

ANSI/SPRI FX-1 2021

Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners

Approved November 1, 2021



Copyright by SPRI 2021

465 Waverley Oaks Road
Suite 421
Waltham, MA 02452

www.spri.org

All Rights Reserved

Disclaimer

This standard is for use by architects, engineers, roofing contractors and owners of low slope roofing systems. SPRI, its members and employees do not warrant that this standard is proper and applicable under all conditions.

Table of Contents

Purpose	3
Definitions	3
Equipment	3
Procedure	3
Personnel	4
Cautions	4
Precision & Bias	4
Reference	4
Commentary	5
Form A Pullout Test Report	6
Form B Pullout Test Report	7

1.0 Purpose

This standard provides procedures used in the field to test the pullout resistance of all types of roofing fasteners. The data developed from these tests provide the roof system manufacturer, design professional, and other practitioners with pullout resistance values for the specific fastener installed into the load resisting material of the deck. See Commentary C1.0.

2.0 Definitions

2.1 Embedment

The length of a fastener that is within the deck after installation (applicable to structural and lightweight concretes, gypsum, cementitious wood fiber, and wood plank).

2.2 Protrusion

The length of a fastener that extends beyond the underside of the deck after installation (applicable to steel, plywood, OSB, and fiberglass decks).

3.0 Equipment

3.1 Use a pullout tester with either a hydraulic or electronic load cell. The gauge shall display values in lbf (kN). Conversion formulas are provided on Form B. During testing, the values obtained shall fall within the working range of the gauge.

3.2 The load gauge shall have a dated calibration certificate showing the calibrated values for the full range of the load gauge. The gauge shall be accurate to +/- 5% of the reading. Calibration shall be performed to a standard that is traceable to a nationally recognized source. The load gauge shall be calibrated every 12 months or sooner if it is suspected that the gauge is out of calibration.

4.0 Procedure

4.1 Remove any roofing material in place above the deck (i.e., roofing membrane, existing insulation) before the test is performed. See Commentary C4.1.

4.2 The fastener shall be installed using the same method and tools as will be used during actual construction (i.e., depth of installation, pre-drilled hole diameter, installation tools).

4.3 The fastener shall be pulled out perpendicular to the deck. The load shall be applied at 2.0 ± 1.0 in/min (50 ± 25 mm/min). See Commentary C4.3.

4.4 Record the results of all pullout tests on Form B.

4.5 Perform a minimum of 10 pullouts for up to 50,000 ft² (4,650 m²), and 5 additional pullouts for each additional 50,000 ft² (4,650 m²) or portion thereof on each project. Perform the pullouts in various areas of the roof, including corners, perimeter, and field, to provide a representative sampling of roof area. 50% of the tests shall be performed in the corners and perimeter areas.

When conditions, such as those identified in Commentary C4.5, exist on the roof the individual performing the pullout test shall inform the designer of record or the building owner's representative of such conditions.

4.5.1 Deviation from the prescribed minimum number of pullout tests shall be allowed when agreed upon by all involved parties. Deviations shall be recorded using Form B or comparable document. See Commentary C4.5.1.

4.6 For a single building each roof section with a different elevation, different deck type, or any variation in roof system assembly shall be considered to be a different test area and shall be tested separately as specified in Section 4.5.

4.7 Prepare a roof plan on Form B to identify the location of each pullout. The roof plan shall be marked with the corresponding test number of each pullout test as recorded on Form B. The roof plan need not be to scale. See Commentary 4.7.

4.8 Complete separate Forms A and B for each roof section. Record all pullouts.

5.0 Personnel (See Commentary 5.0)

- 5.1 The test shall be performed by an individual trained in the proper use of the pull test equipment. A representative of the building owner shall be present to witness the test and verify the values. A roofing professional shall be present to repair the roof in areas where the tests were performed.

6.0 Cautions (See Commentary 6.0)

- 6.1 It is not recommended that fastener pullout tests be performed on decks that can be affected by free water when the deck is 32° F (0° C) or below (i.e., gypsum, cementitious wood fiber, lightweight structural concrete, and lightweight insulating concrete). The pullout values may be elevated and therefore unreliable.

7.0 Precision & Bias

- 7.1 Precision: The precision of this test method indicates the probable error of a single determination is +/- 5% of the true value.
- 7.2 Since there is no accepted reference material suitable for determining bias for this test method, bias has not been determined.

8.0 Reference

- W.J. Rossiter and T.J. Wallace, eds., "Roofing Research and Standards Development: 5th Volume", ASTM STP 1451, ASTM International, West Conshohocken PA, 2003
- B.A. Baskaran, M. Sexton, W. Lei, and S. Molleti, "Pullout Resistance of Roofing Fasteners Using Different Methods", ASTM STP 1451, ASTM International, West Conshohocken PA, 2003

Commentary

This Commentary is a non-mandatory part of this standard, consisting of explanatory and supplementary material designed to assist users in complying with the requirements. It is intended to create an understanding of the requirements through brief explanations of the reasoning employed in arriving at these requirements or to provide other clarifications. It therefore has not been processed in accordance with ANSI Essential Requirements, and may contain material that has not been subjected to public review or a consensus process. Thus it does not contain requirements necessary for conformance with the standard field test procedure.

The sections of the Commentary are numbered to correspond to the sections of the standard to which they refer. Since it is not necessary to have supplementary material for every section in the standard itself, there are gaps in the numbering in the Commentary.

