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Additives for Vehicular M100 Methanol Fuel

M100 车用甲醇燃料添加剂

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Additives for Vehicular M100 Methanol Fuel

1 Scope

This Document specifies the technical requirements, test methods, inspection rules, marking, packaging, transportation, storage and safety of additives for vehicular M100 methanol fuel.

This Document is applicable to the production and inspection of additives for vehicular M100 methanol fuel.

2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 191 Packaging – Pictorial marking for handling of goods

GB/T 261 Determination of flash point – Pensky-Martens closed cup method

GB/T 338-2011 Methanol for industrial use

GB/T 508 Petroleum products – Determination of ash

GB/T 511 Petroleum products and additives – Determination of mechanical impurity

GB/T 514 Specification for liquid-in-glass thermometers for testing of petroleum products

GB/T 3190 Chemical composition of wrought aluminum and aluminum alloys

GB/T 3535 Petroleum products – Determination of pour point

GB/T 4756 Petroleum liquids – Manual sampling

GB/T 6324.9 Test methods of organic chemical products - Part 9: Determination of chloride

GB/T 6682 Water for analytical laboratory use – Specification and test methods

GB/T 7304 Petroleum products and lubricants – Determination of acid number –

actual batch of continuous production of the product is regarded as a batch, but the time for several production batches to form an inspection batch shall not exceed one week.

5.1.2 Sampling shall be carried out in accordance with the provisions of GB/T 4756; and the sample size shall be no less than the type inspection amount for inspection and sample retention.

5.2 Exit-factory inspection

This product shall be conducted exit-factory inspection. Only after passing the inspection and issuing the inspection report can it leave the factory. The exit-factory inspection items include appearance, pour point, flash point (closed), nitrogen content, phosphorus content, sulfur content, organic chlorine content, ash content (mass fraction) in Table 1.

5.3 Type inspection

The type inspection items are all the items specified in Table 1; and the sampling shall be carried out among the products that have passed the exit-factory inspection. In the case of normal production, the type inspection shall be carried out at least once a year. In one of the following situations, type inspection shall also be carried out:

- a) When a new product is put into production or when the product is finalized and identified;
- b) When raw materials, formulations or production processes changes, it shall affect product quality;
- c) When the production is resumed after continuous shutdown for more than 3 months;
- d) When there is a change in the main raw material supplier, which may affect the product quality;
- e) When there is a large difference between the exit-factory inspection result and the last type inspection result.

5.4 Judgement of results

The test results shall be carried out according to the rounded-off value comparison method in GB/T 8170. If one of the test results fails to meet the requirements, the barreled products shall be re-sampled and inspected from twice the number of packaging units; and the canned products shall be re-sampled and inspected at multiple points. If the re-inspection results still have unqualified items, the entire batch of products shall be determined to be unqualified.

6 Marking, Packaging, Transportation, and Storage

6.1 The product packaging container shall be painted with firm signs, the contents of which include but are not limited to:

Appendix A

(Normative)

Test Method of Rust resistance (Rust Degree) of Aluminum Sheet

A.1 Summary of method

Under the condition of $(38\pm 1)^\circ\text{C}$, completely immerse the aluminum sheet in a mixture of 30mL of methanol, 0.5% formic acid, 0.5% distilled water and 0.5% additive for vehicular M100 methanol fuel. Conduct a 15h test to observe the rust marks and the degree of rust on the aluminum sheet.

A.2 Instruments and equipment

A.2.1 Test tubes

Made of borosilicate glass, the outer diameter is 25mm, the length is 150mm, and the wall thickness is 1mm~2mm. The internal dimensions shall be such that the test aluminum sheet can be properly accommodated. When 30mL of the specimen liquid and the aluminum sheet immersed in it are placed in the test tube, the surface of the specimen liquid shall be at least 5mm higher than the upper surface of the aluminum sheet.

A.2.2 Test tube bath

The test tube bath shall be equipped with a suitable stand to support each test tube so that it is in a vertical position in the bath and the test tube is immersed in the bath to a depth of about 100mm (the distance from the bottom of the test tube to the surface of the bath). Either water or oil can be used as the test tube bath medium.

A.2.3 Temperature measuring device

It can stably monitor the test temperature of the test tube bath, and the measurement accuracy is $\pm 1^\circ\text{C}$ or higher. GB-48 total immersion thermometer in GB/T 514 meets the requirements of this method. When using this thermometer, the height of the mercury column exposed to the surface of the bath medium at the test temperature shall be no greater than 10mm.

