Designation: F 1575 – 03

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

This standard is issued under the fixed designation F 1575; 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 nails when subjected to static loading. It is intended only for nails used in engineered connection applications, in which a required connection capacity is specified by the designer.

1.2 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

E 4 Practices for Force Verification of Testing Machines[2]

F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection[3]

F 1667 Specification for Driven Fasteners: Nails, Spikes, and Staples[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bending yield moment*—the moment determined from the load-deformation curve that is intermediate between the proportional limit and maximum load for the nail. It is calculated by the intersection of the load-deformation curve with a line represented by the initial tangent modulus offset 5 % of the fastener diameter.

3.1.2 *transition zone*—the location of the transition from smooth shank to threaded shank on a deformed-shank nail.

3.1.3 *yield theory*—the model for 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 modes being taken as the design load for the connection.

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 deformation with a suitable testing machine. The load on the test specimen at various intervals of deformation is measured. Supplementary physical properties of the test specimen are also determined.

5. Significance and Use

5.1 Nails are a common mechanical fastener in wood structures. Engineering design procedures used to determine the capacities of laterally-loaded nailed connections currently use a yield theory to establish the nominal resistance for laterally-loaded nailed connections that are engineered. In order to develop the nominal resistance for laterally-loaded nailed connections, the bending yield moment 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 Practice E 4.

6.2 *Cylindrical Bearing Points*—Any cylindrical metal member capable of supporting the test specimen during loading without deforming, as shown in Fig. 1, and having diameter (D) = 0.375 in.

6.2.1 Cylindrical bearing points shall be free to rotate as the test specimen deforms.

6.3 *Cylindrical Load Point*—Any cylindrical metal member capable of loading the test specimen without deforming, as shown in Fig. 1, and having diameter (D) = 0.375 in.

6.4 *Recording Device*—Any device with at least a reading of 0.001 in. (0.025 mm) and any suitable device for measuring the load on the test specimen during deformation.

[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] *Annual Book of ASTM Standards*, Vol 03.01.

[3] *Annual Book of ASTM Standards*, Vol 01.08.

*A Summary of Changes section appears at the end of this standard.

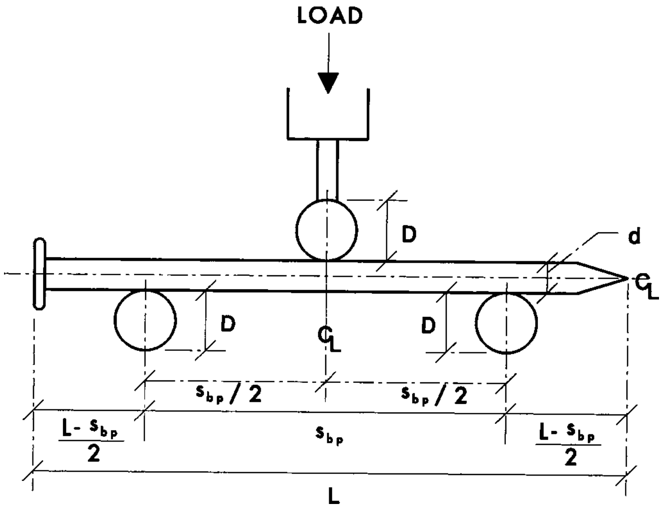

FIG. 1 Center-Point Bending Test for Nails

7. Sampling

7.1 Sampling shall provide for selection of representative test specimens that are appropriate to the objectives of the testing program.

8. Specimens and Tests

8.1 Tests for smooth shank nails shall be performed on either the finished nail or a specimen of drawn wire stock from which the nail would be manufactured. Tests for deformed-shank nails shall be performed on the finished nail.

8.2 *Diameter Measurement*—Measure the actual diameter of each test specimen at the midpoint of its length to the nearest 0.001 in. (0.025 mm). The nail diameter shall be defined as the diameter of the unthreaded shank for partially deformed-shank nails and shall be measured at the midpoint of the length of nail shank between nail head and transition zone.

8.3 *Length Measurement*—The nail shall be long enough to prevent the nail head or point from bearing on the cylindrical nail supports during application of load to the nail through the time when ultimate load is reached.

9. Procedure

9.1 *Test Setup*:

TABLE 1 Length Between Nail Bearing Points

Nail Nominal Diameter (in.), tolerance per Specification F 1667	Length Between Bearing Points (in.)
0.099	1.1
0.113	1.3
0.120	1.4
0.131	1.5
0.148	1.7
0.162	1.9
0.190	2.2
Larger than 0.190	11.5 times the nail diameter, rounded to the nearest tenth of an inch

Length between bearing points for nails with diameters other than shown in Table 1 are the lengths for the next smaller listed diameter.

9.1.1 Cylindrical bearing point spacing, s_{bp}, shall be as indicated in Table 1

9.1.1.1 If nails are too short to meet this requirement and the nails receive no processing after forming that can affect fastener bending yield strength, such as heat treating or thread rolling, the test shall be performed on wire from which the nail is made.

9.1.1.2 If nails are too short to meet this requirement and receive processing after forming that can affect fastener bending yield strength, such as heat treating or thread rolling, the nails shall be tested with the largest possible span and the span and circumstances reported in the report.

NOTE 1—Experience indicates that test results are sensitive to large changes in bearing point spacing, s_{bp}.

9.1.2 The load shall be applied to the test specimen so that the center of the cylindrical load point is equidistant from the center of each cylindrical bearing point ($s_{bp}/2$) as shown in Fig. 1.

9.1.3 Deformed-shank nails shall be placed on the cylindrical bearing points for testing so that the transition zone between shank and thread is as close to the midpoint between the bearing points as possible.

9.2 *Loading*:

9.2.1 The maximum constant rate of loading, r_L, shall be as follows:

$$r_L = 0.25 \text{ in./min}$$

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

9.3 *Load and Deformation Measurement*—Measure the applied load on and deformation of the test specimen from the initiation of load application and take readings of each at sufficiently frequent intervals to permit establishment of a satisfactory load-deformation curve except as permitted in 9.3.1. Continue the loading until the ultimate load is reached and the load capacity begins to decrease.

9.3.1 As an alternative to establishment of a load-deformation curve, initial tests shall be performed to establish a relationship between ultimate load and the 5 % offset value in accordance with 10.1. The ultimate load only shall then be recorded for subsequent tests.

10. Interpretation of Results

10.1 The bending yield moment is determined by fitting a straight line to the initial linear portion of the load-deformation curve, offsetting this line by a deformation equal to 5 % of the nail diameter, and selecting the load at which the offset line intersects the load-deformation curve (see Fig. 2). In those cases where the offset line does not intersect the load-deformation curve, the maximum load shall be used as the yield load. The bending yield moment shall be the average of the specimens tested.

11. Report

11.1 Report the following information:

11.1.1 Tabulated and plotted data on load-deformation relationships or ultimate load and the ultimate/5 % offset load relationship in accordance with 9.3.1,