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Specifications and Bench Test Methods of Automobile Propeller Shaft Assembly

汽车传动轴总成技术条件及台架试验方法

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Specifications and Bench Test Methods of Automobile Propeller Shaft Assembly

1 Scope

This Standard specifies the technical conditions and bench test methods for the cross shaft universal joint propeller shaft assembly (hereinafter referred to as the propeller shaft assembly).

This Standard is applicable to the propeller shaft assembly for light, medium and heavy vehicles and their refitted vehicles; the propeller shaft assembly for miniature vehicles and their refitted vehicle can be used as a reference.

2 Normative References

The following documents are essential to the application of 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 5671 General Purpose Lithium Lubricating Grease for Automobile

GB/T 9239.1-2006 Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances

GB/T 9239.14 Mechanical Vibration - Rotor Balancing - Part 14: Procedures for Assessing Balance Errors

JB/T 8925 Rolling Bearings - Automobile U-Joint Cross Assembly – Specifications

QC/T 484-1999 Automobile Paint Coating

QC/T 518 Tightening Torque for Automotive Threaded Fasteners

YB/T 5209 Electric-Welded Steel Tubes for Cardan Shaft

3 Terms and Definitions

3.1 Propeller shaft assembly

4 Technical Requirements

4.1 General technical requirements

4.1.1 The propeller shaft assembly shall be manufactured in accordance with the drawings and technical documents approved by the prescribed procedures.

4.1.2 The universal joint cross shaft assembly shall comply with the relevant provisions of JB/T 8925.

4.1.3 Electric-welded steel pipes for propeller shaft assembly shall refer to the relevant provisions of YB/T 5209.

4.1.4 The parts used for assembly shall be cleaned before assembly.

4.1.5 The appearance of the propeller shaft assembly and the machined surface of the parts shall not have defects such as burrs, bumps, rust, creases, distortions, cracks, etc.

4.1.6 The welding quality of the welded joints of the propeller shaft assembly and shaft pipe shall be reliable; the size of the welding seam shall meet the requirements of the drawing; the appearance of the welding seam shall be smooth and uninterrupted; and there shall be no defects such as false welding, slag inclusion, etc.

4.1.7 When assembling, it shall not be missed or wrongly installed; the connecting fasteners shall be firm and reliable; and the tightening torque shall comply with the provisions of QC/T 518.

4.1.8 For the universal joint of pressure plate structure; the protruding part of its back plate shall be embedded in the groove of the outer end face of the bearing bowl; and the fixed locking piece shall be locked with the fastening bolts on the pressure plate. For the universal joint with snap ring structure, the snap ring shall be fully embedded in the ear hole grove or the outer groove of the bearing bowl.

4.1.9 When assembling the propeller shaft assembly, if there is a grease nipple on the cross shaft, it shall be on the same side as the grease nipple on the spline pair.

4.1.10 The universal joints at both ends of the propeller shaft assembly shall be on the specified phase plane; and the deviation shall be no greater than 3°.

4.1.11 After the sliding spline pair is assembled, it shall be able to slide axially within the working length range required by the design, and there shall be no jamming phenomenon.

4.1.12 After the propeller shaft assembly is assembled, when it rotates along the conical surface movement trajectory formed by the angle of the universal joint in the

forward and reverse directions, the universal joint shall work smoothly, and there shall be no jamming phenomenon. The angle of the universal joint shall meet the design requirements.

4.1.13 After the propeller shaft assembly is assembled, 100% of the residual unbalance test shall be done. Weld the balance sheet at both ends of the propeller shaft assembly to correct the unbalance. The balance sheet shall be welded firmly, with no more than 3 pieces at each end. The residual unbalance of the propeller shaft assembly for highway vehicles shall be no lower than the G16 balance quality level specified in GB/T 9239.1-2006; and the residual unbalance of the propeller shaft assembly for off-highway vehicles shall be no lower than the G40 balance quality level specified in GB/T 9239.1-2006 (see Appendixes A and B).

