C.2.5.3.2.6 The probe S_3 installed outside the sampling device is adopted for sampling of diluted air at fixed flow by means of pump, filter and flowmeter in the test process.

C.2.5.3.2.7 The sampling probe S_2 installed in diluted gases pipeline and in front of the constant volume pump is adopted for sampling of diluted gases at constant flow by means of filter, flowmeter and pump (where necessary) in the whole test process. In both sampling devices, the minimum sampling flow shall be 150L/h .

C.2.5.3.2.8 Two filters F_2 and F_3 , which are installed behind probes S_2 and S_3 respectively, are used for filtering the suspended particulate matters in the sample gas. Particularly, the filters shall not change the concentration of gas composition in the sample gas.

C.2.5.3.2.9 Two sampling pumps P_2 and P_3 are adopted to collect the sample gas into sampling bags S_a and S_b respectively through probes S_2 and S_3 .

C.2.5.3.2.10 Two manual regulating valves V_2 and V_3 are installed behind pumps P_2 and P_3 so as to control the flow of sample gas into the sampling bags.

C.2.5.3.2.11 Two rotor flowmeters R_2 and R_3 are connected with "probe, filter, pump, regulating valve and sampling bag" (S_2, F_2, P_2, V_2, S_a and S_3, F_3, P_3, V_3, S_b) pipeline in series for the convenience of sample gas flow inspection at any time.

C.2.5.3.2.12 The closed sampling bag used for collecting diluent air and diluted gases shall have enough volume to ensure that the sample gas flow will not be blocked. The sampling bag shall be equipped with a rapidly automatic-closing device for the convenience of rapid disconnection with sampling system after test or connection with analysis system during analysis.

C.2.5.3.2.13 The installation positions of two pressure meters g_1 and g_2 with different functions are as follows:

- a) g_1 is installed in front of constant volume pump P_1 to measure the pressure difference between atmosphere and diluted gases;
- b) g_2 is installed in front/rear of constant volume pump P_1 to measure the pressure difference of air flow in front/rear of the pump.

C.2.5.3.2.14 Revolution-counter CT is used for recording the rotation number of constant volume pump P_1 .

C.2.5.3.2.15 The three-way valve of the above sampling system is used for introducing the sample gas to respective sampling bag or directly exhausting it to air in the test process, thus snap valve shall be adopted, the three-way valve is made of the materials having no influence on gas composition and its flow section and shape shall reduce the pressure loss as possible.

C.2.5.3.2.16 Blower (BL) is used for delivering diluted gases.

C.2.5.3.2.17 Cyclone separator (CS) is used for filtering the particulates in diluted gases.

C.2.5.3.2.18 Pressure gauge (G) is installed in front of the critical flow venturi tube and used for measuring the pressure of diluted gases.

C.2.5.3.3 For the motorcycles with compression-ignition engine, see Attachment CH for the exhaust sampling and volume measuring equipment in the test process.

C.2.5.4 Analytical equipment

C.2.5.4.1 Concentration measurement of hydrocarbon compounds (HC)

In the test process, hydrogen flame ionization method is adopted for measuring the concentration of unburned hydrocarbon compounds (HC) in sample gas collected in sampling bags S_a and S_b .

C.2.5.4.2 Concentration measurement of carbon monoxide (CO) and carbon dioxide (CO₂)

In the test process, nondispersive infrared absorption method is adopted for measuring the concentrations of carbon monoxide (CO) and carbon dioxide (CO₂) in sample gas collected in sampling bags S_a and S_b.

C.2.5.4.3 Concentration measurement of nitrogen oxide (NO_x)

In the test process, chemiluminescent method is adopted for measuring the concentration of nitrogen oxide (NO_x) in sample gas collected in sampling bags S_a and S_b.

C.2.5.4.4 For the motorcycles with compression-ignition engine, see Attachment CH for the analytical equipment in the test process.

C.2.5.5 Instrument and measurement accuracy

C.2.5.5.1 Chassis dynamometer shall be checked in separate test and shall meet the accuracy requirements of Table C.3. As for the total inertia of rotating mass including drum and power absorption unit rotating components, its measurement accuracy is $\pm 2\%$.

