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TORQUE-TENSION TEST PROCEDURE FOR STEEL THREADED FASTENERS—INCH SERIES

Foreword—On some applications of threaded fasteners, it is desirable to control the amount of developed tension when a specific range of torque has been applied or the torque required to develop a specific range of tension. Accurate torque-tension relationships can be achieved only by uniquely defining and controlling the many related test parameters, such as: materials, their hardness and finish coatings, mating part interference fit, lubrication between both mated parts, the presence of foreign materials as rust, dust, and burrs, temperature and humidity, and whether the tightening is by hand or power tool turn nut or bolting wrenching.

1. Scope—This test procedure is intended to provide a quality control method for checking torque-tension characteristics of non-prevailing torque-type threaded steel fasteners 1/4 through 1 in nominal diameters. Realistically, torque-tension relationships for specific individual fastener assembly joints will vary due to the different joint parameters. Tests using actual joint components will be required to determine accurate torque-tension values for those conditions. For the metric version, see SAE J174M.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J174M—Torque-Tension Test Procedure for Steel Threaded Fasteners—Metric Series
SAE J429—Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J995—Mechanical and Material Requirements for Steel Nuts

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing
ASTM B 487—Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section

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3. *Test Material*

3.1 Test Bolt—When evaluating nuts, test bolts conforming to SAE J429, grade 8 requirements shall be used. Threads shall gage to the same class of fit as the nuts. Threads on all bolts shall be produced by rolling.

Bolts shall be free from burrs, loose scale, and contamination. This test procedure can be applied to test bolts with different finish coatings. But to compare torque-tension bolt quality results, various lots, and/or manufacturers, the finish shall be zinc phosphate and oil, meeting a 72-h salt spray life when tested in accordance with ASTM B 117.

NOTE—The lubricant shall neither be added or removed from the test material. It shall be dry to the touch as determined by Waterman #41 filter blot test.

3.2 Test Washer—Washer shall conform to the dimensional, metallurgical, and finish requirements given in Table 1. (See also Figure 1.) Optionally, clipped washers or multihole plates or strips may be used providing they conform to the previous requirements.

TABLE 1—TEST WASHERS—WASHER DIMENSIONS—INCHES

Nominal Fastener Size	Inside Dia A[1] ±0.005	Outside Dia B ±0.010	Width D ±0.012	Thickness C Max	Thickness C Min
1/4	0.281	0.750	0.656	0.080	0.073
5/16	0.344	0.875	0.776	0.080	0.073
3/8	0.406	1.000	0.892	0.080	0.073
7/16	0.469	1.125	1.018	0.080	0.073
1/2	0.531	1.312	1.152	0.121	0.114
9/16	0.625	1.500	1.274	0.121	0.114
5/8	0.688	1.625	1.422	0.121	0.114
11/16	0.750	1.687	1.500	0.121	0.114
3/4	0.812	1.750	1.678	0.160	0.153
7/8	0.969	1.875	1.916	0.160	0.153
1	1.025	2.000	2.184	0.160	0.153

1. The washer ID is intended for use with hex bolts and all nuts. To accommodate other bolts with larger under head fillet radii, washer hole diameter shall be increased proportionally to allow bearing surface of bolt head to seat.

NOTES:

1. All dimensions are in inches.
2. Square washers are preferred. Use of round washers is acceptable during a transition period to exclusive use of square washers.
3. Material shall be carbon steel with a chemical composition of C, 0.48-0.60%; Mn, 0.60-1.50%; P, 0.035% max; and S, 0.045% max; quenched and tempered, with a surface hardness of 85-88, and a core hardness of 73-78 HR A.
4. Washers shall be electrodeposited zinc plated to a coating thickness of 0.0002 to 0.0004 in and shall be subjected to no additional surface treatment. As soon as practicable following plating, washers shall be baked for 1 h at 375 °F ± 25 °F. Plating thickness shall be checked in accordance with ASTM B 487 (Microscopic Test).
5. Washers shall be free from burrs and sharp edges.

