

Test Methods for Metric Threaded Fasteners

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope

- 1.1** This standard establishes procedures for conducting tests to determine the mechanical properties of externally and internally threaded fasteners.
- 1.2** Property requirements and the applicable tests for their determination are specified in individual product standards. In those instances where the testing requirements are unique or at variance with these standard procedures, the product standard shall specify the controlling testing requirements.
- 1.3** This standard describes mechanical tests for determining the following properties:

For externally threaded fasteners:

Product hardness (Section 4.1)
Surface hardness (Section 4.2)
Proof load (Section 4.3)
Yield strength (Section 4.4)
Axial tensile strength (Section 4.5)
Wedge tensile strength (Section 4.6)
Elongation (Section 4.7)
Reduction of area (Section 4.7)

For internally threaded fasteners:

Product hardness (Section 5.1)
Proof load (Section 5.2)

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

SAE J417—Hardness Tests and Hardness Number Conversions

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

ASTM E 18—Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

2.1.3 ANSI PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 965/1—ISO general purpose metric screw threads—Tolerances—Part 1: Principles and basic data

3. **General Precautions**

3.1 Improper machining or preparation of test specimens may give erroneous results. Care should be exercised to assure good workmanship in machining. Improperly machined specimens should be discarded and other specimens substituted.

3.2 If any test specimen fails because of mechanical reasons such as failure of testing equipment or improper specimen preparation, it shall be discarded and another test specimen substituted.

4. **Test Methods for Externally Threaded Fasteners**

4.1 **Product Hardness**—For routine inspection, hardness of bolts, screws, and studs may be determined on head, end, or shank after removal of any plating or other coating and after suitable preparation of the specimen. For referee purposes, the hardness shall be determined at mid-radius of a transverse section through the threaded portion of the product taken at a distance of one diameter from the end of the product. For sizes smaller than M6 the reported hardness shall be the average of two hardness readings. For sizes M6 and larger, the reported hardness shall be the average of four hardness readings located at 90 degrees to one another. The preparation of test specimens and the performance of hardness tests shall be in conformity with the requirements of SAE J417.

4.2 **Surface Hardness**—Tests to determine surface hardness conditions shall be conducted on the ends, hexagon flats, or unthreaded shanks which have been prepared by lightly grinding or polishing to ensure accurate reproducible readings in accordance with SAE J417. Proper correction factors shall be used when hardness tests are made on curved surfaces, per ASTM E 18.

4.3 **Proof Load**

4.3.1 The proof load of a bolt, screw, or stud is the axially applied load which the product must withstand without permanent set.

4.3.2 The overall length of the specimen shall be measured between conical or ball centers on the centerline of the specimen, using mating centers on the measuring anvils. The specimen shall be marked so that it can be placed in the measuring fixture in the same position for all measurements. The measurement instrument shall be capable of measurement to 2.5 μm .

- 4.3.3 The grips of the testing machine shall be self-aligning to avoid side thrust on the specimen. For bolts and screws the specimen shall be assembled in the fixture of the tensile machine so that six complete threads are exposed between the grips. This is obtained by freely running the nut or fixture to the thread runout of the specimen and then unscrewing the specimen six full turns (two turns for products less than 3 D in length and threaded to within 2.5 thread pitches of the bearing surface). Typical fixturing is illustrated in Figure 1. When proof load testing sems, the washer may be removed prior to testing; however, for referee testing the washer shall be removed. When proof load testing studs one end of the specimen shall be assembled in a threaded fixture to the thread runout. For studs having unlike threads, this shall be the end with the finer pitch thread. For studs having unlike diameters (step studs), this shall be the end with the larger minor diameter. The other end of the stud shall likewise be assembled in a threaded fixture, except it shall be unscrewed six full turns from the thread runout, thus leaving six complete threads exposed between the grips (two turns for products less than 3 D in length and threaded to within 2.5 thread pitches of the bearing surface).

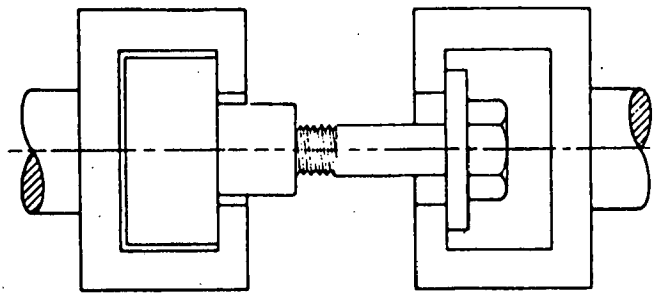


FIGURE 1—TENSILE TESTING OF FULL SIZE BOLT OR SCREW

- 4.3.4 The bolt, screw, or stud shall then be axially loaded to the proof load specified for the applicable size and class in the product standard, the load retained for a period of 15 s, the load removed, and the overall length again measured. The speed of testing, as determined with a free running cross head, shall not exceed 3 mm/min.
- 4.3.5 To meet requirements, the length of the specimen after loading shall be the same as before loading within a tolerance of 12.5 μm allowed for measurement error.
- 4.3.6 Variables, such as straightness and thread alignment (plus measurement error), may result in apparent elongation of the specimen when the proof load is initially applied. In such cases, the specimen may be retested using a 3% greater load, and may be considered satisfactory if the length after this loading is the same as before this loading within the 12.5 μm tolerance for measurement error.

4.4 Yield Strength

- 4.4.1 The yield strength of a bolt, screw, or stud is the stress at which the fastener exhibits a specified limiting deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain.
- 4.4.2 The yield strength test shall be set up as outlined in Section 4.3.3 using, however a machined product as shown in Figure 4. The speed of testing (determined with a free running cross head), shall not exceed 3 mm/min. Load shall be applied axially and as the load is applied the total elongation of the specimen or any part of the specimen which includes the six exposed threads shall be measured. Yield strength shall be determined by the offset method.