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## Evaluation of TetraGRIP™ Fasteners for Nail Squeaks

*Prepared For*

**ITW Paslode**

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## BACKGROUND

Historically, floor squeaks have been a significant “call back” problem for home builders. Homebuyers do not want to hear squeaking sounds as they walk across the floor of their newly constructed home.

There are a number of causes of floor squeaks. The most prominent cause is due to relative movement between the subfloor material and the fastener, resulting in squeaks. Traditional fasteners initially hold the subfloor firmly to the supporting floor joist and relative movement is prevented. However, over time gaps are created and relative movement often occurs.

There are several reasons that relative movement occurs in the floor system and as a result squeaks arise:

- The subfloor material, typically oriented strand board (OSB or plywood) expands and contracts with changes in relative humidity or rain during construction. The swelling of the subfloor can cause traditional or prescriptive fasteners to withdraw slightly from the floor joist.
- After the home is completed the floor joist lumber dries out and shrinks. This decreases the holding power/friction of traditional nails against the wood, which as the floor is walked on and slight movement occurs, contributes to working the nails loose.
- Some subfloors have greater potential to squeak than others depending on the materials used in the construction and the care taken during installation.

In functional use, as someone walks across the completed floor, the subfloor can deflect, rubbing against the fastener, causing a noticeable and undesirable squeaking noise.

In order to avoid the nail squeak phenomena, Paslode developed the TetraGRIP™ fastening system which addresses the causes of the relative movement and prevents squeaking from occurring. The TetraGRIP™ fastener is a pneumatically driven fastener that Paslode describes as “Drives like a nail; Holds like a screw.” The TetraGRIP™ fasteners have a proprietary shank design consisting of barbed helical threads that can be seen in the figure below.

- The barbed helical thread causes the fastener to rotate as it is driven, and engage with the wood similar to a screw.
- The barbed helix clamps the OSB in place.



The NAHB Research Center previously evaluated a test method for determining the propensity of a subfloor fastener to cause squeaks due to relative movement between the subfloor and the fastener. The evaluation is documented in Research Center Test Report #416700106182012. The test method is described in the appendix to this report.

This report documents the evaluation of the TetraGrip fastener per that test method.

## TEST METHOD DESCRIPTION

The test method causes movement between the fastener and a subfloor specimen by immobilizing the subfloor while pushing the fastener up thru the subfloor and then pulling it back until the nail head is flush. The amount of movement is approximately the twice the thickness of the nail head. The movement can be slightly offset to simulate a fastener that is not driven perfectly perpendicular. This movement cycle is repeated at least 1,000 times. The apparatus is located in an acoustics chamber and the noise level is measured with a decibel meter. A rise in the net noise level above a threshold amount determines the presence or absence of a squeak. Background noise level is measured when the test apparatus is operating without a fastener to determine the net noise increase that is attributable to the faster.

## TEST RESULTS

A Research Center representative visited the TetraGRIP production facility in Pocahontas, Arkansas and randomly sampled fasteners for the testing.

The fasteners were tested in several subfloor materials and thickness. The test method also allows for an offset to be introduced in the movement to simulate a nail that is not driven perpendicular.

Eight combinations of subfloor materials and offsets were tested with 5 replicates each for a total of 40 tests. Sound level increases were recorded initially after the cycling began and then again at the end of the cycling.

The results are summarized below:

Thickness (inches)	Type	Offset (degrees)	Average Initial Sound level above background (dBA)	Average Final Sound level above background (dBA)	Maximum Initial Sound level above background (dBA)	Maximum Final Sound level above background (dBA)
23/32	OSB	0	0.6	0.7	2.2	2.4
23/32	OSB	5	0.9	0.9	3.9	1.9
5/8	OSB	0	0.3	0.2	1.0	0.8
5/8	OSB	5	0.3	0.6	1.6	3.1
7/16	OSB	0	1.7	1.6	2.5	2.7
7/16	OSB	5	0.5	0.5	2.6	1.8
3/4	Plywood	0	2.1	1.2	4.2	3.3
3/4	Plywood	5	0.5	1.5	2.4	2.8

The results above represent the average sound level difference between the sound when the fastener is being forced to move thru the subfloor material and a background reading taken immediately at the conclusion of the test. Some background noise variation was present and the result of some individual replicates yielded a slightly negative difference. In those cases the reported average used a value of zero for those test runs.