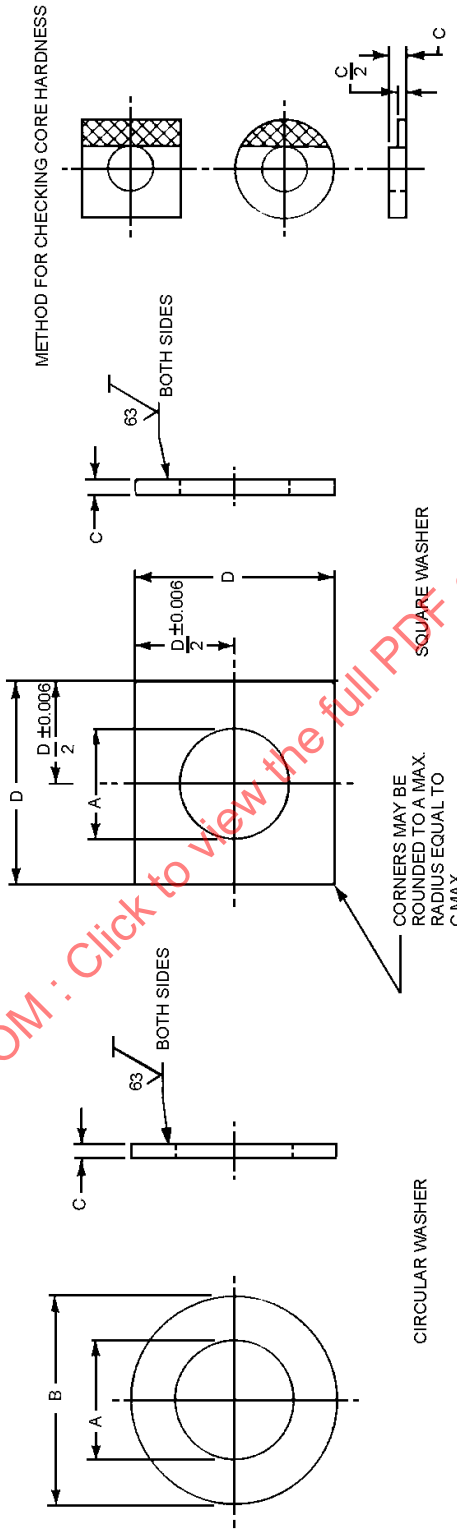

FIGURE 1—TEST WASHERS

3.3 Test Nut—When evaluating bolts, test nuts conforming to SAE J995, grade 8 requirements shall be used to evaluate bolts. Threads shall gage to the same class of fit as the bolt.

Nuts shall be free from burrs, loose scale, and contamination. Similar to test bolts, the test procedure can be applied to test nuts with different finish coatings. But to compare torque-tension nut quality results of various lots and/or manufacturers, the finish shall be zinc phosphate and oil, meeting a 72-h salt spray life when tested in accordance with ASTM B 117.

NOTE—The lubricant shall neither be added or removed from the test material. It shall be dry to the touch as determined by Waterman #41 filter blot paper test.

4. Test Equipment

4.1 Tension-Measuring Device—The tension-measuring device shall be capable of measuring the axial tension induced in the bolt as it is tightened. The device shall be accurate within ±3% of the test load.

4.2 Torque-Measuring Device—The torque-measuring device shall have an accuracy within ±2% of a given torque reading.

4.3 Test Socket Wrench—A socket with a hexagon configuration is preferred, features shall be provided within the socket to prevent the socket from contacting either the test washer or the threaded end of the bolt.

4.4 Test Spacer (If Required)—The test spacer (used only for testing bolts) shall be placed under the nut. The spacer must be hardened to 52 HRC minimum and the faces shall be parallel to each other and perpendicular to the axis within 0.0005 in/in. The spacer hole diameter shall be equivalent to Table 1, dimension A, and minimum spacer wall thickness shall be equivalent to one-half the bolt diameter. A feature of preventing the nut and spacer from rotating shall be provided.

5. Test Method

5.1 Testing Bolt—The bolt, as received, shall be inserted in the tension-measuring device with the test washer placed under the bolt head. The test nut and spacer, if required, shall be assembled onto the bolt by turning the bolt head until the bolt is seated against the hardened washer. The test shall be such that a minimum of two threads protrude through the nut. The bolt shall then be continuously and uniformly tightened at a speed not to exceed 30 rpm with a torque-measuring device or equivalent means, until either the torque or the tension value, as required, is developed, at which time both torque and tension readings shall be recorded.

NOTE—The nut must not have engaged incomplete bolt threads.

During all tests, the test washer shall be prevented from turning and contacting bolt shank. A new bolt, nut, and washer shall be used for each test.

5.2 Testing Nut—To test a nut, the nut and bolt exchange positions and the previous procedure shall apply.

PREPARED BY THE SAE FASTENERS COMMITTEE