C.2.5.5.2 The motorcycle speed is determined according to the rotation speed of chassis dynamometer drum. Where the motorcycle speed is within 0~10km/h, the measurement accuracy shall be ± 2 km/h and it shall be ± 1 km/h if the motorcycle speed is greater than 10km/h.

C.2.5.5.3 The measurement accuracy of temperature is $\pm 1^\circ\text{C}$ in C.2.5.3.2.5 and it is $\pm 2^\circ\text{C}$ in C.2.1.1 and C.2.1.2.

C.2.5.5.4 The measurement accuracy of atmospheric pressure is $\pm 0.133\text{kPa}$.

C.2.5.5.5 The measurement accuracy of relative air humidity is $\pm 5\%$.

C.2.5.5.6 As for the pressure difference between diluted gases and atmosphere measured at inlet of constant volume pump P₁ (see C.2.5.3.2.13), the measurement accuracy is $\pm 0.4\text{kPa}$. For the pressure difference of diluted gases in front and rear sections of constant volume pump P₁, the measurement accuracy is $\pm 0.4\text{kPa}$.

C.2.5.5.7 The exhaust volume at each rotation of constant volume pump P₁ and the displacement value at the minimum pump speed recorded by revolution-counter shall be able to ensure that the measurement accuracy of total volume of diluted gases emitted from the constant volume pump in the whole measuring process is $\pm 2\%$.

C.2.5.5.8 On the premise of not considering the accuracy of standard gas, the accuracy of each span of analyzer shall reach $\pm 3\%$ when measuring different compositions. The hydrogen flame ionization type analyzer used for measuring concentration of hydrogen compounds (HC) shall

speed.

- c) If the gear positions before and after gear shift are the same, and the time of upshift or downshift is less than 4s, the gear position before gear shift shall be continuously used. For example: 2 2 2 2 2 will be used for replacing 2 3 3 3 2; 4 4 4 4 4 will be used for replacing 4 3 3 3 4. In case of continuous and cyclic application of gear position, a certain gear position shall be used for a long time. For example: 2 2 2 2 2 2 2 2 2 2 3 3 3 will be used for replacing 2 2 2 3 3 3 2 2 2 3 3 3. If the gear position is used at the same time, the gear position of the previous phase will be regarded as that of the later phase. For example: 2 2 2 2 2 2 2 2 3 3 3 will be used for replacing 2 2 2 3 3 3 2 2 2 3 3 3.
- d) Downshift is not allowed in acceleration phase.

C.2.5.7.2.2 Optional provisions

The gear position selection may be corrected according to the following provisions:

The gear position lower than that required in C.2.5.7.2.1 is allowed to be used at any phase of the cycle. The gear position suggested by the manufacturer may be adopted if it is not higher than the gear position required in C.2.5.7.2.1.

See Attachment CE for the method explanation, gear shift description and calculation.

C.2.5.7.3 Gear shift description of right three-wheeled motorcycles with manual gearbox

C.2.5.7.3.1 At constant speed, the engine rotation speed shall be 50%~90% of the engine rotation speed as possible. If more than one gear position meets this requirement, the high gear position is adopted for motorcycle test.

C.2.5.7.3.2 The gear position, which is able to provide the maximum acceleration, shall be adopted for motorcycle test at acceleration. When the engine rotation speed reaches 110% of the maximum power rotation speed, the gear position shall be upshifted to continue the test. Where the motorcycle reaches 20km/h by means of the first gear or reaches 35km/h by means of the second gear, the gear position shall be upshifted in such case. The gear position is not allowed to upshift on completion of the aforesaid operation. In acceleration phase, if the gear shift has been completed in the fixed speed point, the next constant speed phase test shall be conducted in the gear position which is used when the motorcycle switches into the constant speed phase; in this case, the engine rotation speed may not be considered.

C.2.5.7.3.3 The gear position shall be downshifted prior to unstable idling operation of engine occurs or when the engine rotation speed drops to 30% of the maximum power rotation speed in deceleration phase. The lowest gear shall not be used at deceleration.

C.3 Test process

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