**Petition for Declaratory Statement**
**Before the Florida Building Commission**

**Nichiha USA, Inc.**
6465 E. Johns Crossing
Johns Creek, GA 30097

**Carolina Drake Albano**
Interim Technical Manager
Phone: 770-805-9466
Fax: 770-805-9467
E-Mail: cdrake@nichiha.com

**DS 2014-115**

Nichiha's Legal Representative: **Bruce C. McCall**
Miller & Martin, PLLC
1180 West Peachtree St.,
Suite 2100
Atlanta, GA 30309
Phone: 404-962-6472
Fax: 404-962-6362
E-mail: bcmccall@millermartin.com

**Code Section on which the Declaratory Statement is sought:**

2010 Florida Building Code Residential, Sections R703, R703.4, R703.10.2 in Chapter 7: Wall Covering

**Background:**

Nichiha USA, Inc. is a Georgia-based manufacturer of fiber cement lap siding used in residential construction throughout the southeast United States. It has come to our attention that 7-1/4" wide fiber cement lap siding is being installed in a manner which may be a threat to public safety. Nichiha's Florida Approval Number is FL-12098 for the residential siding family of products.

The above-referenced code sections are not clear on the appropriate spacing of fasteners, nor does it specify when fastener heads can be concealed or exposed. The code leaves room for interpretation of the manufacturers' installation instructions to the code officials and installers at large.

Nichiha has found through independent testing, research, and engineering calculations that, by ignoring a sentence in the testing standard, a testing lab or manufacturer can increase wind resistance by up to 170 percent.

We will provide proof of this statement in this document and we seek a declaratory statement that disallows blind nailed installation of this width of siding in the areas in question while testing is

performed in the appropriate manner and in accordance with the intent of the wind load testing standard.

**Reason for Test Method ASTM E330**

ASTM E330 is the Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Pressure Difference. Section 4: Summary of Test Method states: This test method consists of sealing the test specimen into or against one face of a test chamber, supplying air to or exhausting air from the chamber according to a specific test pressure difference across the specimen and observing, measuring, and recording the deflection, deformations, and nature of any distress or failures of the specimen. Section 5 states this test method is typically intended to represent the effects of a wind load on exterior building surface elements.

Section 11.1.1 of ASTM E330 states that the plastic film applied to cover the specimen must not prevent movement or failure of the specimen. "Apply film, loosely with extra folds of material at each corner and at all offsets and recesses. When the load is applied, there shall be no fillet caused by tightness of plastic film."

**Independent Evaluation of Fiber Cement Lap Siding Design Pressures**

Progressive Engineering, Inc. (report dated 1/8/2014 and attached) conducted an evaluation of fiber cement lap siding design pressures. In this test, ASTM E330 tests were performed on three different manufacturers' fiber cement lap siding boards. The plastic film was installed loose, per the standard; however, the specimens were also tested with plastic film installed tightly. The table below is taken from PEI Report 2013-1259 (attached).

All specimens were installed on 20-gage metal framing spaced at 16" on center, with a number 8 screw in the concealed fastener head condition. The reason for testing on metal is to avoid fastener pull-out failures (which are heavily dependent on the density of the lumber used). Metal framing also creates a level playing field for all manufacturers as fastener pull-through is mostly dependent on the cross-sectional strength of the siding itself. All siding widths tested were 7-1/4 in.

| Manufacturer | Plastic Film Install | Ultimate Test Pressure (pdf) |
|---|---|---|
| Nichiha | Loose (2 mil) | 98 |
| Nichiha | Loose (4 mil) | 92 |
| Nichiha | Tight (2 mil) | 147 |
| CertainTeed | Loose (2 mil) | 66 |
| CertainTeed | Tight (2 mil) | 132 |
| James Hardie | Loose (2 mil) | 71 |
| James Hardie | Tight (2 mil) | 122 |

The above test pressures prove that ignoring that one sentence in the testing standard can yield inflated wind resistance values of upwards of 170 percent.

A manufacturer having these test results can erroneously allow installation in a concealed fastener manner to the detriment of the customer or homeowner. Allowing the blind nail of this size lap siding in areas exceeding the loose film test pressures listed in the table above will cause fastener to fail at much lower pressures than the customer expects and presents a public hazard.

According to the 2010FBCB wind speed maps, areas with basic wind speeds of 130 mph, especially Wind-Borne Debris areas, cannot allow the blind-nail application of 7-1/4" wide fiber cement lap siding and remain in compliance with the code, regardless of what engineering calculation or test results have been submitted in support.

**Florida Building Code Relevance**

Sections 703.4 and 703.10.2 in the 2010 Residential Florida Building Code are not clear on fastening schedules and do not take into account design pressures, exposure category, and basic wind speeds as determining factors for installation of siding.

Table R703.4 features "note t" under "Spacing of Fasteners." Note t only specifies the nail types to be used when face nailing and blind nailing, without specifying when blind nailing or face nailing is required or appropriate.

Section R703.10.2 Lap Siding only states that "lap siding courses may be installed with the fastener heads exposed or concealed, according to Table R703.4 or approved manufacturers' installation instructions."

If the code defers to the manufacturers and the manufacturers use incorrect test methods, what is the recourse?

---

## Question

**Public safety is the foundational purpose of building codes and thus clear and specific guidance set into the building code is essential to eliminating the potential for confusion and reducing risk in the built environment. Fiber cement lap siding is a commodity product governed by a set of generally accepted industry-wide standards that should result in only minor variances in test performance of physical characteristics and wind load resistance between manufacturing brands. Therefore, should the rules governing the installation of fiber cement lap siding be revised or expanded in Florida Building Code sections R703.4 and R703.10.2, particularly with respect to fastening requirements, in order to provide to Florida consumers, installers, and code officials a unified standard of installation, accounting directly for specific design wind engineering criteria to govern limitations, that elevates public safety while reducing uncertainty and unnecessary risk from storm damage?**

---

**Summary**

Petitioner respectfully believes it is in the best interest of the citizens of Florida, with regards to public safety, for the committee to revise or expand the code sections (highlighted above) pertaining to the installation of fiber cement siding. It is the petitioner's opinion that the committee take into account the attached data and use this data in revising the installation practices as it pertains to concealed-nailing of 7-1/4" or wider lap siding in exposure category C with basic wind speeds of 130 mph or greater.

Respectfully submitted,

Nichiha USA, Inc.

By: _____

Carolina Drake Albano

Interim Technical Manager

Progressive Engineering Inc.

PREPARED FOR: NICHIHA USA

# Evaluation of Fiber-Cement Lap Siding Design Pressures


Prepared By: Timothy A. Baldridge, Cole Reese, and Jason Holdeman

1/8/2014

Reviewed by: Carl D. Fussner 1/16/2014

CARL D FUSSNER LICENSE No 71907 STATE OF FLORIDA PROFESSIONAL ENGINEER

Date Signed: Jan 16,2014

TIMOTHY A. BALDRIDGE REGISTERED PE19800097 STATE OF INDIANA PROFESSIONAL ENGINEER

Date Signed: Jan 08,2014

P.E.I. Engineering Services, Inc.

58640 State Road 15
Goshen, IN 46528
Phone: (574) 533-0337 - Fax: (574) 533-9736
FL C.O.A. Number 27447

## EXECUTIVE SUMMARY

Progressive Engineering, Inc. (PEI) researched and compared the listed data from various fiber cement lap siding products available in the United States. Nichiha (NichiBoard), Certainteed (Weatherboards), and James Hardie (HardiePlank), are the three major brands sold and installed in the United States. Data was obtained from a variety of sources including: International Code Council, Texas Department of Insurance, Miami-Dade County, and PEI tests.

The listed allowable design pressures for the HardiePlank assemblies appeared consistently higher than both NichiBoard and Weatherboard equivalent assemblies. Weatherboard data was more comparable to NichiBoard data, but similar NichiBoard assemblies still yielded consistently lower allowable values than the Certainteed products. In addition to the noticeable difference in allowable design pressures, it was also observed that the allowable pressures for both James Hardie and Certainteed lap siding had not been adjusted for the allowable fastener withdrawal capacity. This adjustment is required per the AC90 test standard to which most of these lap siding configurations appeared to have been tested.

A series of tests was then performed to validate the reported design pressures for the various products and to evaluate the impact of deviating from the test procedure. The testing portion of this project was limited to steel framing with screw fasteners in a blind-nail application using 7.25" lap siding. Steel was chosen for comparison to eliminate the inherent variability of wood fastener withdrawal. The test was performed with the plastic film applied loose, in accordance with ASTM E330, and tight to determine the difference. There was a significant variation between the two methods. The average ultimate test pressure difference from the tight film application was **74% higher** than the loose film application as required in ASTM E330 and ICC-ES AC90. The resulting test pressures for the different siding manufacturers when compared using an identical test method were very similar; the NichiBoard tested higher than the other two for both test methods. An incorrect method of testing significantly skews results higher when evaluating a blind-nailed lap siding product.

