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**Measurement Method of Fuel Saving Technology for
Automobiles**

汽车节油技术评定方法

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Measurement Method of Fuel Saving Technology for Automobiles

1 Scope

This document describes the evaluation index, test items and test methods of the fuel saving technology of vehicles in use, as well as the calculation of the evaluation index.

This document is applicable to the evaluation of the application effect of fuel saving products and technology of vehicles in use.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 260 Test Method for Water in Petroleum Products - Distillation Method

GB/T 265 Petroleum Products - Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity

GB/T 511 Petroleum, Petroleum Products and Additives - Method for Determination of Mechanical Admixtures

GB/T 3142 Standard Test Method for Determination of Load-carrying Capacity of Lubricants - Four-ball Method

GB/T 3535 Petroleum Products - Determination of Pour Point

GB/T 3536 Petroleum Products - Determination of Flash and Fire Points - Cleveland Open Cup Method

GB/T 3730.1 Terms and Definitions of Motor Vehicles, Trailers and Combination Vehicle - Part 1: Types

GB 3847-2018 Limits and Measurement Methods for Emissions from Diesel Vehicles under Free Acceleration and Lugdown Cycle

GB/T 5096 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

GB/T 5181 Automotive Emission - Terms and Definitions

GB/T 6538 Determination of Apparent Viscosity of Engine Oils - Using the Cold-cranking Simulator

GB/T 12543 Motor Vehicles - Acceleration Performance - Test Method

GB/T 12545.1-2008 Measurement Methods of Fuel Consumption for Automobiles - Part 1: Measurement Methods of Fuel Consumption for Passenger Cars

GB 18285-2018 Limits and Measurement Methods for Emissions from Gasoline Vehicles under Two-speed Idle Conditions and Short Driving Mode Conditions

GB/T 18297-2001 Performance Test Code for Road Vehicle Engines

GB 18352.6-2016 Limits and Measurement Methods for Emissions from Light-duty Vehicles (CHINA 6)

GB/T 19233 Measurement Methods of Fuel Consumption for Light-duty Vehicles

JT/T 711-2016 Limits and Measurement Methods of Fuel Consumption for Commercial Vehicle for Passenger Transportation

JT/T 719-2016 Limits and Measurement Methods of Fuel Consumption for Commercial Vehicle for Cargos Transportation

JT/T 1045 Technical Specifications of Vehicle Management for Road Transportation Enterprises

3 Terms and Definitions

What is defined in GB/T 3730.1, GB/T 5181, JT/T 711 and JT/T 719, and the following terms and definitions are applicable to this document.

3.1 fuel saving technologies for automobile

Fuel saving technologies for automobile are technologies that reduce the fuel consumption of automobile without causing any adverse effects on other operational performances of the automobile.

4 Abbreviations

The following abbreviations are applicable to this document.

CO: carbon monoxide

HC: hydrocarbons

conditions;

- 2) Emitted pollutant comparison test of diesel engines under full load and steady speed.

6.1.2 Road test of vehicle performance

The test items of the road test of vehicle performance include:

- a) Comprehensive fuel consumption comparison test of vehicles running at constant speed;
- b) Comparison test of vehicle full-throttle overrun acceleration performance;
- c) Vehicle emitted pollutant comparison test, which is divided into:
 - 1) Emitted pollutant comparison test of gasoline vehicles under two-speed idle conditions;
 - 2) Emitted pollutant comparison test of diesel vehicles under free acceleration.

6.1.3 Chassis dynamometer test of vehicle performance

The test items of the chassis dynamometer test of vehicle performance include:

- a) Fuel consumption comparison test of vehicles operating under multiple operating conditions;
- b) Emitted pollutant comparison test of vehicles operating under multiple operating conditions.

6.1.4 Actual operation test of vehicle fleet

The test items of the actual operation test of vehicle fleet include:

- a) Actual operation fuel consumption comparison test of vehicle fleet;
- b) Subjective evaluation comparison test of vehicle dynamic performance.

6.1.5 Physical and chemical performance test of fuel-saving additives

The test items of the physical and chemical performance test of fuel-saving additives include:

- a) Physical and chemical performance test of fuel-saving additives;
- b) Physical and chemical performance test of lubricating oil-saving additives.

6.2 Test Methods and Test Data Processing

6.2.1 Basic requirements

6.2.1.1 The fuel and lubricating oil used in the test shall be commercially available products of the designations specified by the vehicle or engine manufacturer.

