



Standard Test Method for Fastener Rupture and Tear Resistance of Roofing and Waterproofing Sheets, Roll Roofing, and Shingles¹

This standard is issued under the fixed designation D4932/D4932M; 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.

^{ε1} NOTE—Units information was editorially corrected in January 2014.

1. Scope

1.1 This test method covers the determination of the force needed to pull a fastener through any type of roofing or waterproofing ply sheet, roll roofing, or shingle, or to cause fastener failure under specified laboratory conditions.

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 may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

2. Referenced Documents

2.1 ASTM Standards:²

D226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

3. Summary of Test Method

3.1 The force perpendicular to the fastener shank to tear the sheet or to cause fastener failure is measured with the fastener head seated and not seated (tear).

3.2 The force parallel to the fastener shank to rupture the sheet or to cause fastener failure is measured with the head seated (rupture, head pull-through).

¹ This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.20 on Roofing Membrane Systems.

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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.

4. Significance and Use

4.1 Test values for the resistance of specific ply sheets, roll roofing, or shingles to selected fastener pull-through may assist in the determination of appropriate fastener spacing. The relative behavior of different fasteners and fasteners with and without caps may be evaluated.

4.2 Laboratory data will not permit prediction of field performance, particularly long-term performance, and if all test conditions are not the same, data may not be comparable.

5. Apparatus

5.1 *Testing Machine*—Universal or tensile testing machine with automatic load recording equipment, capable of cross-head movement at a constant rate of 25.4 mm/min [1.00 in./min].

5.2 *Grips*—Self-aligning grips or clamps for holding the free end of the test specimen and the nailer holding jig without slippage during the test.

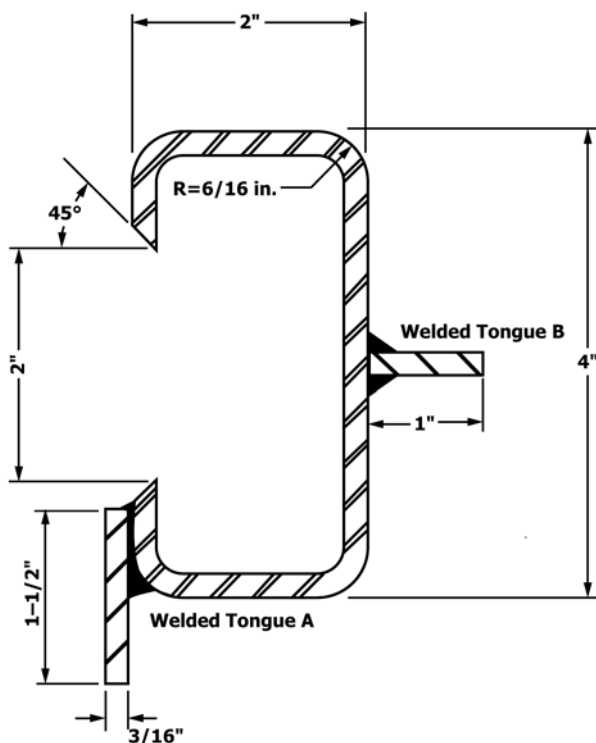
5.3 *Nailer Holding Jig*—100-mm [4-in.] length of cold-formed carbon steel, rectangular structural tubing with outside nominal dimensions of 102 by 51 mm [4 by 2 in.] and 4.8-mm [$\frac{3}{16}$ -in.] wall thickness, fabricated as shown in Fig. 1.

5.4 *Wood Nailers*, 33 by 89 – 13, + 1 by 102 mm [1.5 by 3.5 – 0.5, + 0.05 by 4 in.] (nominal 2 by 4 in. lumber cut to 4 in. length is appropriate). Thirty nailers are required per sample.

NOTE 1—The wood nailers must hold the fastener securely and remain secure in the nailer holding jig during the test. The 89-mm [3.5-in.] dimension is critical for the nailer to be secure in the jig; the other dimensions are not critical and may be varied so long as the nailer works. If preferred, the operator may use continuous lengths of nailer stock up to 1 m [40 in.] long for multiple specimens as opposed to cutting separate nailers for each specimen.

6. Sampling and Test Specimens

6.1 Cut 15 MD specimens, 175 by 100 mm [7 by 4 in.], in the machine direction (MD) and another 15 XMD specimens in the cross-machine direction (XMD) from a representative portion of the sheet to be tested. If no particular sheet is



NOTE 1—Stock wall thickness is 5 mm [$\frac{3}{16}$ in.].