## FINDINGS

Refer to the "Research Information Section" and "Test Results Section" of this document for the information gathered during this study.

## CONCLUSION

The ultimate test pressures were reduced by a safety factor of 3.0 in accordance with ICC-ES AC90 and then compared to the reported allowable pressures for the 7.25" lap siding products blind fastened to 16" o.c. and 24" o.c. framing and this raised additional questions. In many cases the reported allowable pressure was within a few PSF of the ultimate test pressure we reported for loose film application and was less than a 2.0 safety factor for our tests with tight film application. The reported allowable design pressure for 8.25" siding fastened to 24" o.c. framing was in some cases higher than the design pressure we calculated from our tests. In one case, the reported design pressure for 9.5" HardiePlank siding fastened with the same screws used in our tests on a 20 gauge steel frame, studs spaced 16" o.c., resulted in an ultimate pressure that was 47 psf higher than the 7.25" product we tested with the plastic film tight! This same value was used to extrapolate design pressures for other siding sizes on 16" o.c. and 24" o.c. frame spacing.

The inconsistency was not limited to designs using steel framing and screws, but also was true for fasteners into wood framing. The wood fasteners typically had a smaller head diameter than the 3/8" head diameter screw used with steel. Since the failure mode in our tests was predominantly board breakout or pull over at the fasteners, the design pressure with smaller fastener heads is expected to be lower. Below, Table A targets a few of the inconsistencies and focuses mostly on the 7.25" siding size as it provides a better comparison to the test results found in Table 4.

While this study found obvious inconsistencies with the testing and calculation approach for the fiber-cement lap siding industry, it should be noted that PEI is in no way dictating which values are in fact representative of the actual forces experienced during a hurricane or high wind speed event. Further evaluation into these "real world" forces would require extensive study and full scale wind tunnel evaluation to better establish a representative small scale static pressure test procedure. In the case of blind-nail siding application it is unclear how much movement of the unsupported edge is permissible and reasonable in a static pressure test. The opening of the bottom edge of the siding during a load event may result in pressure equalization. Vinyl siding testing procedures apply a Pressure Equalization Factor (PEF) to the test pressure, ranging from 0.36 to 0.70 based on the information reviewed in this study. (See ASTM D3679 and ICC-ES AC37) This factor is currently not used in the fiber-cement siding industry.

As the tests performed in this program have shown the test method has a great deal of impact on the final result and places a large burden and responsibility on the manufacturer, testing laboratory, engineering firm, and product certification body to insure that the test is in accordance with the prescribed procedures. Additionally, the engineering practice of using the fastener load to calculate design pressures for other frame spacing and siding sizes should be addressed; this is especially true in the case of blind-nail application since the tributary area and the prying effect must be considered with the increasing moment exerted at the fastener as the siding size increases. In our experience these calculations should be limited to interpolation, in most cases, to insure consistent data values. All three of the companies evaluated produce siding products that conform to ASTM C1186 at a minimum classification of Type A, Grade II, with similar size and installation procedures; therefore, given this similarity it is expected that the windload test results would be similar.

To this point, a standardized test procedure needs to be enforced for the lap siding industry, whether it is fiber-cement, vinyl, wood-based or composite, in order to create a level and competitive market for this type of product and to insure the safe application for a design professional and/or consumers. It is believed that the next step is the education of the Product Certification Bodies at the national and state level of these inconsistencies and work with them to develop an industry acceptable test method.

| Table A: Examples of Inconsistent Data | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Company** | **Siding Size (in)** | **Framing Material** | **Frame Spacing (in)** | **Fastener** | **Fastener Length (in)** | **Fastening Blind / Face** | **Allowable Pressure (psf)** |
| Certainteed | 5.25 | 2x4 #2 SPF | 16 | 6d Maze Roofing Nails | 2 | Blind | 40 |
| | | 2x4 #2 SPF | 16 | 8d Maze Nails | Not Listed | Face | 53 |
| | | 2x4 #2 SPF | 16 | 8d Maze Nails | Not Listed | Blind | 62 |
| | 7.25 | 2x4 #2 SPF | 16 | 6d Maze Roofing Nails | 2 | Blind | 64 |
| | | 20ga Steel | 24 | Self-Drilling Screws | 1.625 | Blind | 19 |
| | 9.25 | 20ga Steel | 16 | Self-Drilling Screws | 1.625 | Blind | 19 |
| | 12 | 20ga Steel | 16 | Self-Drilling Screws | 1.625 | Face | 23 |
| | | 20ga Steel | 16 | Self-Drilling Screws | 1.625 | Blind | 25 |
| James Hardie | 5.25 | 2x4 (SG ≥ 0.42) | 16 | 11ga Roofing Nail | 1.75 | Blind | 56.4 |
| | | Hem-Fir | 16 | 11ga Roofing Nail | 1.75 | Blind | 100.79 |
| | 7.25 | 2x4 DF | 16 | 11ga Roofing Nail | 1.75 | Blind | 51 |
| | | 2x4 (SG ≥ 0.42) | 16 | 11ga Roofing Nail | 1.75 | Blind | 54 |
| | | Hem-Fir | 16 | 11ga Roofing Nail | 1.75 | Blind | 67 |
| | | 2x4 (SG ≥ 0.42) | 16 | 6d Common Nail | 2 | Face | 51 |
| | | 2x4 (SG ≥ 0.42) | 16 | 8d Common Nail | 2.5 | Face | 56 |
| | | 20ga Steel | 16 | Self-Drilling Screws | 1.25 | Blind | 55 |
| | | 20ga Steel | 16 | Self-Drilling Screws | 1.625 | Blind | 78 |
| | | W-Fir Studs | 16 | Siding Nail | 2.5 | Blind | 32 |
| | 9.5 | 20ga Steel | 16 | Self-Drilling Screws | 1.25 | Blind | 55 |
| | | 20ga Steel | 16 | Self-Drilling Screws | 1.625 | Face | 55 |
| | 6.25 | 2x4 DF | 16 | Maze Roofing Nail | 2.5 | Blind | 25 |
| Nichiha | 7.25 | 2x4 DF | 16 | 6d Box Nail | 2 | Face | 76 |
| | | 2x4 DF | 16 | 6d Box Nail | 2 | Blind | 17 |
| | | 2x4 SPF | 16 | Maze Roofing Nail | 1.75 | Blind | 22 |
| | | 2x4 SPF | 16 | Maze Roofing Nail | 1.75 | Blind | 22 |
| | | 2x4 DF | 16 | Maze Roofing Nail | 2.5 | Blind | 22 |
| | 12 | 2x4 DF | 24 | Maze Roofing Nail | 2.5 | Blind | 9 |

# RESEARCH INFORMATION SECTION

**THE FOLLOWING PAGES CONTAIN SOME OF THE RESEARCH INFORMATION GATHERED DURING THE COURSE OF THIS PROJECT. ADDITIONALLY A SELECTION OF CHARTS WAS CREATED TO GRAPHICALLY DISPLAY SOME OF THE VARIATIONS DISCOVERED.**

**Research & Data Acquisition:**

Online research was conducted by Progressive Engineering, Inc. (PEI) to determine the options available for fiber cement lap siding in the United States. Data from the various fiber cement lap siding manufacturers was obtained from the International Code Council (ICC), Texas Department of Insurance (TDI), Miami-Dade County, and various engineering reports and test data. Nichiha (NichiBoard), Certainteed (Weatherboards), and James Hardie (HardiePlank and Artisan) are the three major brands sold and installed in the United States. The following is a summary of the data obtained for each of the major fiber cement lap siding brands.