As a precaution to make sure the test apparatus was working appropriately one run was conducted with an 8d nail in 5/8 in. OSB during this evaluation. This combination resulted in a sound level increase of 10.1 dBA resulting in a very audible squeak.

Human perception of sound is a complex phenomena but it is generally agreed that changes in sound level of less than 3 dBA are not typically perceptible by the average person.


The Research Center has established the criteria for claiming that a fastener will not squeak as the average dBA net value (measured sound level during test less background sound level) of all the test runs not exceed 3 dBA; and that no individual test exceed 5dBA.

The TetraGrip fastener has met this requirement and has demonstrated that nail squeaks as a result of relative movement between the subfloor and the fastener will not produce audible squeaks noticeable by the average homeowner.

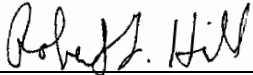
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Testing by: 

Date: June 20, 2012

Review by: 

Date: June 20, 2012



# APPENDIX A: STANDARD PRACTICE FOR OPERATING SUB-FLOOR SQUEAK TESTING APPARATUS

## 1. SCOPE

1.1 This practice describes the apparatus, procedure, and conditions required to capture a fasteners propensity for producing squeaks in a described situation. This practice is designed to mimic the movement seen between a fastener and sheathing substrate measuring force, displacement and cycle number while qualitatively listening for squeaks. This practice describes how to conduct a sub-floor squeak test and how to test assembly specimens. This practice does not prescribe the type of test specimen or exposure periods to be used for a specific product, nor the interpretation to be given to the results.

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 *"Floor Squeaks: Causes, Solutions and Prevention"* by The Engineered Wood Association. APA Technical Note C468N (April, 2002).

2.2 *"Eliminating Sub-floor Nail Squeaks in Residential Construction"* Paslode® White Paper: July, 2010.

## 3. SIGNIFICANCE AND USE

3.1 This practice provides a controlled displacement method of a component assembly sample, utilized to produce test information for the interaction of fasteners and sub-floor materials subjected to any particular test permutation.

3.2 The test results are highly dependent on the type of materials and specimens tested and the evaluation criteria selected, as well as the control of the operating variables. In any testing program, sufficient replicates should be included to establish the variability of the results. See Section 5.

## 4. APPARATUS

4.1 The apparatus required for squeak testing consists of a device that can provide longitudinal displacement of a nail in a controlled fashion and necessary means of control. (A typical universal test machine is one such device but other apparatus may also be used.) The size and detailed construction of the apparatus are optional, provided the conditions obtained meet the requirements of this practice. The apparatus shall be designed to minimize background noise and it should be isolated from ambient noise such that the background sound level does not exceed 50 dBa.

## 5. TEST SPECIMENS

5.1 The type and number of test specimens to be used, as well as the criteria for the evaluation of the test results, shall be defined in the specifications. Performance of a fastener in any one material may be different than the performance in another material; therefore, a variety of different materials is recommended. The criteria shall also specify the number of replicates. Test specimens should encompass the highest density and lowest density and the thickest and thinnest dimension of each type of material recommended for the application.

## 6. PREPARATION OF TEST SPECIMENS

6.1 Conditioning – unless otherwise specified the testing shall be conducted on material dry as received.

### 6.2 Test Specimen Assembly

6.2.1 Materials conditioned per 6.1 are used to prepare test specimens. The minimum sub-floor wood specimen size shall be 2 in. circular. One fastener shall be driven into the center of the test specimen as follows:

- a) Fasteners shall be driven in a manner representative of actual practice
- b) Pneumatically driven fasteners are to be driven through the appropriate pneumatic tool
- c) bulk nails are to be hammer driven
- d) the fastener shall be driven perpendicular to the surface of the wood specimen within 5 degrees.

