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TEST FOR EVALUATING THE TORQUE-TENSION RELATIONSHIP OF BOTH EXTERNAL AND INTERNAL METRIC THREADED FASTENERS

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1. SCOPE:

This standard provides a test method for determining the torque-tension relationship of both external and internal metric threaded fasteners for the purpose of measuring the frictional characteristics of the threaded fasteners. The results obtained by this test are relevant to the test conditions only and should not be utilized for specific applications.

1.1 The test shall consist of a single installation of the sample fastener in a test fixture using a constant speed power tool. The test sample shall be assembled onto an appropriate mating test part (i.e., a nut will be tested by being driven onto a test screw). The test sample shall be driven against a test washer as the bearing surface.

2. TEST MATERIALS:

2.1 Test Screws for Nut Testing:

Test screws shall correspond in size to the nut to be tested. The screws shall conform to the general requirements of ANSI 18.2.3.1M (ISO 4014) and heat treated in accordance with ASTM F568 (ISO 898/1), Property Class 10.9. Decarburization of the screw threads shall be within the limits defined in SAE J121M (ISO 898/1), Class 3/4 H. Screws shall be zinc electroplated to a thickness of 3 to 5 μm when measured on the hexagon flats.

Threads shall conform to ASME B1.13M (ISO 965), Class 6h tolerances and confirmed by ASME B1.3M, System 22, after plating. Threads on all screws M24 and smaller shall be rolled. The thread surface shall be free of burrs or other contamination that might affect an accurate determination of the performance of the nut.

The screw length shall be such that a minimum of two full form threads protrude through the nut when the nut is fully seated against the test washer. The thread length shall be such that a minimum of two full form threads are exposed within the grip length after the nut is fully seated. Refer to Figure 1.

A new test screw and test washer shall be used for testing each nut.

2.2 Test Nuts for Screw Testing:

Test nuts shall correspond in size to the screw to be tested. The nuts shall conform to the general requirements of ANSI B18.2.4.1M (ISO 4032) and heat treated in accordance with ASTM A563M (ISO 898/2), Property Class 10. Nuts shall be zinc electroplated to a thickness of 3 to 5 μm when measured on the hexagon flats. The thread surface shall be completely and uniformly zinc electroplated.

Threads shall conform to ASME B1.13M (ISO 965/1), Class 6H tolerances and confirmed by ASME B1.3M, System 22, after plating. The thread surface shall be free of burrs or other contamination that might affect an accurate determination of the performance of the bolt.

A new test nut and test washer shall be used for testing each screw.

2.3 Test Washer:

Test washers shall conform to the dimensional, metallurgical, mechanical and finish requirements given in Table 1.

For testing of nut and washer or screw and washer assemblies, the test washer may be unhardened mild steel. There shall be no relative motion between the assembled washer and the test washer.

Test strips may be used in place of a test washer provided the above requirements are satisfied.

A new test washer or bearing surface shall be used for each test sample.

3. TEST EQUIPMENT:

3.1 Torque Measuring Device:

The torque measuring device shall be a strain gage torque transducer. The accuracy of the torque measurement shall be within 2.0% of the torque being read at the drive speeds utilized.

3.2 Load Measuring Device:

The load measuring device shall be a tension test fixture with a dynamic load cell that has been specifically designed to measure fastener tension. The accuracy of load measurement shall be within 2.0% of the load being read at the drive speeds utilized.

3.3 Data Collection Device:

The data collection device shall have the capability to simultaneously record torque and tension. The sampling rate and frequency response of the recording system shall be such that, at the test speeds (RPM) specified in Section 3.4, the measurements of torque and load shall meet the accuracies specified in Section 3.1 and 3.2.

3.4 Drive Tool:

The drive tool shall be a fixtured constant speed tool power tool. The tool shall be capable of producing torques greater than the requirements of the parts to be tested and must be able to maintain a continuous speed of 100±10 RPM for the duration of the test. For parts greater than M16, the speed shall be 30 ± 3.0 RPM.

Sockets shall not be allowed to contact the test washer during the rundown.

4. TEST PROCEDURE:

4.1 Loosely assemble by hand the test sample, the appropriate mating test part and the test washer into the test fixture. The parts are to be installed such that the test sample can be driven by the drive tool and its bearing surface rotates against the test washer. The test washer must be prevented from turning during the rundown. Adjust the grip length of the test fixture such that when the parts are fully seated, the screw protrudes a minimum of two full form threads through the nut. A suitable fixture is shown in Figure 1.

4.2 Set the power tool to shut off at a torque approximately 2.0% greater than the maximum torque at clamp value (typically the clamp value is 75% of the proof load for the externally threaded fastener) allowed for the test sample.

4.2.1 Alternatively the tool may be set to shut off on a tension value approximately 1.0% greater than the clamp value. This method is preferred if this test is performed in conjunction with prevailing torque testing.

Tighten the joint by driving the test sample with the power tool at the appropriate speed for the sample being tested. Both torque and tension are to be recorded during the rundown.

5. DATA ANALYSIS:

5.1 Sample Size:

The sample size shall be as specified or as agreed to between manufacturer and purchaser.

5.2 Surrogate Test Samples:

In cases where actual parts can not be tested in this manner or for certification of a plating/finishing process, a surrogate part may be used. The requirements for the surrogate part are the same as defined for test screws in section 2.1 or test nuts in section 2.2 except that the specified plating/finish shall replace the zinc electroplate.

5.3 Results:

The torque required to achieve the specified clamp load in the load cell shall be between the values specified for the test sample. Typically these limits have been specified as absolute maximums and minimums. If statistical limits are to be applied, they must be defined in the specifications for the test sample.

6. REFERENCES:

ANSI 18.2.3.1M (ISO 4014)
ANSI B18.2.4.1M (ISO 4032)
ASME B1.13M (ISO 965/1)
ASME B1.3M
ASTM A563M (ISO 898/2)
ASTM F568 (ISO 898/1)
SAE J121M (ISO 898/1)

7. KEY WORDS:

Torque, Tension, Clamp, Load