Designation: F1575/F1575M – 24

Standard Test Method for Determining Bending Yield Moment of Nails, Spikes, and Dowel-type Threaded Fasteners[1]

This standard is issued under the fixed designation F1575/F1575M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers procedures for determining the bending yield moment and calculation of bending yield strength (F_{yb}) of nails, spikes, and dowel-type threaded fasteners (referred to collectively as fasteners) when subjected to static loading. Bending yield strength is used in engineered connection applications, in which a required connection capacity is specified by the designer.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

NOTE 1—This test method is applicable in either inch-pounds F1575 or SI Units [F1575M]. Values stated in SI are a mathematical conversion of two significant digits and are shown in brackets [ ].

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E4 Practices for Force Calibration and Verification of Testing Machines

E2309/E2309M Practices for Verification of Displacement Measuring Systems and Devices Used in Material Testing Machines

F680 Test Methods for Nails

F1667/F1667M Specification for Driven Fasteners: Nails, Spikes, and Staples

2.2 *ASME Standards:*[3]

B18.2.1 Square, Hex, Heavy Hex, and Askew Head Bolts, and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (inch Series). 2012. The American Society of Mechanical Engineers, Three Park Avenue, New York, NY.

B18.6.1 Wood Screws. 1981 (R2008). The American Society of Mechanical Engineers, Three Park Avenue, New York, NY.

3. Terminology

3.1 *Definitions of Terms Related to All Fasteners of this Standard:*

3.1.1 *bending yield moment*—the moment determined from the yield load point on the load-deformation curve that is intermediate between the proportional limit load and maximum load for the fastener.

3.1.2 *bending yield strength*—the fastener strength characteristic used in yield limit equations to determine lateral capacity of connection; determined from the bending yield moment and dimensions of the fastener.

3.1.3 *certifying body*—an organization that is recognized through compliance with national standards for the purpose of product evaluation.

3.1.4 *proportional limit*—the load at which the load-deformation curve deviates from a straight line fitted to the initial portion of the load-deformation curve (Fig. 1).

3.1.5 *shank*—a portion of the fastener below the head, excluding the tip, which is embedded in the connected materials and the portion of the fastener engaged in a nut or similar anchorage device, if applicable.

[1] This test method is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.05 on Driven and Other Fasteners.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

3.1.6 *transition point*—the location of the transition from smooth shank to deformed shank on a partially deformed-shank nail or spike; the location of the transition from smooth shank to threaded shank or from a reamer knurl to threaded shank for a partially-threaded dowel-type fastener.

3.1.7 *yield load*—load at the intersection of the load-deformation curve and the 5 % offset line, or the maximum load if the load-deformation curve and 5 % offset-line do not intersect.

3.1.8 *yield theory*—the model for determining lateral load design values for dowel-type fasteners that specifically accounts for the different ways these connections behave under load. The capacity of the connection under each yield mode is determined by the bearing strength of the material under the fastener and the bending strength of the fastener, with the lowest capacity calculated for the various yield modes being taken as the design load for the connection.

3.2 *Definitions of Terms Related to Nails and Spikes of this Standard:*

3.2.1 *deformed shank*—a nail or spike shank that has been mechanically deformed with annular rings, barbs, helical flutes, etc. for the purpose of improved withdrawal capacity.

3.2.2 *fully deformed shank*—a nail or spike shank that has deformation along the entire length.

3.2.3 *partially deformed shank*—a nail or spike shank that has been mechanically deformed over a portion of the shank length.

3.3 *Definitions of Terms Related to Dowel-type Threaded Fasteners of this Standard:*

3.3.1 *critical diameter*—the minor diameter in the threaded portion of the fastener.

3.3.2 *dowel-type threaded fastener*—a nominally cylindrical fastener with threads, inserted into materials for the purpose of connecting pieces together. The dowel-type threaded fasteners addressed in this standard include standardized and proprietary screws, standard and self-drilling bolts, and similar fasteners.

3.3.3 *equivalent critical diameter*—a calculated dimension for a shank with non-circular minor diameter cross section that has the same plastic section modulus as a shank with a circular minor diameter.

3.3.4 *fully–threaded shank*—the shank of a dowel-type threaded fastener with a thread along the entire length of the shank.

3.3.5 *minimally-threaded shank*—the shank of a partially-threaded dowel-type fastener that is generally smooth and has a short threaded portion, typically less than three diameters in length, where the lateral load is resisted by the smooth shank.

3.3.6 *minor diameter*—the smallest diameter in the threaded portion of the body (D_{minor}).

3.3.7 *partially-threaded shank*—the shank of a dowel-type threaded fastener having one or more sections of shank that is (are) threaded and one or more sections of shank that is (are) unthreaded.

3.3.8 *reamer knurl*—a screw feature that is a shank deformation located between the smooth portion of the shank and the threaded portion of the shank that facilitates installation in some materials.

3.3.9 *thread*—a type of dowel deformation intended to be keyed into the receiving member, nut, or similar anchorage device by rotation of the fastener.

4. Summary of Test Method

4.1 The test procedure utilizes a three-point bending test where the span dimension is based on the nominal diameter of a nail or the critical diameter of a dowel-type threaded fastener. The load is applied at a constant rate and produces a continuous load-deformation response diagram (Fig. 1). The precision of the test and resulting calculated properties depend on the measurement of the applicable diameter and the positioning of the fastener on the test span supports.

5. Significance and Use

5.1 Nails, spikes, and dowel-type threaded fasteners are common mechanical fasteners in wood structures. Engineering design procedures used to determine the capacities of laterally-loaded connections with these types of fasteners rely on a yield theory to establish the nominal resistance. In order to develop the nominal resistance for laterally-loaded connections, the fastener bending yield strength, length, and diameter must be known.

6. Apparatus

6.1 *Testing Machine*—Any suitable testing machine capable of operation at a constant rate of motion of its movable head and having an accuracy of ±1 % when calibrated in accordance with Practices E4.

6.2 *Deformation Gauge*—Deformation measuring device shall be used for measuring the deflection of the fastener during the bending test. The device shall achieve at least a Class B rating when verified in accordance with Practices E2309/E2309M.

6.3 *Cylindrical Reaction Bearing Points*—Any cylindrical metal member capable of supporting the test specimen during

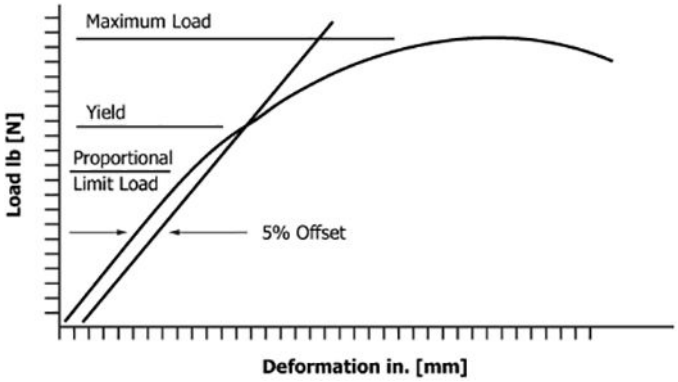

FIG. 1 Example of typical load-deformation diagram from a fastener bending test illustrating the recorded load-deformation curve and 5 % offset line.