Designation: F3359/F3359M – 21

Standard Test Method for Determining Bending Yield Moment of Staples[1]

This standard is issued under the fixed designation F3359/F3359M; 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 of staples when subjected to static loading. Although intended for flat crown staples identified in Specification F1667/F1667M, this procedure is also applicable for staples with round wire. These staples are used in engineered wood building connection applications for which required connection capacities are 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 F3359 or SI Units [F3359M]. Values stated in SI are a mathematical conversion 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

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bending yield moment (M_y)*—the critical strength characteristic used in yield theory calculations and determined in accordance with 9.2.

3.1.2 *flat crown staple*—a two-pronged fasteners in which round or flattened wire is bent into an approximate U-shape with approximately equivalent leg lengths.

3.1.3 *flat crown staple dimensions*—All dimensions taken before application of or after removal of any coating, as shown in Fig. 1.

3.1.3.1 *crown width (C)*—Distance measured along the top of the staple from the outside of the staple legs.

3.1.3.2 *leg length (L)*—Distance from top of staple crown to bottom of leg.

3.1.3.3 *thickness (T)*—Distance perpendicular to the width of the leg for a flattened wire staple.

3.1.3.4 *test span (S_{bp})*—Cylindrical bearing point spacing (test span length) as shown in Fig. 2.

3.1.3.5 *width (W)*—Distance across the flatten portion of wire.

3.1.4 *proportional limit load*—is the load at which the load-deflection curve deviates from a straight line fitted to the initial portion of the load- deflection curve as shown in Fig. 3.

3.1.5 *yield load (P)*—the load determined from the load-deflection curve in accordance with 9.1.

3.1.6 *yield theory*—the model for lateral load design values for dowel-type fasteners that specifically accounts for the different way connections behave under load.

4. Summary of Test Method

4.1 Test specimens are evaluated to determine capacity to resist lateral bending loads applied at a constant rate of deflection with a suitable testing machine. The load on the test specimen at various intervals of deflection is measured. Supplementary physical properties of the test specimen are also determined.

[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.