Nichiha USA allowable design data was obtained from a variety of sources including ICC, TDI, Miami-Dade County, and PEI test data. NichiBoard (also called Ecoplank) is manufactured in widths ranging from 5-1/4 inches to 12 inches wide, and have a thickness of 5/16-inch. Fastening methods include both face and blind nailed/screwed conditions into dimensional lumber, plywood sheathing, or 20ga steel studs. In all cases, the siding was installed with 1-1/4-inch overlap. The following summarizes the data obtained from the various sources:

ESR-2894 (Published by ICC):

| | |
|---|---|
| Siding Widths: | 6-1/4", 7-1/4", 8-1/4", and 12" |
| Framing Material: | 2x4 SPF, 2x4 DF, 2x6 SPF, and 20ga Steel |
| Frame Spacing: | 16" and 24" |
| Fastener Options: | *Wood Studs*—11ga Maze Roofing Nail and 6d Double HD MAZE Coil Nail<br>*Steel Studs*—Aerosmith Steel Pin #2385A |

Total Number of Width & Fastener Configurations = 11

EC-59 (Published by TDI):

| | |
|---|---|
| Siding Widths: | 6-1/4", 7-1/4", and 8-1/4" |
| Framing Material: | 2x6 #2 SPF and 20ga Steel Studs |
| Frame Spacing: | 16" O.C. |
| Fastener Options: | *Wood Studs*—1-3/4" Stormguard R-104 Double HD Galv. Asphalt & Fiberglass Shingle Nails, 2" 6d CLH Double HD Coil Nail, and 2-1/2" 6d CLCEM117 Double HD coil siding nail<br>*Steel Studs*—0.100" x 1-1/2" Gripshank® steel pins |

Total Number of Width & Fastener Configurations = 5

Miami-Dade County Notice of Acceptance:

| | |
|---|---|
| Siding Widths: | 5-1/4" Min. and 12" Max. |
| Framing Material: | 2x4 Wood Studs or 2x6 18ga Steel Studs w/ 5/8" Structural I Grade Plywood (SG ≥ 0.50) |
| Frame Spacing: | 16" O.C. (Fasteners Spaced @ 8" O.C.) |
| Fastener Options: | 8d x 2-1/2" Common Nail (Fastened to Plywood Sheathing) |

Total Number of Width & Fastener Configurations = Max & Min Options Shown

PEI Test Data & Calculations:

| | |
|---|---|
| Siding Widths: | 6-1/4", 7-1/4", 8-1/4", and 12" |
| Framing Material: | 2x4/2x6 SPF, 2x4 DF, and 20ga Steel Studs |
| Frame Spacing: | 16" and 24" |
| Fastener Options: | *Wood Studs*—6d Double HD Maze Box Nail, 1-3/4" Maze Roofing Nail, 2-1/2" Maze Roofing Nail<br>*Steel Studs*—Aerosmith Fastening Systems VersaPin |

Total Number of Width & Fastener Configurations = 88

Certainteed allowable design data was obtained from a variety of sources including ICC, TDI, and Miami-Dade County. Weatherboards are manufactured in widths ranging from 5-1/4 inches to 12 inches wide, and have a thickness of 5/16-inch. Fastening methods include both face and blind nailed/screwed conditions into dimension lumber, structural sheathing, or 20ga steel studs. In all cases, the siding was installed with 1-1/4-inch overlap. The following summarizes the data obtained from the various sources:

ESR-1668 (Published by ICC):

| | |
|---|---|
| Siding Widths: | 5-1/4", 6-1/4", 7-1/4", 8-1/4", 9-1/4", and 12" |
| Framing Material: | 2x4 #2 SPF, 2x4 #2 SPF w/ 7/16", 20ga Steel Studs, 20ga Steel Studs w/ 7/16" OSB, and 16ga Steel Studs |
| Frame Spacing: | 16" and 24" |
| Fastener Options: | *Wood Studs*—8d Box Nails, 6d Box Nails, 2" 6d Roofing Nails (Maze Nails #HD-105), 7d Nails (Maze Nails #225HD-022), 6d Nails (Maze Nails #200HD-018), 1-3/4" Roofing Nails, 8d Nails (Maze Nails #C-CEM8), and 1-1/2" Roofing Nails<br>*Steel Studs*—0.100"x1.5" Knurled Pins (ET&F #AGS-100-0150NA) and 1-5/8" S/D Screw (ITW Buildex "Rock-On" S-12 #2159500) |

Total Number of Width & Fastener Configurations = 66

EC-16 (Published by TDI):

| | |
|---|---|
| Siding Widths: | 5-1/4", 6-1/4", 7-1/4", 8-1/4", and 9-1/4" |
| Framing Material: | 2x4 SPF and 16ga Steel Stud |
| Frame Spacing: | 16" O.C. |
| Fastener Options: | *Wood Studs*—2-1/2" 7d Galv. Siding Nails, and 2" 6d Galv. Roofing Nails<br>*Steel Studs*—#8 x 1-5/8" S/D Wafer Head Screws |

Total Number of Width & Fastener Configurations = 15

Miami-Dade County Notice of Acceptance:

| | |
|---|---|
| Siding Widths: | ≤ 9.5" |
| Framing Material: | 20ga Steel Studs w/ 5/8" CDX Grade Plywood Sheathing |
| Frame Spacing: | 16" O.C. (Fasteners @ 16" O.C. Through Sheathing into Studs) |
| Fastener Options: | ITW Buildex Hi-Lo Rock-On #9 x 2-1/4" x 0.395" HD Ribbed Bugle Screws |

Total Number of Width & Fastener Configurations = 1 Option (Valid for Widths ≤ 9.5")

James Hardie allowable design data was obtained from a variety of sources including ICC, TDI, Miami-Dade County, and an engineering evaluation prepared by Ronald I Ogawa & Associates, Inc. (RIO). HardiePlank (also called Cemplank) is manufactured in widths ranging from 4 inches to 12 inches wide, and have a thickness of 5/16-inch. The Artisan product is manufactured in widths ranging from 5-1/4 inches to 8-1/4 inches, and has a thickness of 5/8-inch. Fastening methods include both face and blind nailed/screwed conditions into dimension lumber, structural sheathing, or 20ga steel studs. In all cases, the siding was installed with 1-1/4-inch overlap. The following summarizes the data obtained from the various sources:

ESR-2290 (Published by ICC):

| | |
|---|---|
| Siding Brand: | HardiePlank (also called Cemplank) |
| Siding Widths: | 4", 5-1/4", 6", 6-1/4", 7-1/4", 7-1/2", 8", 8-1/4", 9-1/4", 9-1/2", and 12" |
| Framing Material: | 2x4 Wood (SG ≥ 042), 20ga Steel Studs, 7/16" OSB Sheathing |
| Frame Spacing: | 16" and 24" |
| Fastener Options: | *Wood Studs/Sheathing*—6d Common Nail, 8d Common Nail, No. 11ga 1-1/4" Roofing Nail, No. 11ga 1-3/4" Roofing Nail, 2" 6d Siding Nail, 1-1/2" Long Corrosion Resistant Nail (0.091" Shank and 0.221" HD)<br>*Steel Studs*—0.100" x 1.5" ET&F Pin (0.25" HD), 0.100" x 1.5" ET&F Panelfast (0.313" HD), No. 8-18 x 1-5/8" Ribbed Bugle Head Screw, and No. 8 x 1-1/4" Ribbed Wafer Head Screws |
| Total Number of Width & Fastener Configurations | = 150 |

EC-23 (Published by TDI):

| | |
|---|---|
| Siding Brand: | HardiePlank (also called Cemplank) |
| Siding Widths: | 5-1/4", 6-1/4", 7-1/4", 7-1/2", 8", 8-1/4", 9-1/4", 9-1/2" and 12" |
| Framing Material: | 2x4 SPF, 2x4 DF, 2x4 SPF w/ 7/16" Wood Structural Panels, and 20ga Steel Studs |
| Frame Spacing: | 16" and 24" |
| Fastener Options: | *Wood Studs/Sheathing*—2-1/2" Corrosion Resistant Nail (0.092" Shank and 0.222" HD), 1-3/4" 11ga Roofing Nail, 1-1/2" Ring Shank Nail (0.090" Shank and 0.215" HD), No. 8 x 1-5/8" Ribbed Wafer Head Screw, and 2-3/8" 8d Ring Shank Box Nail, 2" Corrosion Resistant Nail (0.092" Shank and 0.222" HD)<br>*Steel Studs*—0.100" x 1.5" x 0.25"HD ET&F Knurled Pin |
| Total Number of Width & Fastener Configurations | = 27 |

EC-55 (Published by TDI):

| | |
|---|---|
| Siding Brand: | Artisan Lap Siding |
| Siding Widths: | 5-1/4", 7-1/4", and 8-1/4" |
| Framing Material: | 2x4 SPF Lumber |
| Frame Spacing: | 16" or 24" |
| Fastener Options: | 2-1/4" Corrosion Resistant Nail (0.092" Shank and 0.225" HD), 2-1/2" Corrosion Resistant Nail (0.092" Shank and 0.225" HD) w/ No. 16ga x 2-1/2" Finish Nail, and 2-3/8" 8d Box Nail w/ No. 16ga x 2-1/2" Finish Nail |

Total Number of Width & Fastener Configurations = 9

Miami-Dade County Notice of Acceptance:

| | |
|---|---|
| Siding Brand: | HardiePlank (also called Cemplank) |
| Siding Widths: | ≤ 9.5" |
| Framing Material: | 2x4 SPF Studs w/ 5/8" APA Rated Plywood, and 20ga Steel Studs w/ 5/8" APA Rated Plywood |
| Frame Spacing: | 16" O.C. (Fasteners @ 16" O.C. Through Sheathing into Studs) |
| Fastener Options: | *Wood Studs*—2-1/2" Corrosion Resistant Nail (0.092" Shank and 0.223" HD)<br>*Steel Studs*—No. 8-18 x 2-1/4" Bugle Head Screw (0.315" HD) |

