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1999

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

LOCKING FASTENERS

IFI NOTE:

A number of new coatings have been introduced which have made it extremely difficult to establish torque-tension values for so called "standard coatings". Previously, cadmium, zinc, or phosphate were viewed as standard. However, with whole new families of coatings vying for application, the situation has changed significantly. To bring or restore order to this field, IFI has developed a standard which provides a test method to measure the frictional characteristics of fasteners being coated. Such a standardized test procedure, for example, is very useful in monitoring a given coating application process.

1. Scope

This standard provides a test method for determining the torque-tension relationship on both external and internal 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.

2. Referenced Standards

- ASME B1.13M - Metric Screw Threads – M Profile
- ASME B1.3M - Screw Thread Gaging Systems for Dimensional Acceptability of Metric Screw Threads
- ASME B18.2.4.1M - Metric Hex Nuts, Style 1
- ASME B18.2.3.1M - Metric Hex Cap Screws
- SAE J121M - Decarburization in Hardened and Tempered Metric Threaded Fasteners

3. Test Materials

3.1 Test Screws for Nut Testing. Test screws shall correspond to the size and strength level of the nut to be tested. Decarburization of the screw threads shall be within the limits defined in SAE J121M, Class 3/4 H.

Threads shall conform to ASME B1.13M, page A–20, Class 6g. Screws shall be zinc electroplated 3 µm thickness minimum, when measured on the hex flats. After plating the basic thread size shall not be exceeded when confirmed with a 6h GO ring gage as defined by System 21 of ASME B1.3M, page A–46. Threads on all screws M24 and smaller shall be rolled. The thread surface shall be clean, free of burrs, additional lubricant, 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 four full thread pitches as measured from the end of the bolt will 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 threads are within the grip after the nut is fully seated. Refer to Appendix A.

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

3.2 Test Nuts for Screw Testing. Test nuts shall correspond in size to the screw to be tested. The nuts shall be heat treated and conform to the requirements of ASME B18.2.4.1M, Property Class 10, page D–3. Nuts shall be zinc electroplated 3 µm thickness minimum, when measured on hex flats, the thread surface must be completely covered with zinc electroplating.

Threads shall conform to ASME B1.13M for Class 6H tolerances confirmed by System 21

of ASME B1.3M, after plating. The thread surface shall be clean, free of burrs, additional lubricant, or other contamination that might affect an accurate determination of the performance of the screw.

A new test nut shall be used for each screw tested.

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

For testing of captive nut and washer or screw and washer assemblies, the test washer shall be unhardened mild steel and shall conform to the dimensions of Table 1.

A new test washer shall be used for each test sample.

4. Test Equipment

4.1 Torque Measuring Device. The torque measuring device shall be a strain gage torque transducer. The uncertainty of the torque measurement shall be within 2.0% of the torque being read.

4.2 Load Measuring Device. The load measuring device shall be a tension test fixture with a load cell. The uncertainty of load measurement shall be within 2.0% of the load being read.

4.3 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 4.4 the measurements of torque and load shall meet the accuracies specified in Sections 4.1 and 4.2.

4.4 Drive Tool. The drive tool shall be a fixtured DC electric power tool or hydraulic motor device capable of meeting the continuous speed requirement and shut-off capabilities as specified. The tools 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.

5. Test Procedure

5.1 The test shall consist of one installation of the sample fastener in a test fixture using a constant speed power tool. For the test, 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.

5.2 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. In the event of dispute, the washer shall be placed such that its punch entry side is placed against the test specimen. Adjust the grip length of the test fixture such that when the parts are fully seated the screw protrudes a minimum of four full thread pitches through the nut. A suitable fixture is shown in Appendix A.

5.3 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 external fastener) allowed for the test sample.

5.3.1 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.

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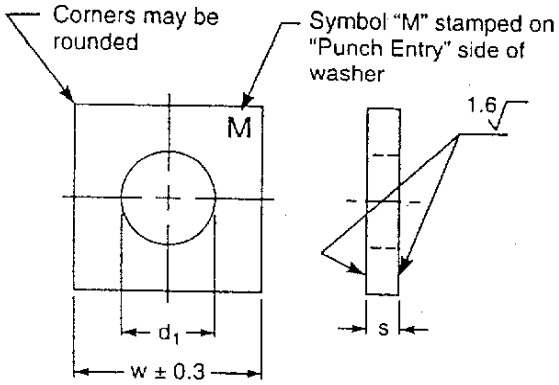

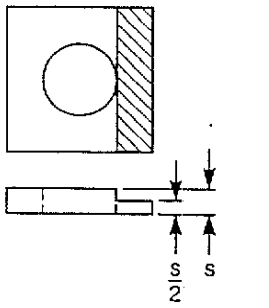

METHOD FOR CHECKING CORE HARDNESS

Table 1 Test Washers

Nominal Diameter of Test Bolt	Hole Diameter d_1		Width w	Thickness s Min
	Max	Min		
M5	5.9	5.8	15.7	1.8
M6	7.1	6.9	16.7	1.8
M8	9.5	9.3	19.7	1.8
M10	11.5	11.3	22.7	1.8
M12	14.0	13.8	29.3	2.9
M14	16.0	15.8	32.4	2.9
M16	18.0	17.8	36.1	2.9
M20	22.7	22.5	42.6	3.9
M24	26.7	26.5	55.5	3.9

NOTES:
1. All dimensions are in millimeters.
2. Material shall be carbon steel with a chemical composition of C 0.48 to 0.60 percent, Mn 0.60 to 1.50 percent, P 0.035 percent max, and S 0.045 percent max, through-hardened, quenched and tempered, with a surface hardness of Rockwell 15N85 to 88 (HV2.5 = 500 – 600) and a core hardness of Rockwell A73 min (HV30 = 450 min).
3. Both faces of the washer shall be unplated, clean and lubricant free unless otherwise specified by the purchaser. The faces must be flat and parallel within a tolerance zone of 4% of the specified minimum thickness.
4. Washers shall be free from burrs and sharp edges.

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.

6. Data Analysis

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

6.2 Surrogate Test Samples. In cases where the actual parts cannot be tested in this manner or for certification of a plating/finishing process, a surrogate part may be used. The requirements for the surrogate screw shall be as defined in ASME B18.2.3.1M, Metric Hex Cap Screws, page C–1, with the length being as required in Section 3.1. The requirements for the surrogate nut shall be as defined in ASME B18.2.4.1M, Metric Hex Nuts, Property Class 10, page D–3.

6.3 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.

APPENDIX A - Plan of a Test Fixture - Clamp Load Measuring Device

CLAMP LOAD MEASURING DEVICE