FIG. 1 Nailer Holding Jig, 100 mm [4 in.] Long, Cold-Formed Carbon Steel

specified, use Type 1 asphalt-saturated organic felt conforming to the requirements prescribed in Specification D226.

6.2 Thirty fasteners of the type to be tested are required. If no particular fastener is specified, use galvanized roofing nails with a 38-mm [$1\frac{1}{2}$ in.] long 3.6-mm [0.1205-in.] diameter straight shank and a 9.5-mm [$\frac{3}{8}$ -in.] diameter head.

7. Conditioning

7.1 Condition all specimens and nailers at 20 to 25°C [68 to 77°F] and at 50 ± 5 % relative humidity for a minimum of 16 h prior to testing.

8. Procedure

8.1 Position each sheet specimen on a broad side of a nailer so that a 100-mm [4-in.] side of the sheet specimen is parallel to and 20 ± 2 mm [0.75 ± 0.125 in.] from a 100-mm [4-in.] side of the nailer as shown in Fig. 2. Fasten each specimen to its nailer with a fastener centered in the nailer and centered with respect to the sheet width.

NOTE 2—If continuous lengths of nailers up to 1 m [40 in.] long are used, the specimens should be positioned side by side on a broad side of a nailer with a 100-mm [4-in.] side 20 ± 2 mm [0.75 ± 0.125 in.] from a long side of the nailer. For each specimen the fastener should be centered with respect to the nailer width and sample width. See Fig. 3.

8.1.1 In ten of the MD specimens and ten of the XMD specimens, seat the heads of the nails firmly, but without crushing the sheet.

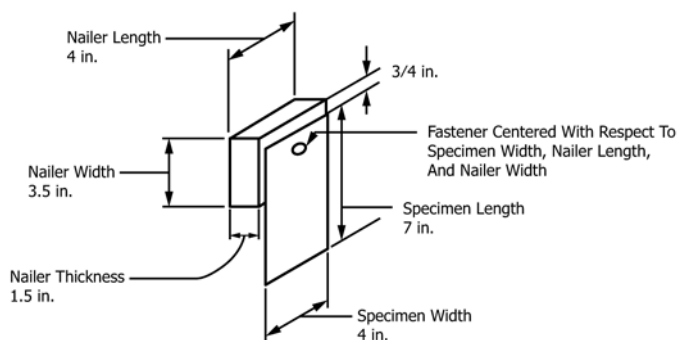


FIG. 2 Specimens Fastened to Nailer

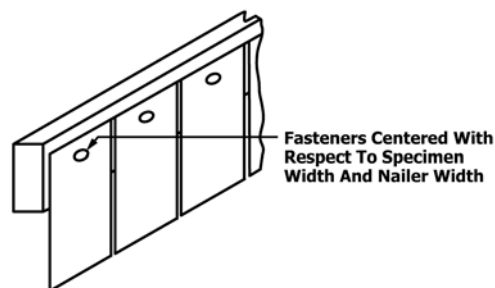


FIG. 3 Multiple Specimens Fastened to Long Nailer

8.1.2 In the remaining five MD and five XMD specimens, set the heads of the fasteners with a 1-mm [0.04-in.] gap between the top of the sheet and the underside of the fastener head or cap.

NOTE 3—A 1-mm [0.04-in.] thick feeler gauge aids in establishing the gap.

8.2 Measure the shank tear resistance on five of the ten MD specimens with seated fasteners and all five with unseated fasteners; similarly measure the shank tear resistance on five of the ten XMD specimens with seated fasteners and all five with unseated fasteners, as follows:

8.2.1 Clamp the tongue on the narrow side of the nailer holding jig in the lower grip of the testing machine, and slide the nailer into the jig so that the sheet specimens are on the same side of the jig as the slot, and the long end of the specimen is on top.