A.2.4 Grinder fixture

The grinder fixture shall firmly clamp the aluminum sheet without damaging its edge, so that the surface of the aluminum sheet to be polished can be higher than the surface of the fixture, and any of such fixture can be used as a grinder fixture.

A.2.5 Tweezers

Tips are stainless steel or PTFE for gripping aluminum sheets.

A.4.1 Surface preparation

A.4.1.1 First use 00# or finer steel wool (cotton), or silicon carbide (aluminum oxide corundum) sandpaper or emery cloth with an appropriate particle size that can effectively achieve the desired effect, to remove the erosion left on the 6 surfaces of the aluminum sheet from the previous test. Further treatment with 65 μ m (p220) silicon carbide sandpaper or emery cloth to remove sanding marks left by other grades of sandpaper. Before final grinding, it shall be ensured that the aluminum sheet that has completed the surface preparation is no longer oxidized. After the metal shavings on the aluminum sheet can be wiped off with quantitative filter paper, the aluminum sheet is soaked in the washing solvent. The aluminum sheet can then be taken out for immediate final polishing, or can be stored in the washing solvent for later use.

A.4.1.2 Manual procedures for surface preparation: place a piece of silicon carbide or aluminum oxide (corundum) sandpaper or emery cloth on a flat surface, and moisten the sandpaper or emery cloth with washing solvent. Rub the aluminum sheet against sandpaper or emery cloth in a rotating manner. When taking out the aluminum sheet, use ash-free filter paper for protection or wear disposable gloves to prevent the aluminum sheet from coming into contact with fingers. Another method is to install dry sandpaper or emery cloth of appropriate grain size on a motor-driven machine, and use the machine to treat the surface of the aluminum sheet.

A.4.2 Polishing

For the new aluminum sheet prepared in A.4.1 or used for the first time, take it out of the storage place (such as from the washing solvent); in order to prevent the surface of the aluminum sheet from being polluted at the end of the polishing stage, direct contact aluminum sheet with fingers is not allowed, disposable gloves shall be worn or protected with ash-free filter paper. Use a piece of absorbent cotton moistened with the washing solvent, dip some 105 μ m (p150) silicon carbide or alumina (corundum) sand grains; first polish each end edge of the aluminum sheet; then polish the side; and then wipe vigorously with a new absorbent cotton ball. During the subsequent processing, the fingers shall not touch the surface of the aluminum sheet, and the aluminum sheet can be held with tweezers. The aluminum sheet is clamped on the grinder fixture, and the main surface of the aluminum sheet is polished with absorbent cotton dipped in silicon carbide or alumina (corundum) sand grains. Rotary motion shall not be used when grinding, and grinding shall be done back and forth along the long axis of the aluminum sheet. Before turning back in the direction, the grinding stroke shall exceed the end of the aluminum sheet. Rub the aluminum piece vigorously with a clean piece of absorbent cotton to remove all metal shavings until no more marks remain when wiped with a new piece of absorbent cotton. Immediately after the aluminum sheet is wiped clean, it is immersed in the prepared specimen.

A.5 Test procedures

A.5.1 Specimen preparation

The specimen shall be prepared according to the ratio of methanol to 0.5% formic acid and 0.5% distilled water (blank test); methanol to 0.5% formic acid, 0.5% distilled water and 0.5%

additive for vehicular M100 methanol fuel by mass fraction.

A.5.2 Test procedures

Pour 30mL of the specimen into a clean, dry test tube. After completing the final grinding procedure of the aluminum sheet, slide the aluminum sheet into the test tube and dip into the specimen. Stopper the test tube with a cork. If more than one specimen to be tested is determined at the same time, it is allowed to prepare each specimen one by one, as long as the interval between the first and the last specimen is kept to a minimum. Plug each test tube one by one with a stopper; and then immerse each test tube in a bath at $(38\pm 1)^\circ\text{C}$. During the test, strong light shall be prevented from irradiating the contents of the test tube to prevent the stopper from falling off. After the test tube is placed in the bath for $15\text{h}\pm 5\text{min}$, take out the test tube; take out the aluminum sheet with tweezers; let it drip dry; and then clean it with petroleum ether.

A.6 Judgment of results

A.6.1 After the test, observe under natural light (illuminance about 650 lx), if any rust spots or rust marks can be observed, it is judged as rust; wipe the surface with lint-free cotton cloth or toilet paper, if there are pits or the surface is rough, it shall be judged as rust.

A.6.2 In order to report whether the test sample is qualified or not, parallel tests shall be carried out. If, at the end of the test, both aluminum sheets are corroded, the test sample is reported to have failed the test. If one aluminum sheet is corroded and the other is not corroded, then test the two aluminum sheets again; in the retest test, if the neither the two aluminum sheets are corroded, report that the test sample has passed the test.