Total Number of Width & Fastener Configurations = 2 Options (Valid for Widths ≤ 9.5")

Engineering Evaluation Report (Prepared by RIO):

| | |
|---|---|
| Siding Brand: | HardiePlank (also called Cemplank) |
| Siding Widths: | 5-1/4", 6-1/4", 7-1/4", 7-1/2", 8", 8-1/4", 9-1/4", 9-1/2", & 12" |
| Framing Material: | W-Fir Studs, Hem-Fir Studs, DFL Studs, SPF Studs, & 20ga Steel Studs |
| Frame Spacing: | 16" and 24" |
| Fastener Options: | *Wood Studs*—2-1/2" Siding Nail (0.093" Shank), No. 11ga x 1-3/4" Roofing Nail, No. 11ga x 1-1/4" Roofing Nail, 2" 6d Common Nail, 2-3/8" 8d Ring Shank Box Nail, 8d Siding Nail (0.092" Shank), and 6d Siding Nail (0.092" Shank)<br>*Steel Studs*—0.100"x1.5"x0.25"HD ET&F Knurled Shank Pins, 0.100"x1.5"x0.313"HD ET&F Knurled Shank Pins, and No. 8 x 1-5/8" Ribbed Wafer Head Screws |

Total Number of Width & Fastener Configurations = 216*

**Over 90 percent of these configurations appeared to have been interpolated or extrapolated from data in 15 Ramtech Test Reports.*

Data compiled from the sources listed above were entered into an excel matrix where pivot charts were used to compare and contrast the data obtained. Nichiha and Certainteed products showed similar results between their different sources and were comparable in allowable design pressure data for most cases. Certainteed did, however, have some blind nailed outlier data that outperformed their own assemblies with stronger fastening patterns (See Figure 1 and Figure 5). James Hardie products (specifically HardiePlank) had consistently higher allowable design pressures than both Certainteed's and Nichiha's comparable products and assemblies (See Figure 4). The James Hardie products were also found to have large discrepancies between the different data sources. Specifically, the data obtained from the RIO engineering evaluation report often gave allowable design pressures up to 50% higher than that of an equivalent James Hardie assembly with ICC or TDI approval (See Figure 2). Table 1 lists some examples of data that appears to be out of the ordinary or incorrect.

**Table 1:Examples of Atypical Design Data**

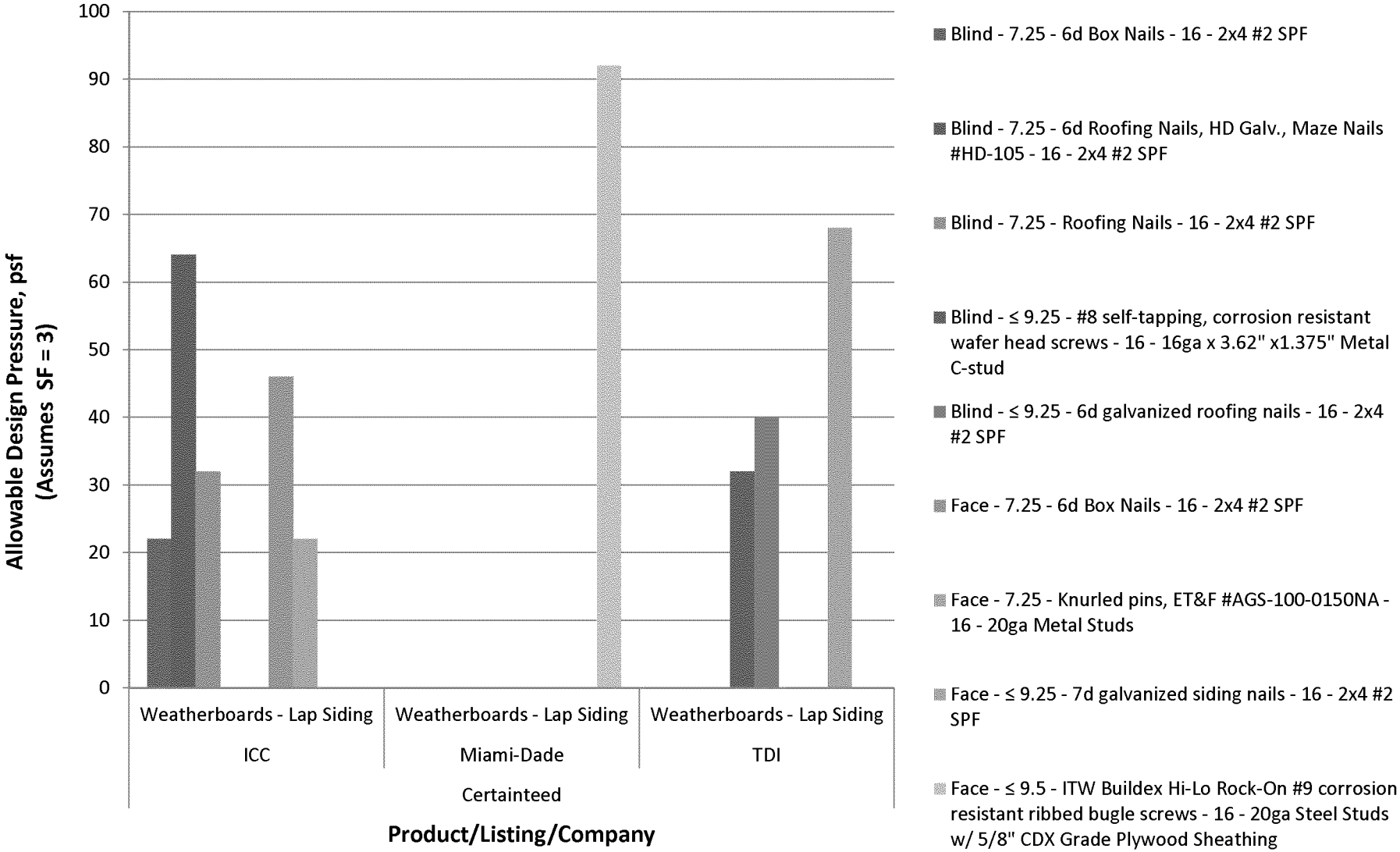
| Company | Siding Width (in) | Framing Type | Frame Spacing (in) | Fastening | Allowable Design Pressure (psf) | Listed Fastener Load (lbs) | Applicable Figure |
|---|---|---|---|---|---|---|---|
| Certainteed (ICC) | 7.25 | 2x4 #2 SPF | 16 | 6d Roofing Nails – Blind | 64 | 43 | Fig. 1 and Fig. 5 |
| Certainteed (ICC) | ≤9.25 | 2x4 #2 SPF | 16 | 7d Siding Nails – Face | 68 | Not Listed | Fig. 6 and Fig. 10 |
| James Hardie (RIO) | 7.25 | 20ga Steel Studs | 16 | No. 8 Ribbed Wafer Head Screw – Blind | 77.55 | 51.7 | Fig. 2 and Fig. 4 |
| James Hardie (RIO) | 8.25 | 20ga Steel Studs | 16 | No. 8 Ribbed Wafer Head Screw – Blind | 66.47 | 51.70 | Fig. 7 and Fig. 9 |

In addition to the allowable pressure data that appeared atypical, many of the listed fastener loads were greater than the corresponding allowable fastener withdrawal load. In the cases where this is evident, the allowable pressures for the assembly shall be adjusted to reflect the allowable fastener withdrawal per AC90 Section 4.1(1b). Table 2 lists a few examples of where the listed fastener load is greater than the allowable fastener load.