- C1.0 The pullout resistance of any roofing fastener that the test equipment can latch onto can be evaluated using this test procedure.
- C4.1 Use of a core cutter has been found to be an effective method of removing materials above the deck before performing the pull tests.
- C4.3 Rates of withdrawal can be pre-set on motorized pullout testers. On testers where the load is applied via a threaded rod, an acceptable method to determine the rate of withdrawal is to calculate the number of seconds per 360° revolution.
- Seconds per Revolution = $60 \div (\text{number of threads per inch} \times \text{desired number of inches per minute})$
- C4.5 On certain projects, it may be necessary to perform additional pullout tests beyond the minimum number required in Section 4.5. This includes, but is not limited to, occasions when:
- ▶ pullout tests that result in a coefficient of variation that exceeds 20%;
 - ▶ tests are performed in decks that are inherently less consistent such as lightweight insulating concrete, cementitious wood fiber and gypsum;
 - ▶ there exists multiple damaged or questionable areas;
 - ▶ water or other chemicals may have infiltrated the roof systems;
 - ▶ local building codes require additional tests; and/or
 - ▶ roofs with high wind loading should have pulls taken in all corners.

Record the test results and the reasons for the additional tests in the Comment Section on Form B.

If there are anomalies in pull values, deck at the point of the anomaly should be inspected to determine cause. An anomaly is defined as one or more pullout values that fall exceedingly high or low from the population.

- C4.5.1 Circumstances may arise where the minimum prescribed pulls may not be possible or necessary. These may include but aren't limited to: inclement weather, equipment malfunction, or interested parties not requiring the minimum number of tests. For these circumstances, a deviation can be signed-off by said parties (Form B or comparable document).
- C4.7 Additional data on the pullout form (Form A) exists for informational purposes for the roof designer. These areas have been marked "Optional Information", and are to be completed at the discretion of the personnel completing the Pullout Test Report.
- C5.0 Fasteners tested should be installed by individuals trained in the proper installation techniques for the specific fasteners being tested.
- As with all work performed in a rooftop environment, personnel should be familiar with all OSHA, company, and project specific safety requirements. This includes, but is not limited to, safe access, fall protection, exposure to electrical hazards and environmental hazards including weather.
- C6.0 The temperature of the deck may be taken to determine if it is subject to freezing conditions.

Form A Pullout Test Report

(Refer to the Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners for full documentation)

Job name:	
Location:	
Test date: / /	Ambient temperature:
Roof area: sq. ft	Tester mfg:
Max. cap. of tester:	Select one: <input type="checkbox"/> lbf <input type="checkbox"/> kN
Date of last calibration: / /	Number of pulls recorded on Form B:
Fastener tested:	Fastener manufacturer:
Fastener tested:	Fastener manufacturer:
Fastener tested:	Fastener manufacturer:
Test performed by:	
Witnessed by:	Test cut areas repaired by:
Project type (select one): <input type="checkbox"/> New construction <input type="checkbox"/> Tear off <input type="checkbox"/> Retrofit	

Deck type (select one):		
<input type="checkbox"/> Steel	Gauge:	
<input type="checkbox"/> Structural concrete	Thickness:	Select one: <input type="checkbox"/> Poured in place <input type="checkbox"/> Precast
<input type="checkbox"/> Lightweight concrete	Thickness:	
<input type="checkbox"/> Insulating concrete	Thickness:	
<input type="checkbox"/> Cementious wood fiber	Thickness:	
<input type="checkbox"/> Gypsum	Thickness:	Select one: <input type="checkbox"/> Poured in place <input type="checkbox"/> Precast
<input type="checkbox"/> Wood	Thickness:	Select one: <input type="checkbox"/> OSB <input type="checkbox"/> Plywood <input type="checkbox"/> Plank
<input type="checkbox"/> Fiberglass	Thickness:	
<input type="checkbox"/> Other: _____	Thickness:	

Embedment or protrusion:

Drill bit diameter, where applicable:

Optional Information

Test time:	Building height:	Thickness of existing roof assembly:
------------	------------------	--------------------------------------

New system manufacturer:

Roof cover type (select one):

<input type="checkbox"/> Mechanically attached single-ply	<input type="checkbox"/> Modified bitumen
<input type="checkbox"/> Ballasted single-ply	<input type="checkbox"/> Built-up roofing
<input type="checkbox"/> Adhered single-ply	<input type="checkbox"/> Other: _____

New insulation:

Type:	Thickness:
-------	------------

Form B Pullout Test Report

Report all test results and units of measure.

Conversion formulas

$$\text{lbf} \times .00448222 = \text{kN} \times 224.8089431 = \text{lbf}$$

1.	6.	11.	16.
2.	7.	12.	17.
3.	8.	13.	18.
4.	9.	14.	19.
5.	10.	15.	20.

Pullout Results of Additional Tests Performed (See C4.5.)

21.	26.	31.	36.
22.	27.	32.	37.
23.	28.	33.	38.
24.	29.	34.	39.
25.	30.	35.	40.

Deviation from standard procedure authorized by:

Reason for deviation:

Roof plan not to scale. Identify where the pullouts were performed with corresponding test number.

Comments

Disclaimer: Manufacturer's installation requirements shall be followed when using any of the tested fasteners. Neither the technician performing the pullout tests nor his/her company is responsible for the waterproofing integrity of the repairs. This test report does not certify the structural integrity of the roof deck.