TEST PROCEDURE FOR THE LOCKING ABILITY PERFORMANCE OF NON-METALLIC LOCKING ELEMENT TYPE PREVAILING-TORQUE LOCK SCREWS

IFI 124 1987

IFI Notes:

1. *IFI-124 is a standard developed through the procedures of the Industrial Fasteners Institute. IFI-124 is under the jurisdiction of IFI Divisions II and IV and is the direct responsibility of their joint Lock Screw Technical Committee.*

2. *IFI-124 defines the testing of lock screws to determine their conformance with specified prevailing-torque requirements. While the standard was originally established for non-metallic insert type lock screws, it does not preclude other types of lock screws, e.g. all-metal screws with a "designed-in" distortion of their threads, providing such screws meet the test requirements.*

3. *IFI-124 was first published in 1973. It was extensively reviewed in 1982 and again prior to the issuance of this 1987 edition.*

1.0 Scope.

1.1 Scope. This standard establishes a conformance test procedure for the locking ability performance of prevailing-torque type lock screws, in nominal screw sizes No. 0 thru 1½ in., which utilize a non-metallic locking element (hereinafter called "lock screw").

While the requirements of this standard apply to non-metallic locking element type lock screws, it is not the intent to preclude alternate types of lock screws which totally satisfy the requirements of this standard.

(Note: "Lock" is a generic term used to identify the externally threaded products covered in this standard. The terms "lock" and "locking" are not intended to imply an indefinite permanency of fixity.)

The prevailing-torque values given in this standard are conformance requirements for lock screws and apply only to the combination of test conditions described in the locking ability test procedure (4.1). If the conditions of the actual service application differ from those of 4.1 (e.g., internally threaded hole in a different material, length of thread engagement, class of internal thread tolerance, speed of driving, different plating or coating on screw or mating part) the prevailing-torque values may vary. Such values can only be determined through testing the lock screw in its application.

This standard is not concerned with dimensional features such as head styles, or with other mechanical or performance capabilities such as strength properties, corrosion resistance, sealing, suitability for use in high or low temperatures, and/or consistency of torque-to-tension relationships during assembly. Such features and properties are covered in other standards and specifications and must be referenced when specifying a lock screw to assure that all of the service conditions of the particular engineering application are properly met.

(Note: The application of some non-metallic elements requires heating of an isolated area in the thread to approximately 600°F which may have an adverse effect on the mechanical properties of some products.)

1.2 Definitions.

1.2.1 A prevailing-torque lock screw is an externally threaded fastener which is frictionally resistant to rotation due to a self-contained prevailing-torque feature, and not because of a compressive load developed against the under head bearing surface of the screw or a tensile load developed in the shank of the screw.

1.2.2 Non-metallic locking element type prevailing-torque lock screws are metallic screws to which have been added a non-metallic insert or fused non-metallic substance in their threaded length. The design of the locking feature shall be in accordance with the practice of the manufacturer. Depending upon the amount of friction present because of surface finish and lubricants, the dimensional characteristics of the locking element may vary to achieve the performance requirements stated in Table 1.

2.0 Strength Grades.

2.1 Strength Grades. This standard covers only steel lock screws produced to meet the mechanical strength requirements of one of three basic strength grades, SAE J429 Grades 5 and 8, page B-50, and ASTM A574, page G-34.

3.0 Requirements.

3.1 Finish. Lock screws shall be furnished plain or with a protective coating as specified by the purchaser.

At the option of the manufacturer, lock screws may be provided with a supplementary lubricant.

3.2 Threads.

3.2.1 *Thread Tolerances.* Threads of lock screws shall be Unified coarse or fine series, as specified in ANSI/ASME B1.1, page A-26, except that the portion of the threaded length containing the locking element need not conform. Unless otherwise specified, threads of lock screws shall have Class 2A tolerances prior to plating, except that lock screws of strength grade ASTM A574 of nominal sizes 1 in. and smaller shall have Class 3A tolerances.

3.2.2 *Thread Start.* Lock screws, except those covered in 3.3.2, shall assemble a minimum of one full turn by the fingers into any mating internally threaded component that is acceptable to Gaging System 21 of ANSI/ASME B1.3M, page A-53.