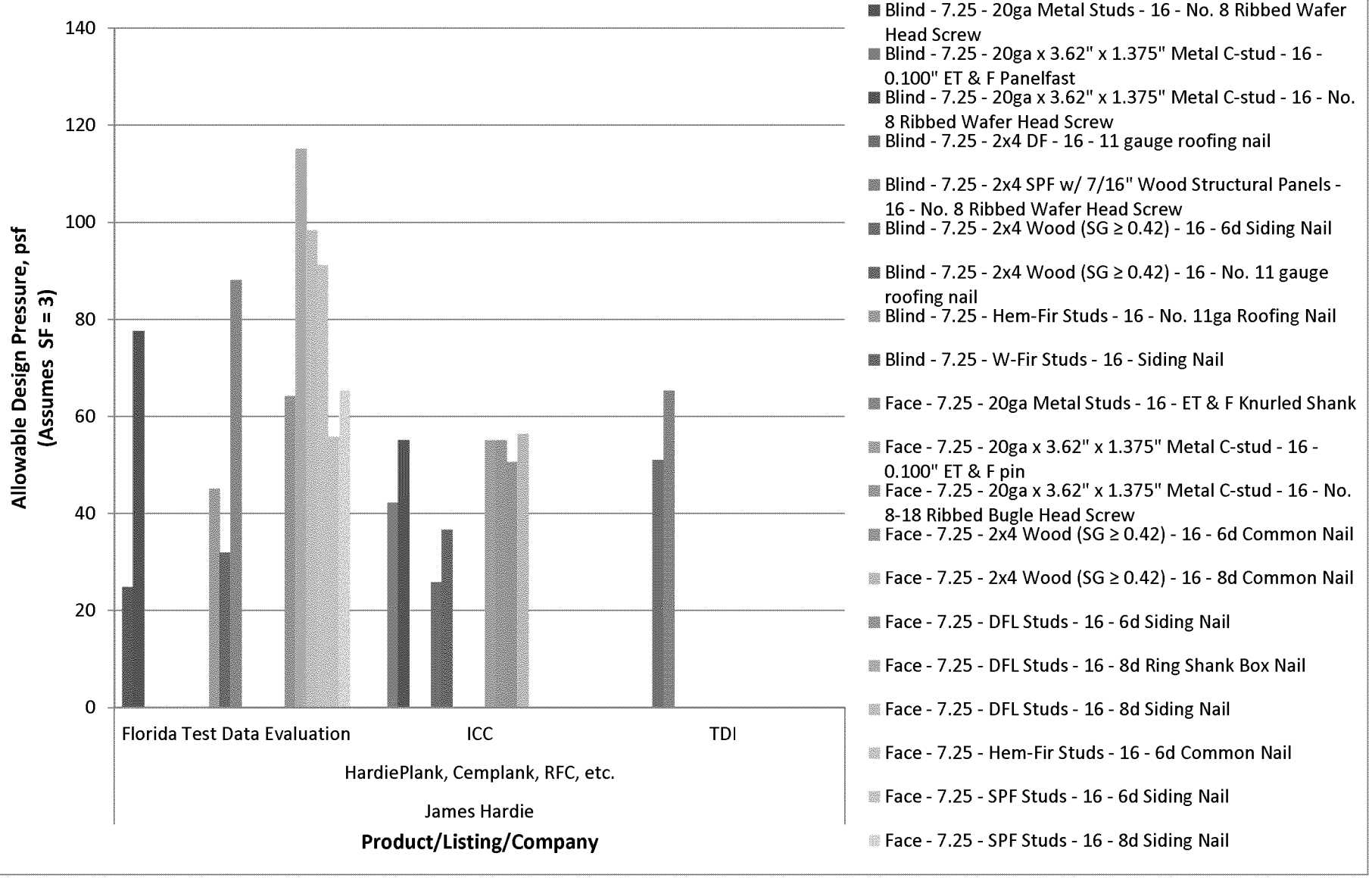
**Table 2: Examples of Listed Fastener Loads Greater than Allowable Withdrawal Loads**

| Company | Framing Type | Fastener | Listed Fastener Load (lbs) | Allowable Fastener Load (lbs) | Applicable Figure |
|---|---|---|---|---|---|
| Certainteed | Spruce-Pine-Fir | 8d Box Nail | 88 | 62 | Fig. 11 |
| James Hardie | Hem-Fir | 6d Common Nail | 60.81 | 51 | Fig. 12 |
| James Hardie | Hem-Fir | 11ga Roofing Nail | 30.1 | 23 | Fig. 12 |

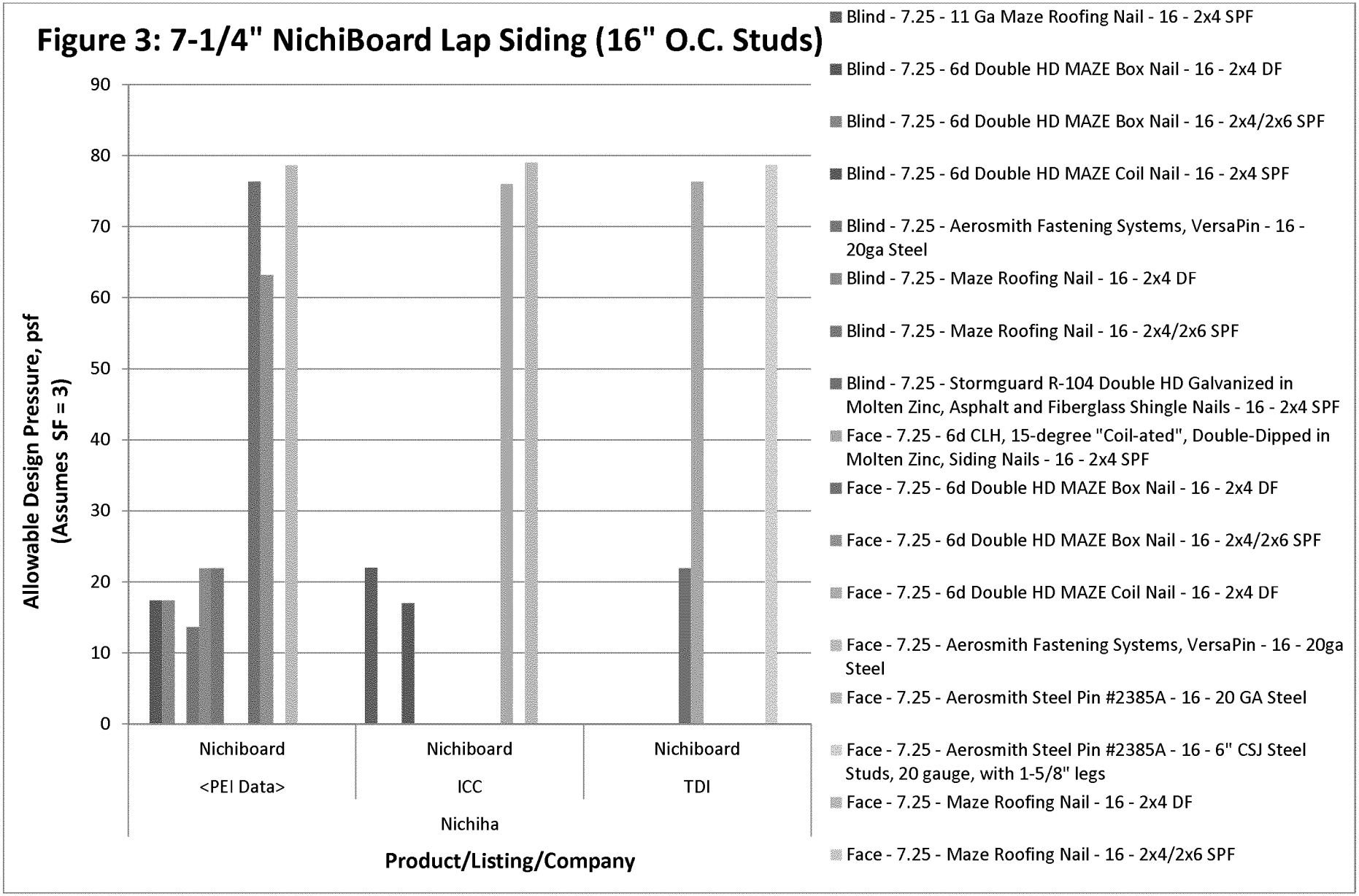
## Figure 1: 7-1/4" - WeatherBoards Lap Siding (16" O.C. Studs)



