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of the People's Republic of China

GB/T 19055-2003

Replacing QC/T 525-1999

Reliability Test Methods for Motor Vehicle Engines

汽车发动机可靠性试验方法

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Foreword

Both of this standard and GB/T 18297-2001 *Performance test code for road vehicle engines* belong to the same series of national standards. And this standard is an important part of test methods of motor vehicle engines.

This standard shall replace QC/T 525-1999, from the implementation date.

Annex A of this standard is normative.

This standard was proposed by China Association of Automobile Manufacturers.

This standard shall be under the jurisdiction of National Automotive Standardization Technical Committee.

The drafting organization of this standard: Dongfeng Automobile Engineering Research Institute.

The main drafters of this standard: Fang Dachun, Wu Xinchao, Rao Rulin, Bao Donghui, and Zhou Mingbiao.

The previous editions replaced by this standard are:

- JBn 3744-84, QC/T 525-1999.

Introduction

On the basis of long time application experience of JBn 3744-84 i.e., QC/T 525-1999 *Reliability Test Methods of Motor Vehicle Engines*, with the reference to the state-of-the-art overseas technologies, this standard was stipulated.

Compared with QC/T 525-1999, the main technical modifications of this standard are as follows:

-- Extend the scope of application of this standard. Not only is it suitable for gasoline and diesel engines; but also suitable for engines fuelled with natural gas, LPG and alcohol fuel;

-- Modify the reliability test specifications. For the vehicle engine with the max total mass of less than 3.5 t, adopt the alternating load test specifications that are more approaching to the use operating mode; for the one with max total mass of 3.5 t – 12 t, adopt the mixed load test specifications to improve the lubrication state. The thermal shock test was conducted only on the compression ignition engine in the past. Now it is extended to the spark ignition engine; and it is added with "Parking" mode, so as to increase the variation rate of temperature to which the parts and components can withstand;

-- Modify the limit of max piston air leakage at full load. First-time introduce the limit calculating formula that is suitable for non-supercharger, supercharger, supercharger inter-cooling machine at the different speed ranges, so as to make the evaluation to be more reasonable.

-- Modify the limit of oil/fuel consumption ratio (changed from 0.8% to 0.3%) at rated speed and full load, in order to enable the motor vehicle engines to meet the particulate emission limit requirements prescribed in the national emission standards;

-- List the "Processing of test results" as an independent chapter. Require to analyze and evaluate in detail the performance stability of complete engine, damage and wear of parts and components, etc.;

-- Add Annex A *Reliability evaluation methods of motor vehicle engines*, so as to make the evaluation to be more accurate and comprehensive;

-- In light of vehicle engine emission contaminant must meet the requirements of national emission standards, the special inspection will be conducted in accordance with the emission standards when certification. Thus this standard does not involve that.

Reliability Test Methods for Motor Vehicle Engines

1 Scope

This standard specifies the general reliability test methods of motor vehicle engines of complete vehicle on bench, including the load test specifications (such as the alternating load, mixed load and full-speed full-load), thermal shock test specifications and reliability evaluation methods.

This standard is applicable to the water-cooling engines of passenger and commercial vehicles, and not applicable to the engines of motorcycle and tractor. The engine is reciprocating type and rotor type one, free piston type engine exclusive. This standard covers the spark ignition and compression ignition engines; two-stroke and four-stroke engines; non-supercharger and supercharger (mechanical supercharging and turbo supercharging, water to air and air to air inter-cooling); and is applicable to the engines fuelled with gasoline, diesel fuel, natural gas, LPG and alcohol fuel.

Approval of new designed or important modified motor vehicle engines, approval of engines entrusted to manufacture and quality inspection of currently-produced engines are subject to the reliability test in accordance with the methods provided in this standard.

This standard is also acted as the technical basis of exchange between the engine and automobile manufacturers.

2 Normative references

The provisions contained in the following normative documents constitute provisions of this standard through reference in this text. For dated reference, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

GB/T 15089 Motor vehicle - Classification
GB/T 17754 Tribology terminology
GB/T 18297-2001 Performance test code for road vehicle engines

3 Terms and definitions

For the purposes of this standard, the terms and definitions defined in GB/T 17754 and GB/T 18297 and the following apply.