A.6.3 The degree of rust is observed under natural light, and the classification is as follows:

- Mild corrosion: there are no more than 6 rust spots, and the diameter of each rust spot is less than 1mm;
- Moderate corrosion: more than 6 rust points, but less than 5% of the surface area of the test piece;
- Severe corrosion: the rust spots exceed 5% of the surface area of the test piece.

A.6.4 The retest test shall be carried out with new aluminum sheets.

A.7 Report

The report should contain the following:

- a) Inspection organization;
- b) The inspected organization;

B.1.2 The engine bench and measurement and control system can accurately control the test boundary conditions and engine operating conditions, and collect test data as required.

B.1.3 The working cycle of the engine consists of two working conditions. In the first working condition, the engine speed is 5600r/min, the engine torque is 14.3N•m, and it runs for 20 min; in the second working condition, the engine speed is 4200r/min, the engine torque is 14.3 N•m, and it runs for 10 min. The transition time between the two working conditions is 15s; a complete cycle time is 30min, the engine runs 240 cycles, and runs for a total of 120h.

B.2 Test equipment

B.2.1 Test site

B.2.1.1 Engine test site

There shall be engine exhaust system and ventilation system for cooling to facilitate the control of air inlet parameters.

B.2.1.2 Methanol nozzle test site

The temperature and humidity of the nozzle flow measurement place shall be maintained at a relatively constant and appropriate level.

B.2.1.3 Total combustion deposit collection site

The sediment is sensitive to the environment; and the humidity and temperature of the sediment collection site shall be maintained at a relatively constant and appropriate level.

B.2.2 Test bench

B.2.2.1 General layout of the stand

The engine is connected to the dynamometer through an elastic coupling, and the engine angle is arranged according to the state of the entire vehicle. Engine accessories include generator and air compressor (no-load state); the generator shall be connected to the battery, and the battery only supplies power to the engine management system (EMS).

B.2.2.2 Dynamometer and control system

The dynamometer and control system used in the test shall meet the requirements of test parameters and working conditions in Table B.2.

The engine cooling system shall be able to control the coolant outlet temperature and flow according to the requirements in Table B.2. Add coolant as required by the cooling system.

B.2.2.8 Engine oil system

The engine oil control system shall be able to control the oil according to the requirements in Table B.2; and all connections shall be firm and reliable.

B.2.2.9 Blowby measurement system

The system is used to monitor the working state between the piston ring and the cylinder, and it shall meet the accuracy requirement of $\pm 5\%$.

B.2.2.10 Temperature sensor and location

Thermocouples can be Type-J, Type-T or Type-K. When installation, the end of the thermocouple shall be installed on the center line of the medium flow, inserted against the direction of the medium flow; and its range, accuracy, and measurement position shall meet the requirements in Table B.3.

B.2.2.11 Pressure sensor and location

When the pressure sensor is installed, the pressure measuring end is flush with the inner wall of the pipe. The measuring range, accuracy and position shall meet the requirements in Table B.4.

B.2.2.12 Flow sensor and location

The flow measurement system or sensor shall ensure the accuracy and resolution of the measurement; in the case of ensuring the accuracy, install the flow sensor at the most suitable position for using the measurement equipment.

B.2.2.13 Speed and load measuring equipment and location

The speed equipment shall meet the accuracy of $\pm 0.5\%$, and the load equipment shall meet the accuracy control requirements of $\pm 1\%$. The speed sensor and load sensor are installed according to the specific bench requirements.

B.2.2.14 Ignition advance angle measurement equipment

The ignition advance angle measurement equipment shall ensure the accuracy and resolution of the measurement, and read the data through the calibration equipment.

B.2.3 Engine and nozzle

Before assembly, each part shall be inspected according to the requirements of precision inspection, and only after meeting the requirements can it be assembled into a testing machine.

Each engine is used once.

B.2.4 Other equipment

B.2.4.1 Graduated cylinder

When adding additive for vehicular M100 methanol fuel to methanol (satisfying first-class and above industrial methanol in GB/T 338-2011) according to the volume concentration; it should use a measuring cylinder with a specification of 1000mL.

B.2.4.2 Balance

When adding additive for vehicular M100 methanol fuel to methanol (satisfying first-class and above industrial methanol in GB/T 338-2011) according to mass concentration, it shall use a balance with an accuracy of 0.01g and a maximum range of 2000g. When weighing the mass of the combustion chamber deposit, the accuracy of the used balance is 0.001g.