3.3 Locking Ability.

3.3.1 The prevailing torque of lock screws occuring during any installation or removal, shall not exceed the maximum prevailing torque specified in Table 1 when tested as specified in 4.1. In addition, the highest prevailing torques developed by lock screws during first and fifth removals shall not be less than the minimum first and fifth removal torques, respectively, specified in Table 1 when tested in accordance with 4.1. In addition, the lowest prevailing torque developed by lock screws during the fifth removal shall not be zero, when tested in accordance with 4.1.

3.3.2 Lock screws which are too short or which have thread lengths too short to permit testing in accordance with 4.1, shall have their prevailing-torque requirements and test procedure established by agreement between the purchaser and manufacturer.

3.4 When lock screws are altered in any manner by any source following shipment by the manufacturer to a purchaser, the screw manufacturer shall not be held responsible for failures of the lock screw to meet dimensional or performance requirements traceable to the alteration.

4.0 Locking Ability Test.

4.1 Test Procedure. A sample lock screw shall be assembled with a test washer (4.1.4) and a test nut (4.1.3) in a load measuring device (4.1.1) with the test washer located adjacent to the component to be turned. During the complete performance of the test, either the lock screw or the test nut shall be turned. When the lock screw is turned, the restraining mechanism shall be such that it imparts no radial distortion to the test nut. The lock screw or test nut shall be advanced until its bearing surface is seated against the test washer. The total thickness of spacer material in the test assembly shall be selected so that at seating the mid length of the locking element of the screw shall coincide as closely as practical with the mid thickness of the test nut, and a minimum length of lock screw equivalent to two thread pitches shall project through the top of the test nut. During this first installation the maximum prevailing (first on torque) torque occurring while the lock screw or test nut is in motion and prior to development of any axial load shall be measured and recorded.

Tightening shall be continued until an axial tensile clamp load equal to the load as specified in Table 1 for the applicable thread series and grade of lock screw is developed.

The axial tensile clamp load in the lock screw shall be reduced to zero by backing the screw or test nut off until the test washer is free to turn by the fingers. Following a pause (it is generally necessary to change the wrench to one of a lower torque capacity) removal shall be continued and the maximum torque (first removal torque) occurring while the lock screw or test nut is being backed off throughout the next 360 deg of rotation shall be measured and recorded. The lock screw and test nut shall be disassembled

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and then reassembled and disassembled four more times. On each reassembly the lock screw shall be assembled with the test nut until the turned element is seated against the test washer but no tensile load shall be induced in the lock screw. During the fifth removal, the highest torque (fifth removal torque) occurring while the lock screw or test nut is being backed off throughout the first 360 deg of rotation shall be measured and recorded. At no time during this 360 deg of rotation shall the torque be zero.

At no time during the four additional installations and removals should the prevailing torque exceed the maximum prevailing torque as specified in Table 1.

(Note: The intent of this last requirement is to demonstrate that galling between the sample lock screw and test nut has not occurred. With certain designs of lock screws there may be an increase in the prevailing torque during the five assembly cycles and in rare instances the specified maximum prevailing torque may be exceeded. In such instances the manufacturer, when requested, shall give evidence that galling was not a contributing factor.)

Sufficient time shall elapse between torquing cycles to prevent overheating of the test assembly.

Speed of driving shall not exceed 30 RPM.

4.1.1 *Tensile Load Measuring Device.* The tensile load measuring device shall be an instrument capable of measuring the actual tension induced in the lock screw as it is being tightened. The device shall be accurate within plus or minus 5 percent of the tensile clamp load to be induced. Diameter of the lock screw clearance hole in the backing plate shall be the lock screw nominal diameter plus 0.016 in. for screw sizes No. 10 and smaller, plus 0.031 for screw sizes 1/4 to 1 in., incl., and plus 0.062 in. for screw sizes 1-1/8 in. and larger.

4.1.2 Torque wrenches shall be accurate within plus or minus 2 percent of the maximum of the specified torque range of the wrench.

4.1.3 *Test Nut.* When testing lock screws in sizes No. 0 through No. 10, the test nut shall conform to dimensions given in Table 2. When testing coarse thread series lock screws in sizes 1/4 in. and larger, the test nut shall be a heavy hex nut, and when testing fine thread series lock screws in sizes 1/4 in. and larger, the test nut shall be a hex nut. Dimensions of both nuts shall conform with ANSI/ASME B18.2.2, page D-1. Thread tolerances of all test nuts shall be Class 2B when testing lock screws with Class 2A thread tolerances, and Class 3B when testing lock screws with Class 3A thread tolerances. Nuts shall be made of carbon steel, and shall have proof load strengths equal to or greater than the minimum specified ultimate strength of the lock screw being tested. (For guidance, refer to ASTM A563, page B-108.) Test nuts shall be free of rust and dirt, and shall have a plain (non-coated or plated) finish with oil coating. The screw shall be assembled into the countersunk side of the nut.