6.2.1.2 Before the test, the test vehicle or engine shall be inspected and maintained, so as to confirm that there is no fault or abnormal operation. During the test, no technical adjustments shall be made to the test vehicle or engine that are not related to the use of fuel-saving products or technology.

6.2.1.3 During the test, if the test vehicle or engine fails, the comparison test shall be re-started after the vehicle or engine failure is repaired.

6.2.1.4 For fuel-saving additives, lubricating oil-saving additives and fuel-saving products, before use, they shall be subject to the physical and chemical performance test in accordance with the stipulations of 6.2.6, so as to confirm that they have no adverse effects on the operation of the vehicle or engine.

6.2.2 Bench test of engine performance

6.2.2.1 Test conditions

6.2.2.1.1 The comparison test of using and not using fuel-saving products or technology shall be carried out with the same engine, and all tests of not using fuel-saving products or technology shall be completed before conducting the tests of using fuel-saving products or technology.

6.2.2.1.2 The accessories attached to the engine shall comply with the requirements for the accessories attached to the engine during the total power test specified in Table 4 of GB/T 18297-2001.

6.2.2.1.3 The instrument precision and measuring positions, and the control of general conditions of the engine bench shall respectively comply with the stipulations of Chapter 4 and Chapter 6 in GB/T 18297-2001.

6.2.2.1.4 Before the test, check the operation of the test engine. The transition of operation shall be smooth, the total power shall be greater than 95% of the engine's rated power, and the minimum fuel consumption rate under full load shall be not greater than 105% of the engine's nominal value.

6.2.2.2 Total engine power and torque comparison test

6.2.2.2.1 The total engine power and torque comparison test shall be carried out in accordance with the power test method specified in 8.3 of GB/T 18297-2001.

6.2.2.2.2 The total engine power shall be corrected in accordance with the formula in Table 3 f) of GB/T 18297-2001.

6.2.2.2.3 The engine torque shall be corrected in accordance with the formula in Table 3 e) of GB/T 18297-2001.

6.2.3.4.1 For gasoline vehicles, in accordance with the stipulations of Appendix A in GB 18285-2018, measure the emitted pollutant under two-speed idle conditions.

6.2.3.4.2 For diesel vehicles, in accordance with the stipulations of Appendix A in GB 3847-2018, measure the emitted pollutant under free acceleration.

6.2.3.5 Pre-driving

After using fuel-saving products or technology, if the test vehicle needs pre-driving, then, the pre-driving shall be respectively completed before and after using the fuel-saving products or technology before carrying out the vehicle performance road comparison test. It is recommended to carry out pre-driving in accordance with the cycle specified in Table 3. During the pre-driving and after the pre-driving is completed, the technical condition of the test vehicle shall be normal.

6.2.3.6 Lubricating oil aging treatment

For the lubricating oil-saving products or technology for automobiles, the test vehicle shall respectively use the reference lubricating oil and the sample lubricating oil, and carry out no less than 5 cycles of pre-running in accordance with the cycle specified in Table 3. After the lubricating oil aging treatment is completed, carry out the vehicle performance road comparison test.

6.2.4 Chassis dynamometer test of vehicle performance

6.2.4.1 Test conditions

6.2.4.1.1.1 The test vehicle and test sequence shall comply with the stipulations of 6.2.3.1.1.

6.2.4.1.1.2 Vehicle preparation, chassis dynamometer settings, environmental conditions, test fuel, test procedures and test vehicle speed deviation shall comply with the stipulations of Appendix C in GB 18352.6-2016.

6.2.4.2 Fuel consumption comparison test of vehicles operating under multiple operating conditions

6.2.4.2.1 The fuel consumption comparison test of vehicles operating under multiple operating conditions is only applicable to light-duty vehicles, and the test shall be carried out in accordance with the stipulations of GB/T 19233.

6.2.4.2.2 In accordance with Formula (6), calculate the standard deviation (σ) of the 95th percentile distribution of the three fuel consumption test data; compare the difference $\Delta Q_{\max}$ between the maximum value and the minimum value in the three fuel consumption test data with the value σ :

---If $\Delta Q_{\max}$ is not greater than σ , then, it passes the repeatability verification; take the average value of the three test data as the measured value of the fuel consumption under multiple operating conditions;

---If $\Delta Q_{\max}$ is greater than σ , then, it fails to pass the repeatability verification; the number of tests shall be gradually increased, until passing the repeatability verification.

$$\sigma = 0,063\overline{Q} \dots\dots\dots (6)$$

Where,

σ ---the standard deviation of the 95th percentile distribution, expressed in (L/100 km);

$\overline{Q}$ ---the arithmetic mean of the three fuel consumption test data, expressed in (L/100 km).

