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

1. Scope.

1.1 This standard establishes a conformance test procedure for the locking ability performance of metric prevailing-torque type lock screws in nominal thread diameters M1.6 thru M36 inclusive, and which utilize a non-metallic locking element (hereinafter called "lock screw").

(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 differ. 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.

1.2 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 satisfy the requirements of this standard.

1.3 Definitions.

1.3.1 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.

1.3.2 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.

2. Property Classes.

2.1 **Property Classes.** This standard covers only steel lock screws produced to meet the mechanical strength requirements of one of four basic property classes, 8.8, 9.8, 10.9 and 12.9 as specified in ASTM F568, page B—1.

The standard sizes of lock screws for each of the four property classes are given in Table 1.

3. 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 tolerance class 6g as specified in ANSI B1.13M, page A—8, except that the portion of the threaded length containing the locking element need not conform.

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 has threads acceptable to Gaging System 21 of ANSI B1.3M, page A—35.

3.3 Locking Ability.

3.3.1 The prevailing torque of lock screws occurring 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 maximum prevailing torque developed by lock screws during first and fifth removals shall not be less than the minimum first and fifth removal

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Table 1 Prevailing Torques for Non-Metallic Locking Element Type Lock Screws

Nom Screw Size and Thread Pitch	Clamp Load (1) kN				Prevailing Torque	First Removal Prevailing Torque	Fifth Removal Prevailing Torque
	Property Class of Screw				max	min	min
	8.8	9.8	10.9	12.9	N·m	N·m	N·m
M1.6 × 0.35	—	0.6	—	0.9	0.10	0.01	0.004
M2 × 0.4	—	1.0	—	1.5	0.20	0.02	0.01
M2.5 × 0.45	—	1.6	—	2.5	0.40	0.05	0.03
M3 × 0.5	—	2.4	—	3.7	0.60	0.14	0.06
M3.5 × 0.6	—	3.3	—	4.9	0.90	0.22	0.11
M4 × 0.7	—	4.3	—	6.4	1.2	0.26	0.16
M5 × 0.8	—	6.9	8.8	10	2.3	0.36	0.23
M6 × 1	—	9.8	12	15	3.0	0.45	0.30
M8 × 1.25	—	18	23	27	10	0.90	0.58
M10 × 1.5	—	28	36	42	14	1.8	1.1
M12 × 1.75	—	41	52	61	21	2.6	1.5
M14 × 2	—	56	72	84	30	3.6	2.3
M16 × 2	—	76	98	110	40	5.0	3.4
M20 × 2.5	110	—	150	180	60	8.0	5.5
M24 × 3	160	—	220	260	90	13	8.5
M30 × 3.5	250	—	350	410	120	19	13
M36 × 4	370	—	510	590	150	28	18

NOTE:
1. Clamp loads equal 75 percent of the proof loads specified for the property class in ASTM F568, page B—1.

torques, respectively, specified in Table 1 when tested in accordance with 4.1. In addition, the minimum 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 screws to meet dimensional or performance requirements traceable to the alteration.

4. Locking Ability Test.

4.1 Test Procedure. The 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 torque (first on 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 specified in Table 1 for the applicable screw size and property class is developed.

The axial tensile clamp load in the lock screw shall be reduced to zero by backing the turned member off until the test washer is free to move by the fingers. Following a pause (it is generally necessary to change the wrench to one of a lower torque capacity), removal

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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 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 maximum 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 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 size plus 0.4 mm for screw sizes M5 and smaller, plus 0.8 mm for sizes M6 to M24 incl., and plus 1.6 mm for sizes M30 and M36.

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 classes 9.8 and 12.9 lock screws in sizes M2.5 and smaller, ASTM A563M class 10 nuts, page B—10, shall be used. When testing classes 8.8 and 9.8 lock screws in sizes M3 and larger, ASTM A563M class 9 nuts shall be used. When testing classes 10.9 and 12.9 lock screws in sizes M3 and larger, ASTM A563M class 12 nuts shall be used. ***(Note: class 10 nuts are hex, style 1, in conformance with ANSI B18.2.4.1, page D—1, and classes 9 and 12 nuts are hex, style 2, in conformance with ANSI B18.2.4.2, page D—5.)***

Test nuts shall be free of rust and dirt, and shall have a plain (non-coated or plated) finish with oil coating.

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

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

5. Inspection.

5.1 Inspection Procedure. Lock screws shall be inspected to determine conformance with the requirements of this standard.

Unless otherwise specified, from each lot of lock screws the following number of tests shall be conducted to determine the acceptability of each of the requirements:

Lot Size (pieces)	No. of Tests
to 50	2
51 to 500	3
501 to 35,000	5
over 35,000	8

A lot shall consist of all units of product of a single type, property class, size, length and material manufactured under essentially the same conditions and submitted for inspection at one time. Acceptance is based on all samples meeting the requirements of the test.

Alternate inspection procedures may be specified by the purchaser on the purchase order or engineering drawing.