B.2.4.3 Nozzle flow test bench

The nozzle flow test bench shall meet the test requirements; the flow of the methanol nozzle can be measured repeatedly, which is used to test and evaluate the flow of the methanol nozzle. At the same time, the test bench shall meet the following requirements:

- a) The test fluid pressure is kept at (400 ± 10) kPa, and the temperature is kept at $(23\pm 2)^{\circ}\text{C}$;
- b) The power frequency is 60Hz, and the voltage is maintained at (13.5 ± 0.2) V.

B.3 Test accessories

B.3.1 Vehicular M100 methanol fuel

B.3.1.1 Test dosage

The engine running-in needs about 500L, and the working condition test needs about 1800L.

B.3.1.2 Requirements for vehicular M100 methanol fuel

The additive for vehicular M100 methanol fuel is evenly blended into vehicular M100 methanol fuel according to the manufacturer's ratio requirements and methanol (satisfying first-class and above industrial methanol in GB/T 338-2011). Before the blended fuel is loaded into the storage container, the storage container shall be cleaned with a small amount of blended fuel to ensure that the container is clean and pollution-free.

B.3.1.3 Engine oil

The lubricant shall match the test engine and meet the performance requirements of the test engine.

B.3.2 Engine coolant

The coolant that meets the LEC- II -40/LPC- II -40 model is filled with the test amount according to the specific bench requirements.

B.3.3 Nozzle test fluid

The fluid that satisfies first-class and above industrial methanol in GB/T 338-2011 as the test liquid.

B.4 Preparation before the test

B.4.1 Test bench preparation

B.4.1.1 Calibration of test bench and sensors

Calibrate at least every 10 tests or every six months, whichever comes first.

B.4.1.2 Installation and inspection of pipelines, pipeline connections, sensors and installation locations

Install various sensors and pipelines according to the requirements of B.2.2; check all pipelines, pipeline connections, probes and sensors, and the installation location of each sensor. There shall be no cracks, blockages, leakage, etc., and replace them if necessary.

B.4.2 Preparation of engine parts

B.4.2.1 Engine wiring harness inspection

Check whether the coil harness connector is installed in place and intact, and reassemble or replace it if necessary.

B.4.2.2 Methanol nozzle flow detection

The 2.5ms dynamic flow rate of the nozzle is tested for 3 times, and the nozzle is sprayed 3000 times for each test. Record each test value, take the average of 3 flow tests as the flow rate of the nozzle, and test according to GB/T 25363.

B.5 Test procedures

B.5.1 Engine running-in

Before the test, the engine shall be run-in for a total of 18 h. The engine running-in test shall meet the following requirements.

- a) The engine oil temperature is less than 125°C, the methanol temperature is (25 ± 2) °C, the intake air inlet temperature is (25 ± 2) °C, the coolant outlet temperature is (88 ± 2) °C, and the coolant inlet pressure is (55 ± 25) kPa. At the same time, record other parameters of

Stop the engine when the outlet water temperature and engine oil temperature reach 90°C. Remove the spark plugs of all cylinders, fully open the throttle, and use the reverse dragging method to measure, and the rotation speed is (250 ± 10) r/min; if the starter is used for dragging, the actual dragging speed of the starter, cylinder pressure, outlet water temperature and oil temperature shall be recorded.

B.5.2.3 Engine oil weighing

B.5.2.3.1 Stop the engine for 5 min after completing the test of B.5.2.2, drain the oil from the oil pan for 20 min, weigh and record the drained engine oil.

B.5.2.3.2 Refill the drained engine oil into the engine.

B.5.3 Operation during the test

B.5.3.1 Engine operating parameters

The engine operating and monitoring parameters during the test are shown in Table B.2.

B.5.3.2 Test running time

The test running time refers to the running time of the engine controlled by the parameters in Table B.2. Any uncontrolled running time cannot be counted as test time. When the engine is running in an uncontrolled state, it can be idling or in a test state, and the uncontrolled running time of the engine for each test shall not exceed 1h. Once the engine is switched to a controlled state, the test starts timing, and the test time is 120h (a total of 240 cycles).

B.5.3.3 Accumulative downtime

The accumulative downtime (including planned and temporary shutdown) during the test shall not exceed 10h.

B.5.3.4 Accumulative shutdown frequency

The accumulative shutdown frequency (including planned and temporary shutdowns) during the test shall not exceed 10 times.

B.5.3.5 Planned and temporary shutdown

Except for emergency situations, all shutdowns of the engine shall be carried out at the beginning of working condition 1.

B.5.3.6 Engine oil level check

The oil level may be checked occasionally during the test. Follow the procedures below.

- a) Shut down after entering working condition 1 of the test phase.

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