6.2.4.3 Emitted pollutant comparison test of vehicles operating under multiple operating conditions

6.2.4.3.1 The emitted pollutant comparison test of vehicles operating under multiple operating conditions is only applicable to light-duty vehicles, and the test and data processing shall be carried out in accordance with the stipulations of Appendix C in GB 18352.6-2016.

6.2.4.3.2 The emitted pollutant comparison test of vehicles operating under multiple operating conditions shall be carried out simultaneously with the fuel consumption comparison test of vehicles operating under multiple operating conditions.

6.2.4.4 Vehicle pre-driving and lubricating oil aging treatment

In accordance with the requirements for the use of fuel-saving products or technology, vehicle pre-driving or lubricating oil aging treatment shall be carried out in accordance with 6.2.3.5 or 6.2.3.6.

6.2.5 Actual operation test of vehicle fleet

The actual operation test and data processing of vehicle fleet shall be carried out in accordance with the stipulations of Appendix B.

6.2.6 Physical and chemical performance test of automobile oil-saving additives

6.2.6.1 Physical and chemical performance test of automobile fuel-saving additives

6.2.6.1.1 The copper corrosion test shall be carried out in accordance with the stipulations of GB/T 5096.

6.2.6.1.2 The compatibility test shall be carried out in accordance with the stipulations of Appendix C.

6.2.6.2 Physical and chemical performance test of automobile engine lubricating oil-saving additives

6.2.6.2.1 The determination of moisture content shall be carried out in accordance with the stipulations of GB/T 260.

Appendix B

(normative)

Test Method for Actual Operation of Vehicle Fleet

B.1 Test Conditions

B.1.1 Test route

The test route shall select a fixed passenger transport route. The road is paved with asphalt or concrete, and there should be no construction section.

B.1.2 Vehicles

B.1.2.1 The technical management of the vehicle fleet shall comply with the stipulations of JT/T 1045.

B.1.2.2 Vehicles of the same brand in the passenger transport route shall be selected. The vehicle type, power transmission system and after-treatment system shall be the same. The initial mileage of the vehicle shall not be less than 30,000 km and the maximum initial mileage difference shall not exceed 100,000 km.

B.1.2.3 Before and during the test, the test vehicles shall be inspected and maintained in accordance with the period specified by the vehicle manufacturer, and the vehicles shall have no fault alarms or fault codes. Vehicle mileage, work content and replacement parts during the inspection and maintenance shall be recorded.

B.1.2.4 Divide the test vehicles into a group not using the fuel-saving product or technology and a group using the fuel-saving product or technology. At the end of the test, the number of valid test vehicles in each group shall be no less than 5.

NOTE: in order to ensure that there are no less than 5 valid test vehicles in each group at the end of the test, the initial number of vehicles shall be appropriately increased in accordance with the historical data of abnormal vehicle operation in the fleet.

B.1.2.5 Before the test, the correction coefficient for the odometer indication value of all test vehicles shall be confirmed. The correction coefficient of the odometer indication value is calculated in accordance with Formula (B.1):

$$\beta = \frac{l}{s} \dots\dots\dots (B.1)$$

Where,

β ---the correction coefficient of odometer, rounded (off) to 3 decimal places;

l---the actual mileage, expressed in (km);

s---the mileage indication of the odometer, expressed in (km).

B.1.3 Fuel addition

B.1.3.1 Fuel that complies with the designations specified by the vehicle manufacturer shall be added, and gas stations with reliable supply quality and accurate computation shall be selected. When conditions permit, gas stations and fuel dispensers can be designated.

B.1.3.2 For each refuel, the refueling time, refueling mileage, refueling volume, fuel specification and refueling location shall be recorded. In case of special circumstances, for example, abnormal fuel volume, it shall be recorded in time, and the fuel consumption and mileage data corresponding to the next refueling shall be eliminated.

B.1.4 Drivers

B.1.4.1 The drivers shall have a driver's license of driving the test model for more than 3 years and be familiar with the passenger transport route.

B.1.4.2 The driver rotation shall be arranged in accordance with the daily operation, and the driving time, mileage, vehicle condition and abnormal road conditions of each shift shall be recorded.

B.2 Operation Test

B.2.1 The two groups of test vehicles shall start and end the test on the same day, and the continuous operation shall not be less than 3 months; the effective mileage of each test vehicle shall not be less than 30,000 km.