3.1 Valve sinkage

The distance of sinkage of valve into the valve seat in the axial direction of valve when the conical contact surface between the valve and valve seat wears during operating is referred to as valve sinkage.

3.2 Speed of maximum net power

The speed of engine at which the maximum effective power output of the vehicle accessories kit attached to engine (see Chapter 7 of GB/T 18297-2001) is obtained in case of no more than rated speed, the symbol is n_P.

3.3 Speed of maximum net torque

The speed of engine at which the maximum effective torque output of the vehicle accessories kit attached to engine (see Chapter 7 of GB/T 18297-2001) is obtained, the symbol is n_M.

3.4 Rated net power

The corrected effective power that is yielded by the vehicle accessories kit attached to engine (see Chapter 7 of GB/T 18297-2001) at rated speed and full load.

4 Test engine

Two test engines (A engine and B engine) shall conform to the technical conditions specified by the engine manufacturers concerned. All fasteners shall be tightened to specified value. The valve clearance shall be regulated to specified value. The lubricating oil, grease and sealant for current production shall be adopted.

5 General requirements

The accuracy of instrument used in test, the measuring position and calculation of test data are subject to the provisions provided in Chapters 4 and 5 of GB/T 18297-2001.

6 Control of general conditions

6.1 Fuel

The fuel designation is subject to the provision specified by the engine manufacturer concerned. The temperature of gasoline shall be controlled at 298 K±5 K; the temperature of diesel fuel shall be controlled at 311 K±5 K; and the temperature of other fuels shall be controlled in accordance with the provisions specified by the engine manufacturer concerned.

6.2 Oil

The oil designation is subject to the provisions specified by the engine manufacturer concerned. The temperature of oil shall be controlled between 363 K and 398 K or subject to the provisions specified by the engine manufacturer concerned.

6.3 Coolant

Soft water (both Ca and Mg contents are below 200 mg/kg) shall be adopted or the coolant specified by the engine manufacturer shall be adopted. The temperature of coolant shall be

if necessary.

10.2 Inspection per 1 h

Within 1 h, record in time the corrected maximum net torque, maximum net power, rated net power, ignition advance angle, fuel consumption, oil pressure and temperature, intake pressure and temperature inside intake pipe, exhaust temperature, fuel temperature, and maximum piston air leakage and running time (h) at full load operating mode. Plot them on the supervising curve on which the running time is acted as its abscissa. Record in time the corresponding speed of engine and air intake state, etc.

10.3 Inspection and maintenance per 24 h

10.3.1 After the engine shuts down and is placed for 16 min, use a measuring cup to refill the engine oil accurately up to the upper limit of oil dipstick. The weight of oil refilled is used to calculate the average oil/fuel consumption ratio of 24 h. Plot the values on the supervising curve. Other methods may also be applied to determine the oil consumption.

10.3.2 Check the oil leakage, water leakage and air leakage, inwards and outwards condition of engine. For example, the exhaust pipe breakage, flange joint air leakage and cylinder gasket sealing failure may result the emulsification of engine oil, water flowing into the cylinder barrel, and air blowing into the cooling system, etc. Keep the engine clean to provide the convenience to the leakage inspection.

10.3.3 Check the electrode and porcelain body of spark plug. If there are severe ablation and cracks, replace it with colder-level spark plug.

10.3.4 Go around and check the engine and test equipment. Check the fasteners, connections and pipelines, especially the hose. Check the tension of belt, and tighten it if necessary.

10.3.5 Check all heights of fluid level.

10.4 Inspection and maintenance per 96 h

10.4.1 Operate the engine at the idle speed. Sample the oil from the main oil passage. The first-time discharged oil shall be back to the oil sump. Sample a certain amount of oil again (it isn't counted to the engine oil consumption). After sampling, tightly close the valve. Analyze the oil sample. Determine its viscosity, percentage of insoluble matter, total acidity, total alkalinity, content of metal element, and appearance of grinding dust, etc.

10.4.2 Replace the engine oil and oil filter element.

10.5 Inspection and maintenance per 192 h

10.5.1 Measure the valve clearance and valve sinkage (do not measure the valve sinkage for engine B). And adjust its clearance to the specified value.

10.5.2 Measure the compression pressure of cylinder when the starter drives. Find out the individual cylinder of which the cylinder pressure is much less than the mean pressure value of all cylinders. Place the throttle to the Full-Open position during measurement. And remove the spark plugs or injectors from all cylinders.