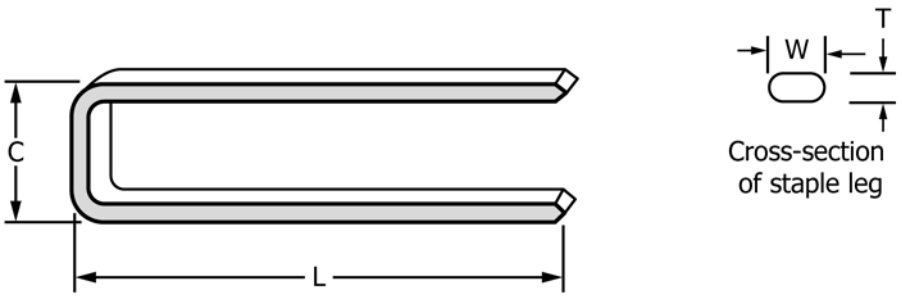

FIG. 1 Flat Crown Staple Dimensions

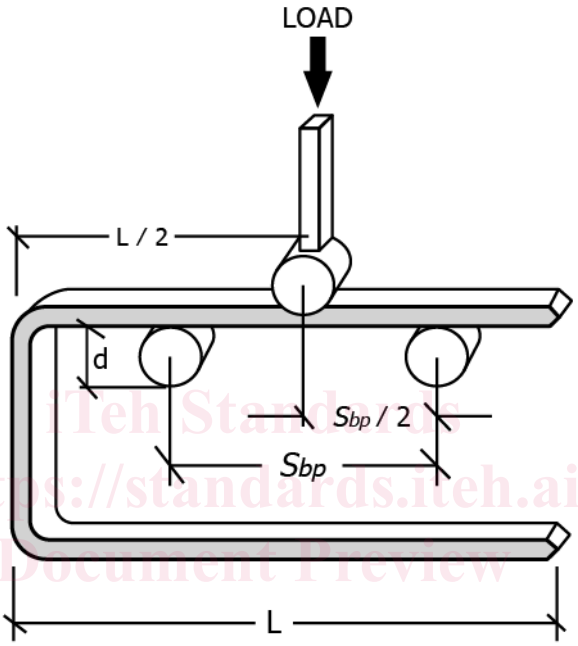

FIG. 2 Cylindrical bearing point spacing

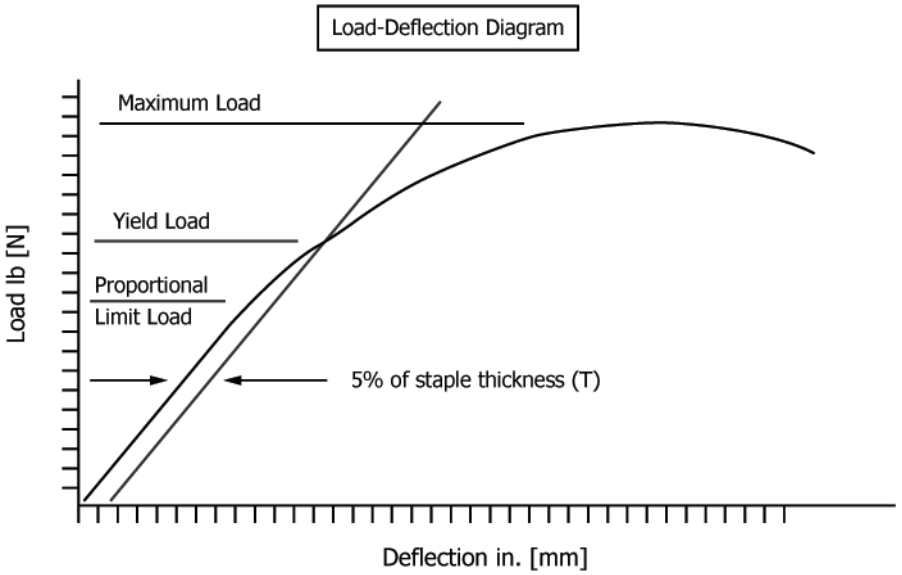

FIG. 3 Load- Deflection Curve

5. Significance and Use

5.1 Staples are mechanical fasteners used in wood structures. Engineering design procedures used to determine the capacities of laterally-loaded staple connections use a yield theory to establish nominal resistance (Note 2). In order to develop nominal resistance for laterally-loaded stapled connections, the bending yield moment must be known.

NOTE 2—When used as a structural fastener in shear walls and diaphragms, staples are installed with the crown parallel to the long dimension of the framing member. The orientation of the staples for this bending yield moment test represents the bending yield moment applicable for this intended use).

6. Apparatus

6.1 *Testing Machine*—Any suitable testing machine capable of operation at a constant rate of motion of its movable head.

6.2 *Cylindrical Bearing Points*—Any cylindrical metal members with a diameter of 0.375 in. [9.53 mm], capable of supporting the test specimen during loading without being deformed, as shown in Fig. 2.

6.2.1 Cylindrical bearing points shall allow free rotation as the test specimen is deformed.

6.3 *Cylindrical Load Point*—Any cylindrical metal member with a diameter of 0.375 in. [9.53 mm] capable of loading the test specimen without being deformed, as shown in Fig. 2.

6.4 *Instrumentation*—Load and deflection shall be continuously measured and recorded.

6.4.1 Deflection shall be measured with a transducer having at least a sensitivity of 0.001 in. [0.01 mm].

6.4.2 Load shall be measured with a sensor having an accuracy of ± 1 % when calibrated in accordance with Practice E4.

7. Sampling, Test Specimens, and Test Units

7.1 Test specimens shall be randomly selected to represent the parent population of staples from the manufacturing process. A minimum of 15 specimens shall be tested for each unique set of cross-sectional dimensions, as show in Fig. 1.

7.2 All testing shall be performed prior to the application of or after the removal of any coatings or finish.

7.3 Prior to placing a specimen in the test apparatus, dimensions in. [mm] of crown width *(C)*, thickness *(T)*, leg length *(L)* and leg width *(W)* shall be taken and recorded. Width and thickness measurements shall be taken at the load point on the staple leg.

8. Procedure

8.1 *Test Setup:*

8.1.1 The test setup is shown in Fig. 2. Test Span (S_{bp}) shall be 1 in. [25.4 mm].

8.1.2 Place the staple leg on the circular supports. The load shall be applied to the test specimen across the width of the staple leg. The center of the cylindrical load point shall be equidistant from the center of each cylindrical bearing points (S_{bp} /2) as shown in Fig. 2 and located within 0.01 in. [0.25 mm] from the midpoint of the leg length (L /2).

8.1.3 *Exception*—Only when the design of the test apparatus interferes with and prevents an intact staple from being properly mounted on the support bearings, then a leg from each specimen shall be permitted to be cut off of a staple or bent out of the way and used in the test. The leg shall be removed or bent immediately below the crown and shall not be distorted or altered in the process. This shall be noted in the test report.

8.1.4 The thickness measurement *(T)* of the staple leg shall be used in determining the 5 % offset on the load-deflection diagram.

8.2 *Loading:*

8.2.1 The maximum constant rate of loading shall be 0.25 in./min [6.35 mm/min].

8.2.2 The procedures described herein are for static loading. Procedures to evaluate staples subjected to impact or cyclic loads are not a part of this test method.

8.3 *Load and Deflection Measurement*—Measure the applied load on and deflection of the test specimen from the initiation of load application taking continuous readings to permit establishment of a satisfactory load-deflection curve. Continue loading until the maximum load is reached and the load begins to decrease.

9. Calculation or Interpretation of Results

9.1 The yield load, *(P)* lb [N], is determined by fitting a straight line to the initial linear portion of the load-deflection curve, offsetting this line by a deflection equal to 5 % of the staple leg thickness *(T)* and selecting the load at which the offset line intersects the load-deflection curve as shown in Fig. 3. In those cases where the offset line does not intersect the load-deflection curve, the maximum load shall be used as the yield load. The bending yield moment shall be based on the average yield load for all of the specimens tested.

9.2 The bending yield moment in.-lb or [mm-N] shall be determined by the following:

$$M_y = \mathrm{P}\ S_{bp}/4 \quad (1)$$

10. Report

10.1 The following shall be included in the report:

10.1.1 Tabulated and plotted data on load-deflection diagrams as shown in Fig. 3.

10.1.2 Physical description of the test specimens including nominal diameter, crown *(C)*, width *(W)*, leg length *(L)* and thickness *(T)* in. [mm].

10.1.3 Span Length in. [mm],

10.1.4 Rate of loading in./min [mm/min], and

10.1.5 Number of replicate tests.

10.1.6 Individual and average values of the following:

10.1.6.1 Calculated yield load (*P*) lbs [N], and

10.1.6.2 Calculated bending yield moment (M_y) in.-lb [mm-N].