4.1.14 The balance error shall be checked in accordance with the provisions of GB/T 9239.14. After the dynamic balance test is completed, the phase of the propeller shaft assembly shall be rotated 180° and re-installed for double balance detection; and the measured value shall not exceed 1.5 times the allowable value.

4.1.15 The non-assembled surface of the propeller shaft assembly shall be painted according to the TQ6 coating specification in QC/T 484-1999 or user requirements.

4.1.16 The assembly surface of the propeller shaft assembly shall be rust-proof.

4.1.17 The propeller shaft assembly shall be marked with a permanent assembly mark and identification code at an obvious assembly location.

4.1.18 Before the propeller shaft assembly leaves the factory, all lubricating parts shall be filled with lithium-based grease for automobiles in accordance with the provisions of GB/T 5671; and other greases not lower than the above-mentioned standards can also be filled.

4.1.19 After the propeller shaft assembly is assembled, the intermediate support bearing shall rotate flexibly.

4.1.20 It is recommended that the universal joint angle of the propeller shaft assembly shall not exceed 5° when the vehicle is fully loaded.

4.2 Performance requirements

4.2.1 Static runout

It shall meet the requirements of product drawing technical conditions.

4.2.2 Torsional clearance

It shall meet the requirements of product drawing technical conditions.

4.2.3 Residual unbalance

It shall meet the requirements of product drawing technical conditions.

4.2.4 Critical speed

The critical speed shall be calculated according to Formula (4) as follows:

$$n_t > \frac{1.05 n_{emax}}{0.7 i_{min}} \quad \cdots\cdots (4)$$

Where:

n_t – the measured value of the critical speed, in r/min;

n_{emax} – the maximum speed of the vehicle power source, in r/min;

i_{min} – the minimum total speed ratio from vehicle power source to the propeller shaft assembly;

1.05 – overspeed coefficient of vehicle power source;

0.7 – safety coefficient of critical speed.

4.2.5 Static tortional stiffness

It shall meet the requirements of product drawing technical conditions.

4.2.6 Static tortional strength

The safety coefficient, n_s, of the static tortional strength shall be greater than 1.5.

4.2.7 Tortional fatigue

The minimum life value of the propeller shaft assembly fatigue test shall be no less than 200 thousand times.

4.2.8 Wear of universal joint

The minimum life value in the universal joint wear test shall be no less than 1.5 million times. After the test, the evaluation objects of the sample include the diameter of the cross shaft, the needle roller and the outer ring of the bearing. When the maximum size of pitting or peeling on the friction surface exceeds 2mm, the sample is judged to have wear failure.

4.2.9 Wear of sliding spline

The minimum life value in the sliding spline wear test shall be no less than 150

Key:

1 – loading and testing device;

2 – test piece.

Figure 6 – Schematic Diagram of Torsion Machine

6.5.2 Test procedures

The test procedures are as follows:

a) Install the datum plane of the propeller shaft assembly on the test bench according to the standard state;

b) Pre-torque the propeller shaft assembly according to the force direction of the propeller shaft assembly when the vehicle is driven forward, pre-torque to the rated torque and then unload to 0 N • m;

c) Load the propeller shaft assembly to the rated torque in the pre-torque direction, then unload to 0 N • m; and collect the test angle torque data to calculate the static torsional stiffness of the propeller shaft assembly.

6.6 Static torsional strength test

6.6.1 Testing device

The testing device refers to the torsion machine shown in Figure 6.

6.6.2 Test procedures

The test procedures are as follows:

a) Install on the datum plane of the propeller shaft assembly on the test bench according to the standard state;

b) Pre-torque the propeller shaft assembly according to the force direction of the propeller shaft assembly when the vehicle is driven forward; pre-torque to the rated torque and then unload to 0 N • m;

c) Slowly load the propeller shaft assembly in the pre-torque direction; the loading rate shall be no greater than 30°/min, until the propeller shaft assembly is damaged (broken or the shaft tube is obviously yielded and deformed); collect the angle torque data, and draw the angle torque curve.

6.7 Torsional fatigue test

6.7.1 Testing device

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