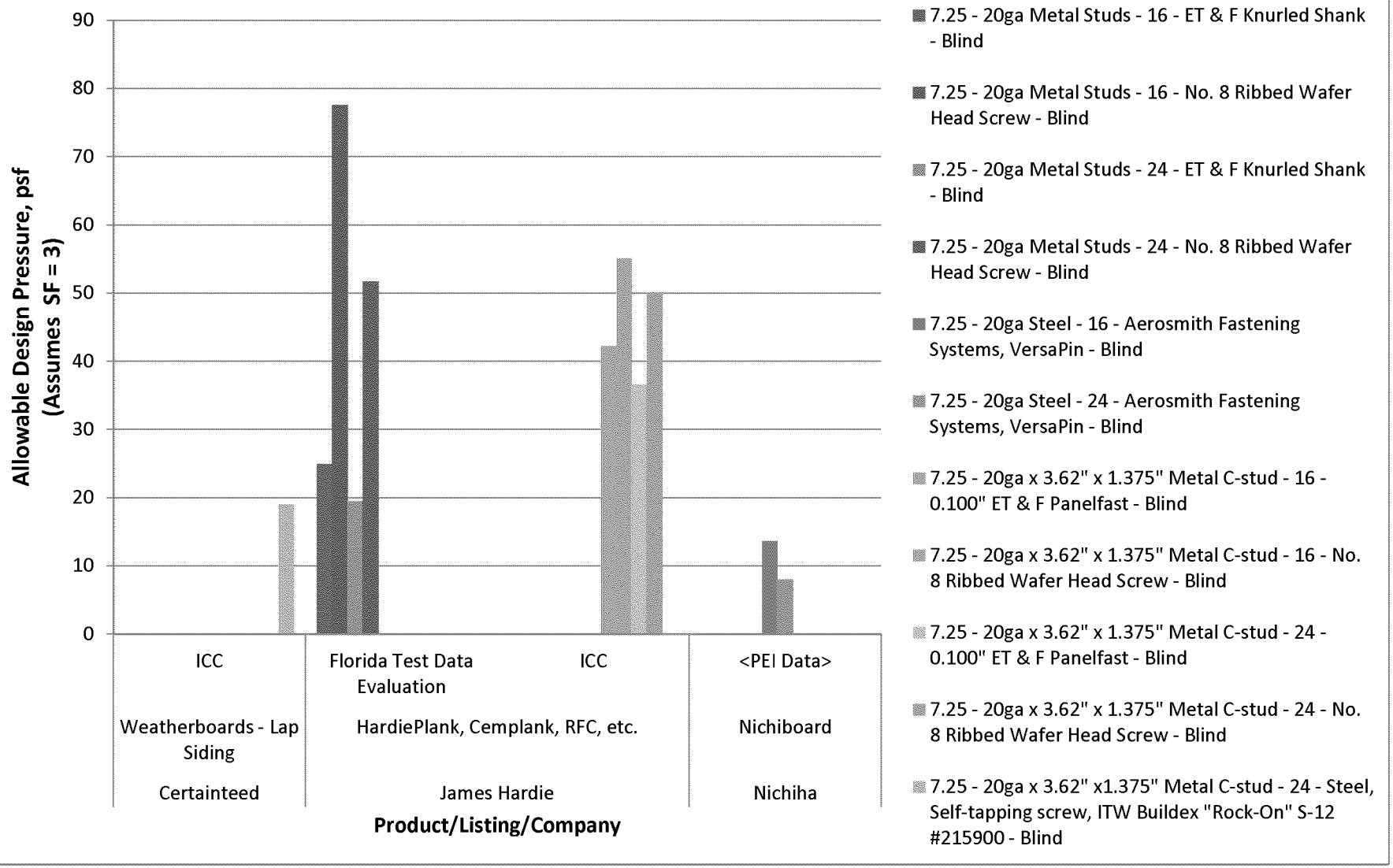
## Figure 2: 7-1/4" HardiePlank Lap Siding (16" O.C. Studs)



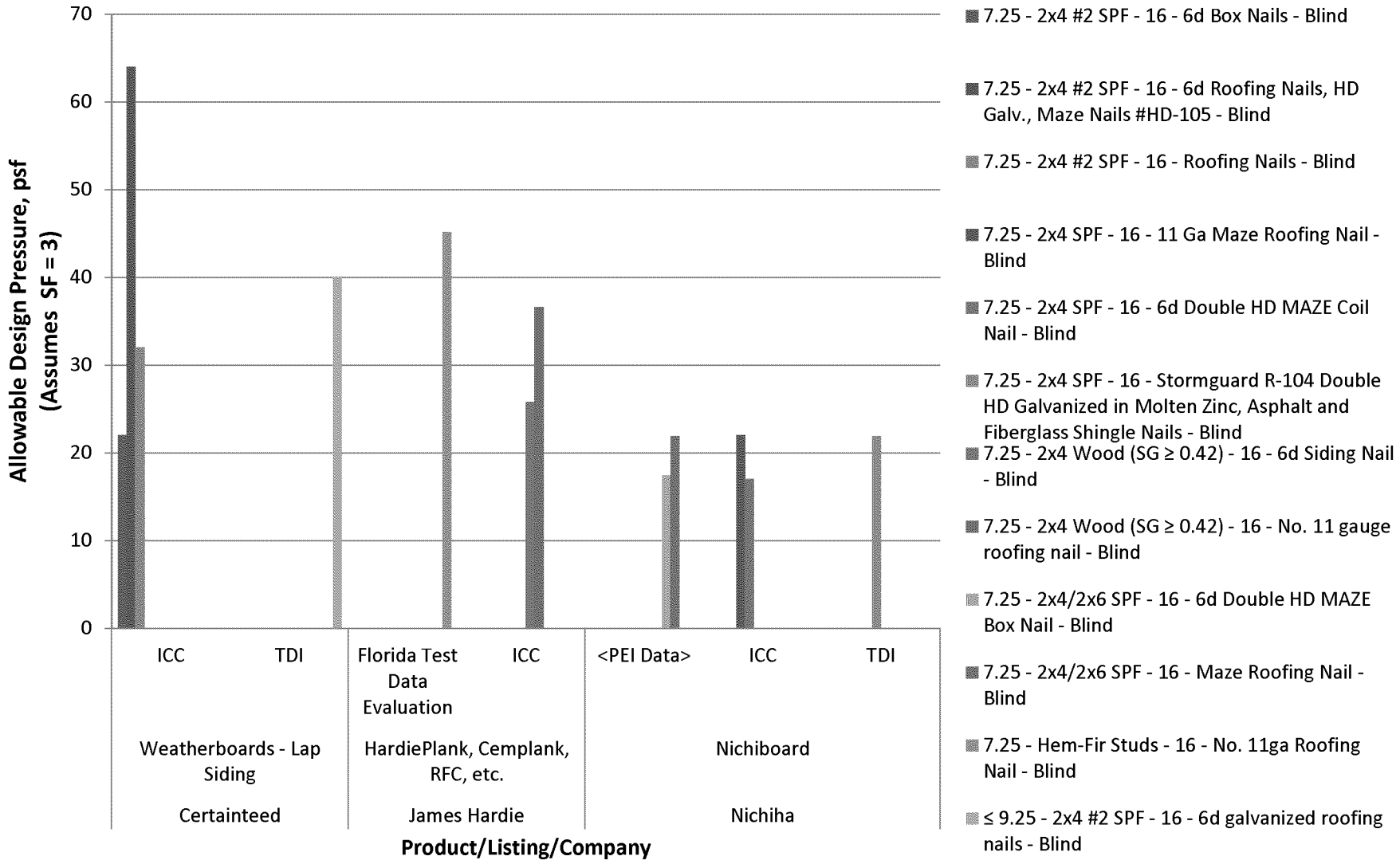
## Figure 3: 7-1/4" NichiBoard Lap Siding (16" O.C. Studs)



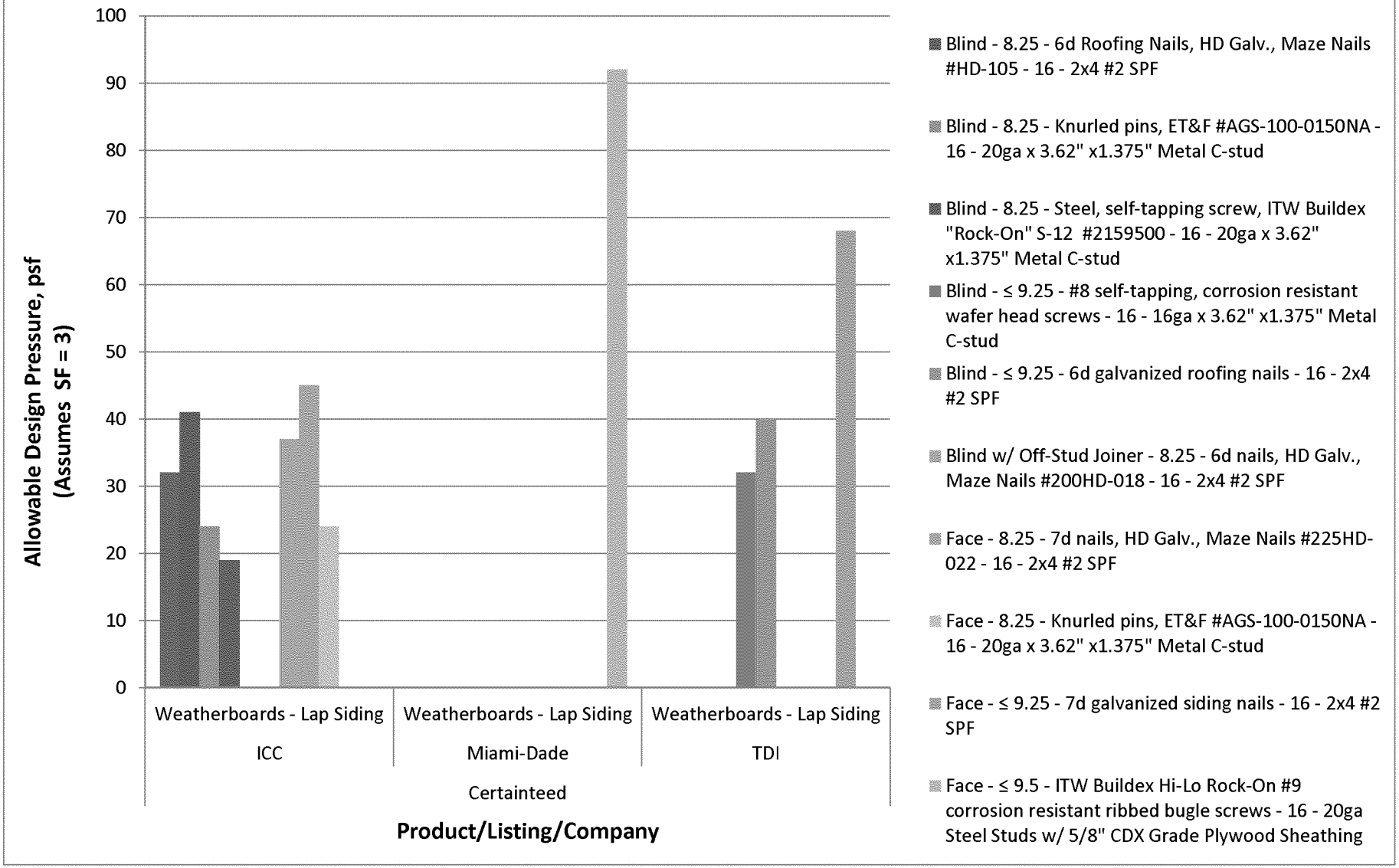
## Figure 4: 7-1/4" - Blind Fastened - 20ga Steel Studs