Annex A

(Normative)
Reliability evaluation methods of motor vehicle engines

A.1 In case that the engine has no significant structure damage, the actual duration of engine operation (h) shall meet the provisions prescribed in Table 1. The parts and components replaced during test shall reach its respective design service life.

A.2 During the engine operating, the drop of the corrected maximum net torque, maximum net power and rated net power shall not exceed the 5% of initial value.

A.3 The oil/fuel consumption ratio at rated speed and full-load shall not exceed 0.3%.

A.4 The maximum piston air leakage (B_{max}) of four-strokes engine at full load shall not exceed its limit (B_L).

$$B_L = CV_t = 0.6\ \%\ V_H\ (n_r/2)\ r_r\ (298/Tm)$$

Where: C – Coefficient (set to 0.6 %);

V_t – The theoretical air auction amount of four stroke engine at rated speed under standard condition (L/min), i.e., inflation coefficient $\eta_v = 1$;

V_H – Engine displacement (L);

n_r – Rated speed (r/min);

r_r – The rate of absolute pressures of superchargers at rated speed and full load, i.e., the rate ($r_r=p_o/p_i$) of absolute pressure of compressor outlet p_o and the absolute pressure of compressor inlet p_i; suppose $r_r = 1$ for non-supercharger;

T_m – Intake temperature inside the intake manifold (K); assume T_m = 298 K for non-supercharger.

A.5 Evaluate the number of failure shutdown, time of first failure and average failure time during the reliability test.

A.6 On basis of the amount of looseness of tightening torque of fasteners, analyze the causes of looseness and its effect on the reliability and sealability of engine.

A.7 The engine shall not have the oil/fuel or water leakage, inwardly and outwardly; the air shall not enter into the negative pressure system of the engine. In the engine, the combustion air shall not whisk into the oil/fuel passage or water passage, fuel/water mixture, etc. Mainly evaluate the sealability of cylinder gasket, inlet/outlet pipe gasket, exhaust pipe, oil seal and other parts and components.

A.8 Evaluation of crack or breakage of parts and components

A.8.1 The severity of crack or breakage of parts and components is subject to the classification shown in Table A.1.

B	Low scratch	Few	Shallow	Not easy to feel it	Nil
C	Middle scratch	Medium quantity	Deep	Slightly feel it	It may have influence, but it doesn't result a failure
D	Severe scratch or damage	Many	Very deep	Feel it	It can result a severe failure

A.9.2 Differentiate the other wear types occurred on the parts and components of engine in accordance with the provisions of GB/T 17754, such as corrosion wear (cylinder liner–ring steering area, exhaust valve/exhaust valve seat conical surface, etc.), fatigue wear (tappet, bearing, gear surface, etc.), fretting wear (bearing steel back, flywheel forcing position, flywheel housing forcing position, wet cylinder liner rabbet, etc.), electric erosion (spark plug electrode, etc.) and cavitation erosion (water pump impeller, etc.).

A.10 Evaluation of friction pairs contact condition

The contact strip of main friction pairs (see paragraph 8.6 b) shall be in normal position. There is appropriate contact area, without the breakage of strip symptom.

A.11 Evaluation of parts and components' surface deposits

A.11.1 The deposits on surface of piston ring groove and ring shall be classified in accordance with Table A.5.

Table A.5 Classification of Deposits on Surface of Piston Ring Groove and Ring

Category	Severity	Appearance		Hazard
		Status of Ring and Ring Groove	Thickness of Deposit	
A	Slight deposit	Flexible ring	The deposit is almost invisible	Nil
B	Medium deposit	Active ring	There are a few of visible deposits which don't fully occupy the gap	Nil
C	Slightly serious deposit	Blunt ring (inflexible rotation)	There are many deposits which almost fully occupy the gap	It may result a failure
D	Severe deposit	Dead ring (not rotatable)	The deposits fully occupy the gap	It can result a severe failure

A.11.2 Analyze the deposits, oil sludge and paint films on the oil sump, hood and cover, upper surface of cylinder cover, piston, intake valve, cam and other surfaces. Evaluate the relationship BETWEEN the oil/fuel quality AND parts and components operating state.

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