8.2.2 Set the grips of the testing machine 152 ± 5 mm [$6 \pm \frac{1}{4}$ in.] apart.

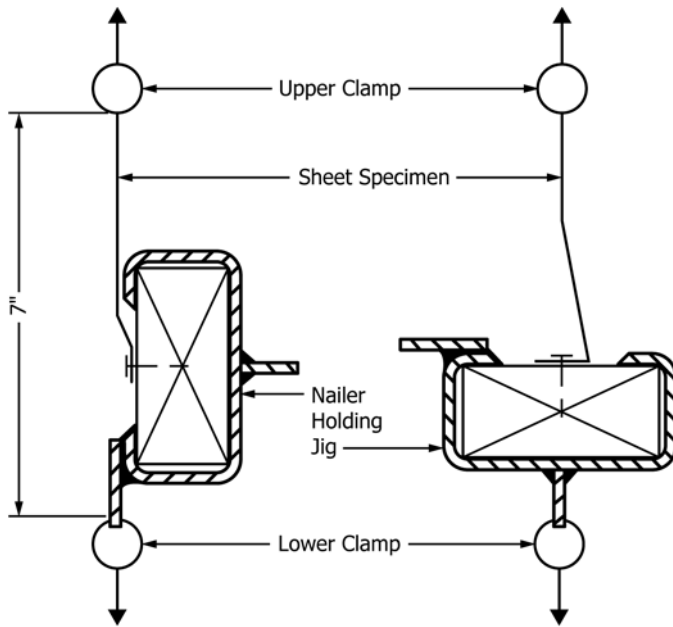
8.2.3 Position the nailer in the jig so that the long end of the specimen can be centered with respect to the upper grip and clamp it into the upper grip. See Fig. 4a.

8.2.4 Start the testing machine and move the grips apart at the rate of 25.4 mm/min [1.0 in./min].

8.2.5 Record the maximum force and the type of failure observed (shank tear or fastener failure). Reject results if the fastener pulls out of the nailer.

8.2.6 Repeat the steps described in 8.2.2 through 8.2.5 until all 20 specimens have been tested for shank tear resistance.

8.3 Measure the nail head rupture resistance on the remaining five MD and five XMD specimens with seated nails as follows (see Fig. 3):



a. Tear

b. Rupture

FIG. 4 Tear and Rupture Configurations at the Start of Testing

8.3.1 Clamp the tongue on the wide side of the nailer holding jig in the lower grip of the testing machine, and slide the nailer into the jig so that the sheet specimen is on the same side of the jig as the slot.

8.3.2 Set the grips of the testing machine 152 ± 5 mm [$6 \pm \frac{1}{4}$ in.] apart.

8.3.3 Position the nailer in the jig so that the long end of the specimen is centered with respect to the upper grip and clamp it into the upper grip. See Fig. 4b.

8.3.4 Start the testing machine and move the grips apart at the rate of 25.4 mm/min [1.0 in./min].

8.3.5 Record the maximum force and the type of failure observed (nail head rupture of the sheet or fastener failure). Reject results if the fastener pulls out of the nailer.

8.3.6 Repeat the steps described in 8.3.2 through 8.3.5 until all ten specimens have been tested for nail head pull-through resistance.

9. Calculation

9.1 Calculate the mean value and an estimate of the standard deviation for each condition as follows:

$$X = \frac{\sum x}{5} \quad \text{and} \quad S = \sqrt{\frac{\sum x^2}{4} - \frac{(\sum x)^2}{20}} \quad (1)$$

where:

X = mean tear or rupture resistance,

x = individual test value, and

S = unbiased estimate of the standard deviation.

10. Report

10.1 Report the following:

10.1.1 The source and complete description of the sheets and fasteners tested.

10.2 Prepare the following table:

Condition	N [lbf], Mean	Standard Deviation
Tear MD—seated fastener		
Tear MD—unseated fastener		
Tear XMD—seated fastener		
Tear XMD—unseated fastener		
Rupture MD—seated fastener		
Rupture XMD—seated fasteners		

11. Precision and Bias

11.1 The following criteria shall be used for the acceptability of the test results (95 % probability). The value X equals the average of two duplicate values required for tear or rupture of material in the repeatability and reproducibility intervals stated below.

11.2 *Repeatability*—Duplicate values by the same operator shall not be considered suspect unless they differ by more than the following limits for the stated conditions:

Test Condition	Repeatability Limit
Tear MD—seated fastener	0.507 X
Tear MD—unseated fastener	0.314 X
Tear XMD—seated fastener	0.481 X
Tear XMD—unseated fastener	0.314 X
Rupture MD—seated fastener	0.413 X
Rupture XMD—seated fastener	0.368 X

11.3 *Reproducibility*—Values reported by each of two laboratories, representing the arithmetic average of five determinations per test condition, shall not be considered suspect unless they differ by more than the following limits for the stated conditions:

Test Condition	Reproducibility Limit
Tear MD—seated fastener	0.634 X
Tear MD—unseated fastener	0.529 X
Tear XMD—seated fastener	0.560 X
Tear XMD—unseated fastener	0.458 X
Rupture MD—seated fastener	0.750 X
Rupture XMD—seated fastener	0.555 X

12. Keywords

12.1 fastener rupture; roll roofing; roofing membranes; shingles; tear resistance

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