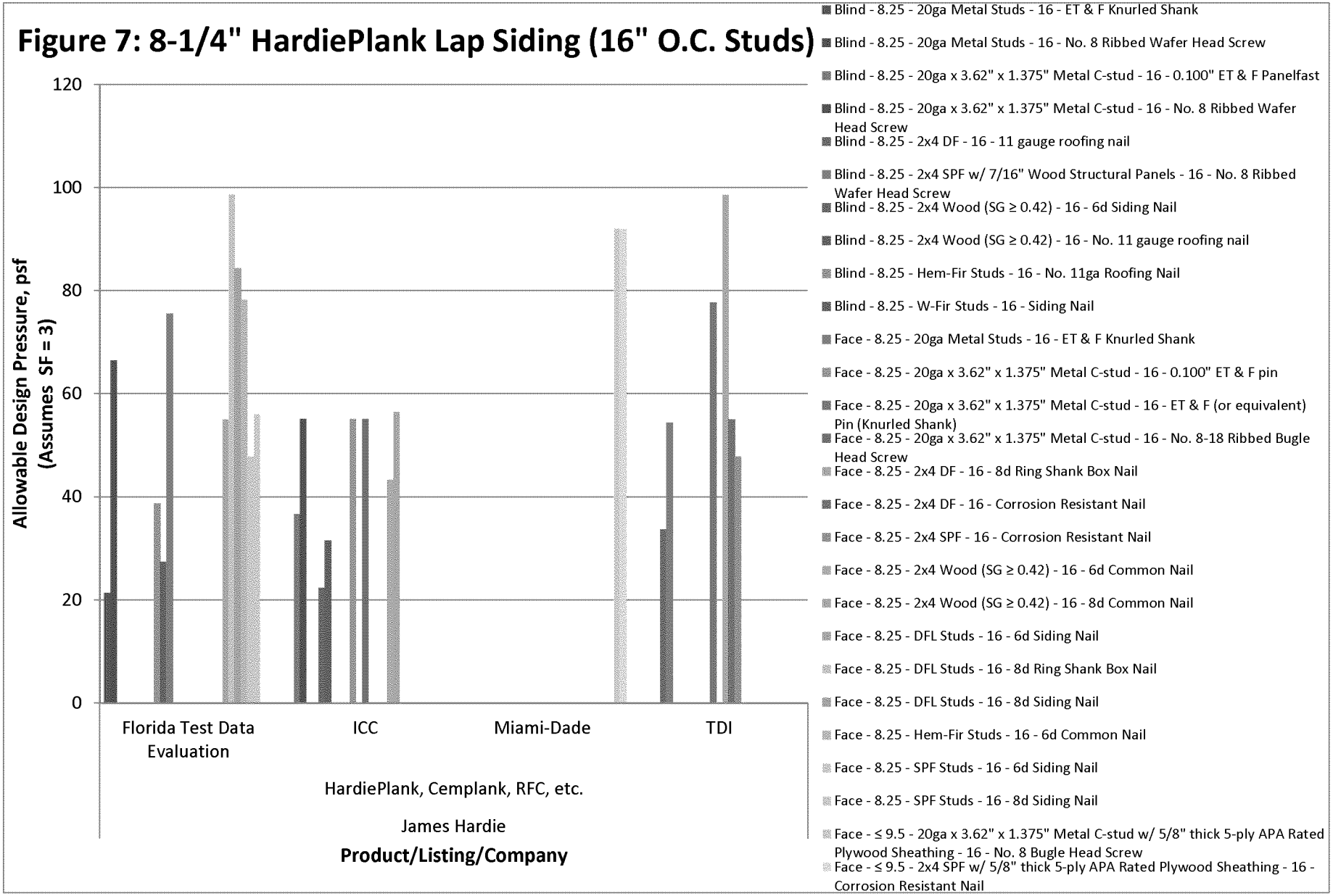
## Figure 5: 7.25" - Blind Fastened - SPF or Hem-Fir Studs



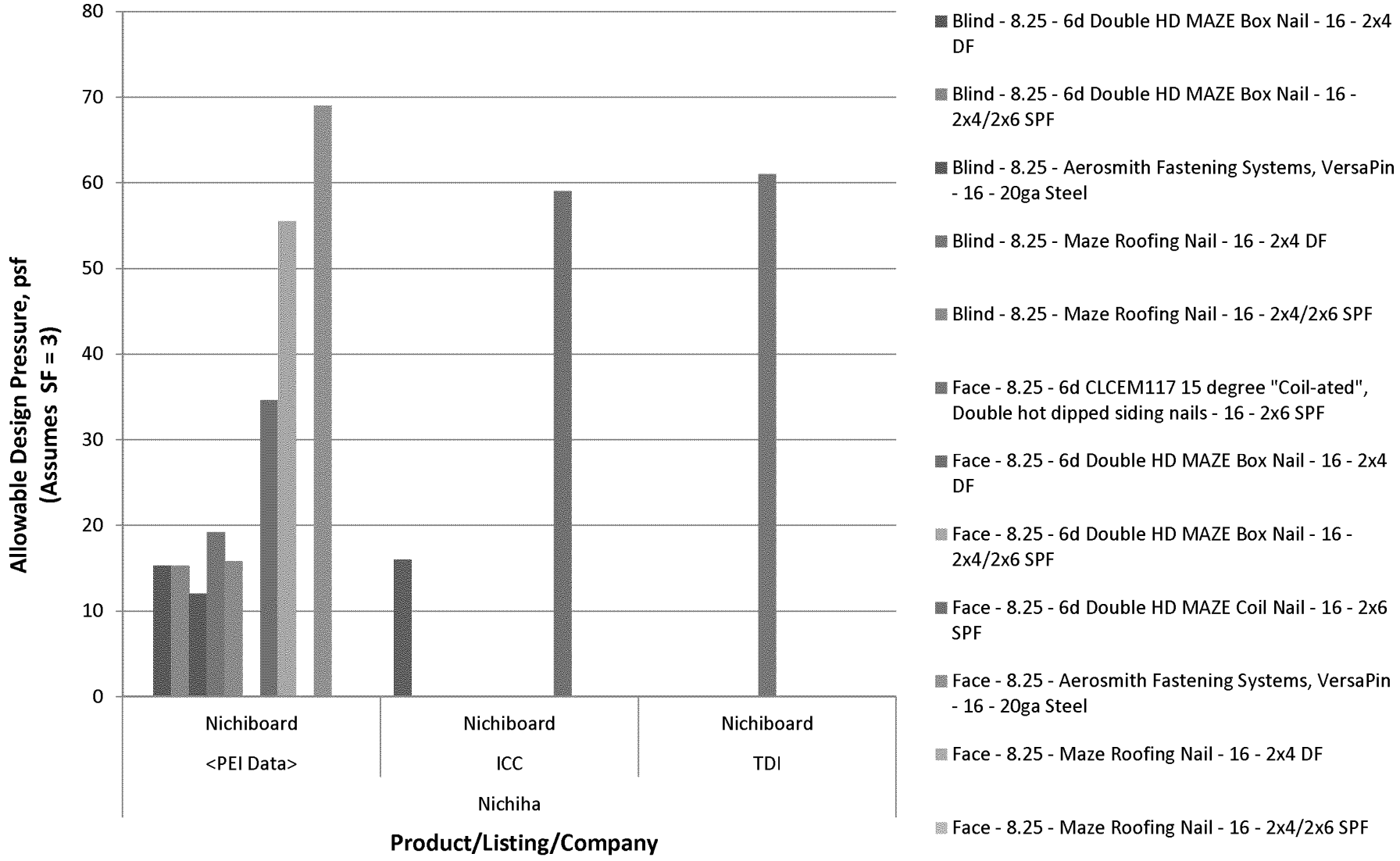
## Figure 6: 8-1/4" - WeatherBoards Lap Siding (16" O.C. Studs)