6.2.2 The sub-floor wood member shall be backed by a 2x4 or other suitable backing member so as to provide support for the subfloor member and to prevent the back side of the subfloor member from inappropriate damage, such as splitting or blow-out. After assembly, carefully remove the backing material to expose the fastener shank for testing.

## 7. ALIGNMENT

7.1 Bending load on the nail is found to have important effect on squeaking. It creates uneven contacts, concentrates the friction at corners and is found to facilitate squeaking. Test specimens shall be evaluated with and without an offset. For specimen evaluated with an offset, a 5° +/- 1° offset from perpendicular to the wood specimen shall be created to one side of the upper fixture. This provides an increase in the normal force interaction between the fastener and wood specimen. This phenomenon, depicted in Figure A1, is common as a home goes through changes in moisture content causing dimensional changes and misalignment between the joist and subfloor, and inconsistencies in the straightness of a joist.

## 8. TEST PROCEDURE

8.1 The wood subfloor specimen is held fixed to the loading fixture. The fastener penetrating the wood specimen is held by the lower part of the fixture and forced to move cyclically against/thru the wood sample. Allowance for fastener rotation is not required.

8.2 Displacement of the cyclic test shall be set at 0.050 to 0.100 in. peak to peak nail movement, approximately twice the thickness of a typical nail head and representative of a typical nail head pop.

Unless otherwise specified cycling frequency shall be 0.1 to 0.5 Hz. A cycle shall have four distinct phases:

1. upward movement of the nail shank (in one-half to one second)
2. pause (approximately one-half to two seconds)
3. downward movement of the nail shank (in one-half to one second)
4. pause (approximately one-half to two seconds)

Testing shall be conducted at room temperature (between 65°F and 75°F).



8.3 A decibel meter having shall be used to monitor noise levels and collect data. The meter shall be calibrated to NIST standards and shall have a minimum operation range of 30 - 120 dBa over a minimum frequency range of 30 - 5,000 Hz.

8.4 Unless otherwise specified cycling shall continue for a minimum of 30 minutes or 1,000 cycles whichever is longer or until a noticeable squeak has been produced.

8.5 Monitor the sound level for the entire test period. For the peak sound level period, average a 3-minute data acquisition for each test sequence using the "slow" setting on the meter.

8.6 At the conclusion of the test period conduct a baseline sound level measurement (3 minute average).

## 9. EVALUATION OF RESULTS

9.1 A careful and immediate examination shall be made as required by the specifications covering the material or product being tested.

9.2 A squeak for any test sample shall be defined as having a cyclic peak noise measurement more than 3.0 dBA greater than the peak unloaded apparatus measurements.

## 10. RECORDS AND REPORTS

The following information shall be recorded, unless otherwise prescribed in the specifications covering the material or product being tested:

10.1 Sub-floor type, thickness, density and conditioning

10.2 Type of fastener and its dimensions, or number or description of part.

10.3 Cycle rate.

10.4 Total cycles.

10.5 Fastener type.

10.6 Report any testing deviations.

10.7 Results of all testing.

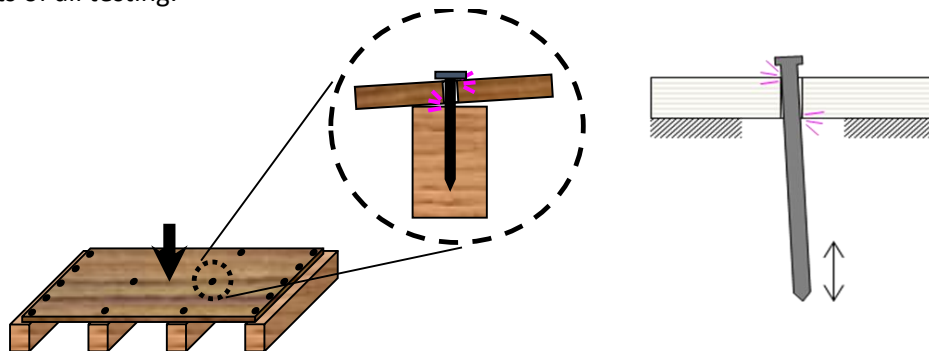


Figure A1. Squeaking occurs between nail and subfloor







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