NOTE: conduct inspection and maintenance in accordance with the period specified by the vehicle manufacturer, and the outage time caused by external uncontrollable factors is regarded as continuous operation.

B.2.2 Before starting the test, the fuel tank shall be filled with fuel, and the odometer reading shall be recorded as the initial mileage of the test.

B.2.3 The odometer reading, fuel filling volume and corresponding odometer reading, passenger capacity and weather (clear, cloudy, rainy, snowy, foggy, windy and air temperature) of each test vehicle shall be recorded daily.

B.2.4 From the beginning of the test and every 10,000 km $\pm$ 400 km, the test vehicles shall be subject to the comparison tests of emitted pollutants and subjective evaluation of dynamic performance. The emitted pollutants of gasoline vehicles shall comply with the requirements of GB 18285-2018, and the emitted pollutants of diesel vehicles shall comply with the requirements of GB 3847-2018. In the comparison test of subjective evaluation of dynamic performance, the driver participating in the test shall conduct a comparative subjective evaluation on the two groups of test vehicles and adopt the rating method specified in Table

Appendix C

(normative)

Test Method for Automobile Fuel-saving Additives and Fuel Compatibility

C.1 Test Principle

Prepare the fuel-saving additives and fuel oil into mixed fuel. After centrifugal operation, there shall be no stratification, turbidity or precipitation.

C.2 Test Instruments

C.2.1 Conical flask: with a stopper, 250 mL.

C.2.2 Centrifuge tube: 50 mL, 2 PCS.

C.2.3 Oven: the temperature control range is $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

C.2.4 Centrifuge: it can rotate 2 or more centrifuge tubes to generate a relative centrifugal force of $600\text{ g} \sim 700\text{ g}$.

C.2.5 Constant-temperature bath: the temperature control range is $50\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

C.2.6 Low-temperature bath: the temperature control range is $-40\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

C.3 Test Procedures

C.3.1 Clean the conical flask and centrifuge tubes, then, use distilled water to rinse them and dry them.

C.3.2 In accordance with the recommended dosage of the product, prepare the additives and fuel oil into 200 mL mixed fuel in the conical flask.

C.3.3 Put on the stopper and shake the conical flask for 1 min.

C.3.4 Respectively pour 50 mL of mixed fuel into the two centrifuge tubes.

C.3.5 Put the two centrifuge tubes into the symmetrical positions of the centrifuge.

C.3.6 Turn on the centrifuge. At a relative centrifugal force of $600\text{ g} \sim 700\text{ g}$, operate it for 30 min, then observe the state of the mixed fuel. The centrifuge speed shall be calculated in accordance with Formula (C.1):

$$n = 1\,337 \sqrt{\frac{f_{\text{ref}}}{d}} \dots\dots\dots (C.1)$$

Where,

Appendix D

(normative)

Test Method for the Stability of Engine Lubricating Oil-saving Additives

D.1 Test Principle

Prepare the lubricating oil-saving additives and the lubricating oil into mixed lubricating oil. After centrifugal operation, there shall be no stratification, turbidity or precipitation.

D.2 Instruments and Materials

D.2.1 Conical flask: with a stopper, with a capacity of 250 mL.

D.2.2 Centrifuge tube: 50 mL, 2 PCS.

D.2.3 Oven: the temperature control range is $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

D.2.4 Centrifuge: it can rotate 2 or more centrifuge tubes to generate a relative centrifugal force of $600\text{ g} \sim 700\text{ g}$.

D.2.5 Constant-temperature bath: the temperature control range is $93\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

D.2.6 Petroleum ether: analytical pure reagent, with a boiling range of $90\text{ }^{\circ}\text{C} \pm 120\text{ }^{\circ}\text{C}$.

D.3 Test Procedures

D.3.1 Clean the conical flask and centrifuge tubes, then, use distilled water to rinse them and dry them.

D.3.2 Add 200 mL of lubricating oil and 20 mL of petroleum ether into the conical flask. The lubricating oil additives shall be added in accordance with the recommended dosage of the product.

D.3.3 Put on the stopper and vigorously shake for 1 min.

D.3.4 Put the conical flask in the oven and maintain the temperature constant for 8 h.

D.3.5 Take out the conical flask and cool it to room temperature.

D.3.6 After vigorously shaking the conical flask for 1 min, respectively pour 50 mL of mixed lubricating oil into the two centrifuge tubes.

D.3.7 Put the centrifuge tubes into the constant-temperature bath and heat for 5 min.

D.3.8 Put the 2 centrifuge tubes into the symmetrical positions of the centrifuge.

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