A new test nut shall be used for testing each lock screw. Prior to the use of the test nut its threads shall be gaged and shall be acceptable to the requirements of Gaging System 21 of ANSI/ASME B1.3M.

Table 2 Dimensions of Test Nuts

Nom Size or Basic Major Dia of Thread		Width Across Flats min	Thickness	
			max	min
No. 0	0.060	0.150	0.117	0.109
2	0.086	.180	.146	.138
4	0.112	.241	.194	.182
6	0.138	.302	.243	.231
8	0.164	.332	.243	.231
10	0.190	.362	.306	.294

NOTES:

1. Bearing surface shall be washer faced or with chamfered corners. Bearing surface shall be at right angles to axis of the threaded hole within a tolerance of 2 deg.
2. Tapped hole shall be countersunk on the bearing face or faces. The included countersink angle shall be 90 deg with a tolerance of plus or minus 5 deg. Countersink diameter at the bearing surface shall be the basic major diameter of the thread plus 0.020 in. for sizes No. 4 and smaller, and 0.031 in. for sizes No. 6 and larger. Tolerance on countersink diameter shall be plus or minus 0.010 in. for all sizes.

4.1.4 *Test Washer.* Washers shall be steel with dimensions, hardness and finish at option of testing agency.

5.0 Inspection.

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5.1 Inspection Procedure. Lock screws shall be inspected to determine conformance with this standard. Inspection procedures may be specified by the purchaser on the inquiry, purchaser order, or engineering drawing or shall be as agreed upon between the purchaser and supplier prior to acceptance of the order. In the absence of a defined agreement, the requirements of B18.18.2M shall apply.

Table 1 Prevailing Torques for Lock Screws — Coarse and Fine Thread Series

Nom Size of Screw and Threads Per Inch	Clamp Load lbs — Strength Grade of Screw			First On Prevailing Torque	First Removal Prevailing Torque	Fifth Removal Prevailing Torque
	SAE GR. 5	SAE GR. 8	ASTM A574	in. lb, max	in. lb, min	in. lb, min
0.060-80	115	160	190	0.75	1.5*	0.5*
0.086-56 0.086-64	235 250	330 355	390 410	2	3 *	1.5*
0.112-40 0.112-48	385 420	540 595	635 690	5	1	.5
0.138-32 0.138-40	580 650	820 910	950 1,060	8	2	1
0.164-32 0.164-36	900 940	1,260 1,330	1,470 1,540	12	2.5	1.5
0.190-24 0.190-32	1,120 1,280	1,580 1,800	1,840 2,100	18	3	2
0.250-20 0.250-28	2,020 2,320	2,850 3,260	3,220 3,680	40	5	3
0.312-18 0.312-24	3,340 3,680	4,720 5,210	5,300 5,870	85	8	5
0.375-16 0.375-24	4,950 5,590	6,980 7,880	7,880 8,900	110	14	9
0.438-14 0.438-20	6,790 7,580	9,600 10,600	10,800 12,000	150	20	12
0.500-13 0.500-20	9,080 10,200	12,800 14,400	14,400 16,200	220	26	16
0.562-12 0.562-18	11,600 13,000	16,400 18,300	18,400 20,600	270	35	22
0.625-11 0.625-18	14,400 16,400	20,300 23,000	22,900 26,000	350	45	30
0.750-10 0.750-16	21,300 23,800	30,100 33,600	33,800 37,800	460	60	45
0.875-9 0.875-14	29,500 32,500	41,600 45,800	46,800 51,500	700	95	65
1.000-8 1.000-12	38,600 42,300	54,500 59,700	61,400 67,100	900	130	85
1.125-7 1.125-12	42,400 47,500	68,700 77,000	77,200 87,000	1,050	150	110
1.250-7 1.250-12	53,800 59,600	87,200 96,600	98,200 109,000	1,150	200	140
1.375-6 1.375-12	64,400 73,000	104,000 118,000	117,000 134,000	1,300	240	150
1.500-6 1.500-12	78,000 87,800	126,000 142,000	142,000 160,000	1,500	280	185

* Torque values are in in. oz.