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Bolt tension test procedure for automotive threaded joints - Ultrasonic piezoelectric ceramics method

汽车紧固连接螺栓轴力测试 超声波压力压电陶瓷片法

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1 Scope

This document specifies the requirements for test preparation, test methods, data processing, test reports, for the ultrasonic piezoelectric ceramics method of bolt tension test procedure for automotive threaded joints.

This document applies to M6 ~ M27 bolts.

2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for dated references, only the version corresponding to the date applies to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 16823.2-1997 General rules of tightening for threaded fasteners

GB/T 16823.3-2010 Fasteners - Torque/clamp force testing

3 Terms and definitions

The terms and definitions, which are defined in GB/T 16823.2-1997, as well as the following terms and definitions, apply to this document.

3.1

Bolted joint

An assembly, which is composed of threaded fasteners and connected parts.

[Source: GB/T 16823.2-1997, 3.1]

3.2

Yield clamping force

The axial force, at which the bolt reaches yield, when tightened.

[Source: GB/T 16823.2-1997, 3.1]

3.3

Yield tightening torque

The torque, at which the yield clamping force is reached, when tightening.

[Source: GB/T 16823.2-1997, 3.1]

3.4

Ultimate clamping force

Maximum axial force, during tightening to bolt breakage.

[Source: GB/T 16823.2-1997, 3.1]

4 Test preparation

4.1 Requirements of test devices

4.1.1 Torque angle sensor

The allowable error of torque measurement shall be ±2%; the allowable error of angle measurement shall be ±1°.

4.1.2 Axial force sensor

The allowable error of the axial force sensor measurement shall be ±1%.

4.1.3 Ultrasonic measuring device

The data collection frequency shall not be lower than 1000 Hz; the signal is sensitive; the display resolution can distinguish the echo time difference of 0.1 ns. The measuring device shall contain a temperature compensation interface.

4.1.4 Piezoelectric ceramic sheet

The natural frequency of the piezoelectric ceramic sheet shall be between 2 MHz ~ 10 MHz.

4.1.5 Calibration pad

The calibration pad is used to adjust the clamping length during calibration; its rigidity shall comply with the provisions of 6.2 in GB/T 16823.3-2010.

4.2 Test samples

5.1.6 If there are no special requirements, the tightening tool shall be set, according to the actual assembly parameters. The torque-axial force-angle curve shall be recorded, after tightening.

5.1.7 It shall repeat the steps 5.1.1 to 5.1.6, to complete the test of all samples.

5.2 Residual axial force test of bolt

5.2.1 The number and state of the test samples shall be checked. If the temperature changes, after the connection point is verified, by dynamic load, THEN, it shall be allowed to stand for a long enough time, to ensure that it returns to the ambient temperature.

5.2.2 An ultrasonic test device shall be set up, to test the residual axial force of the bolt AND compensate for the temperature difference, between the bolt test and the environment when the echo is zero.

5.2.3 If the bolt is tightened, in the elastic region, by the torque method, it shall directly test the time difference of the current bolt echo; compare with the calibration curve when the bolt is tightened, to directly read the residual axial force.

5.2.4 If the bolt is tightened to the yield area, by the torque-angle method, the bolt shall be loosened, based on the current ultrasonic propagation time of the bolt, as the zero reference, to test the ultrasonic propagation time difference of the bolt, after loosening; take the absolute value. Then calibrate the bolt on the axial force sensor, to generate the calibration curve of the yielded bolt. Directly compare the residual axial force of the bolt, on the calibration curve, through the absolute value of the time difference.

6 Data processing

6.1 Test curve processing: For the convenience of data analysis, the torque-axial force-angle curve, which is recorded after the test, can be combined on one graph, AND aligned to the target torque or the torque at the starting point of the rotation angle, as shown in Figure 4.

6.2 The statistics of test data can be processed, according to the format of Table 2.

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