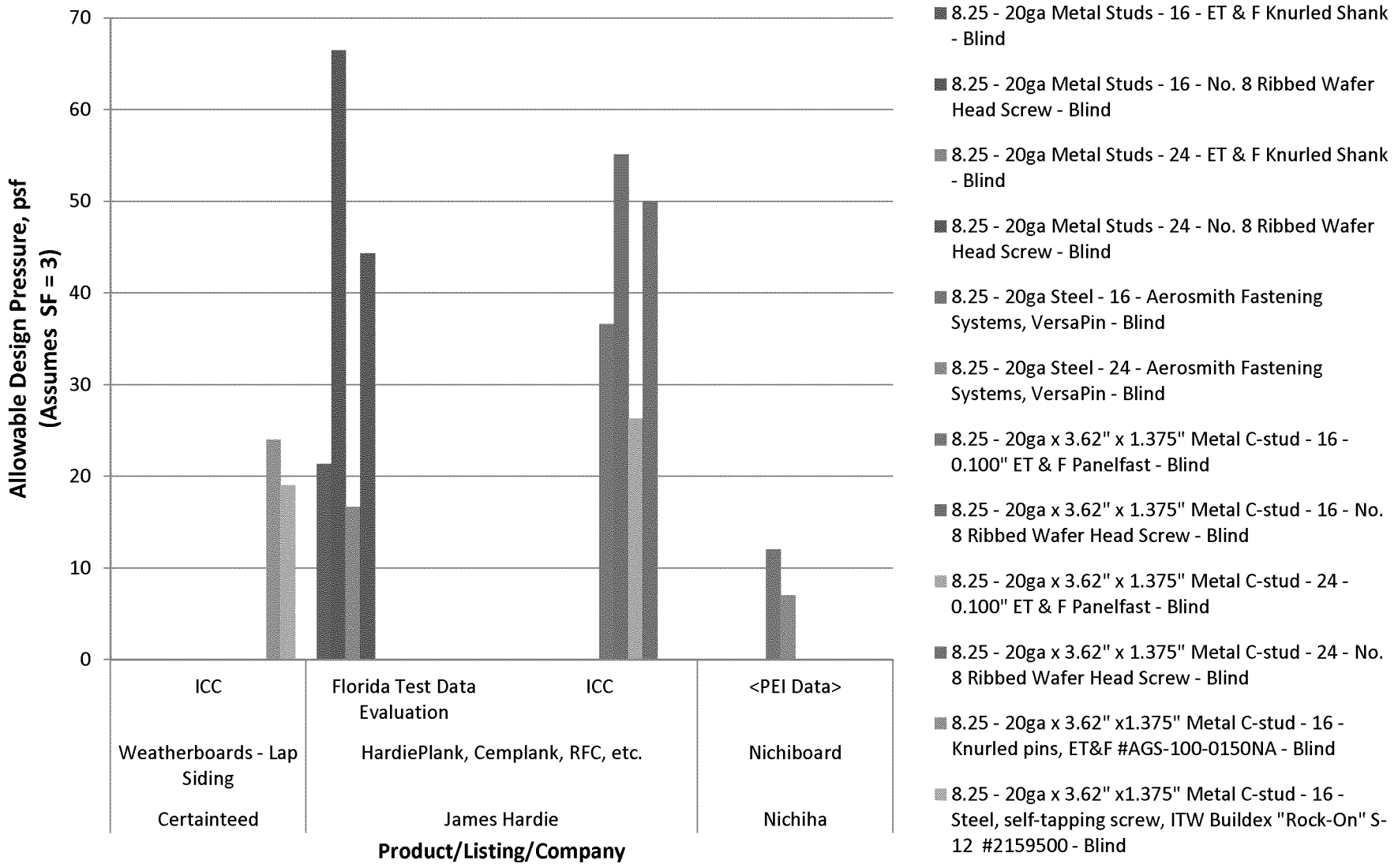
## Figure 7: 8-1/4" HardiePlank Lap Siding (16" O.C. Studs)



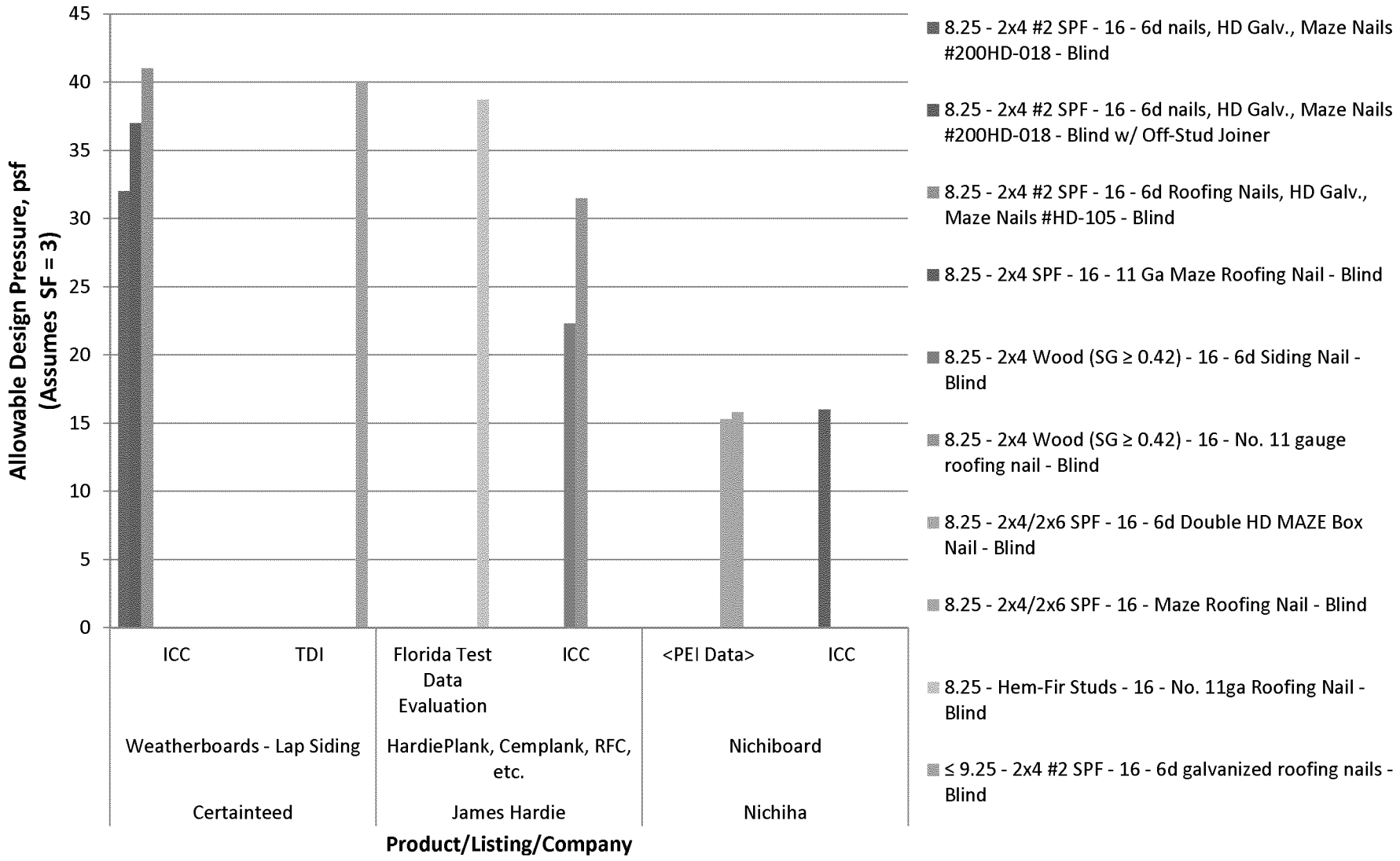
## Figure 8: 8-1/4" NichiBoard Lap Siding (16" O.C. Studs)



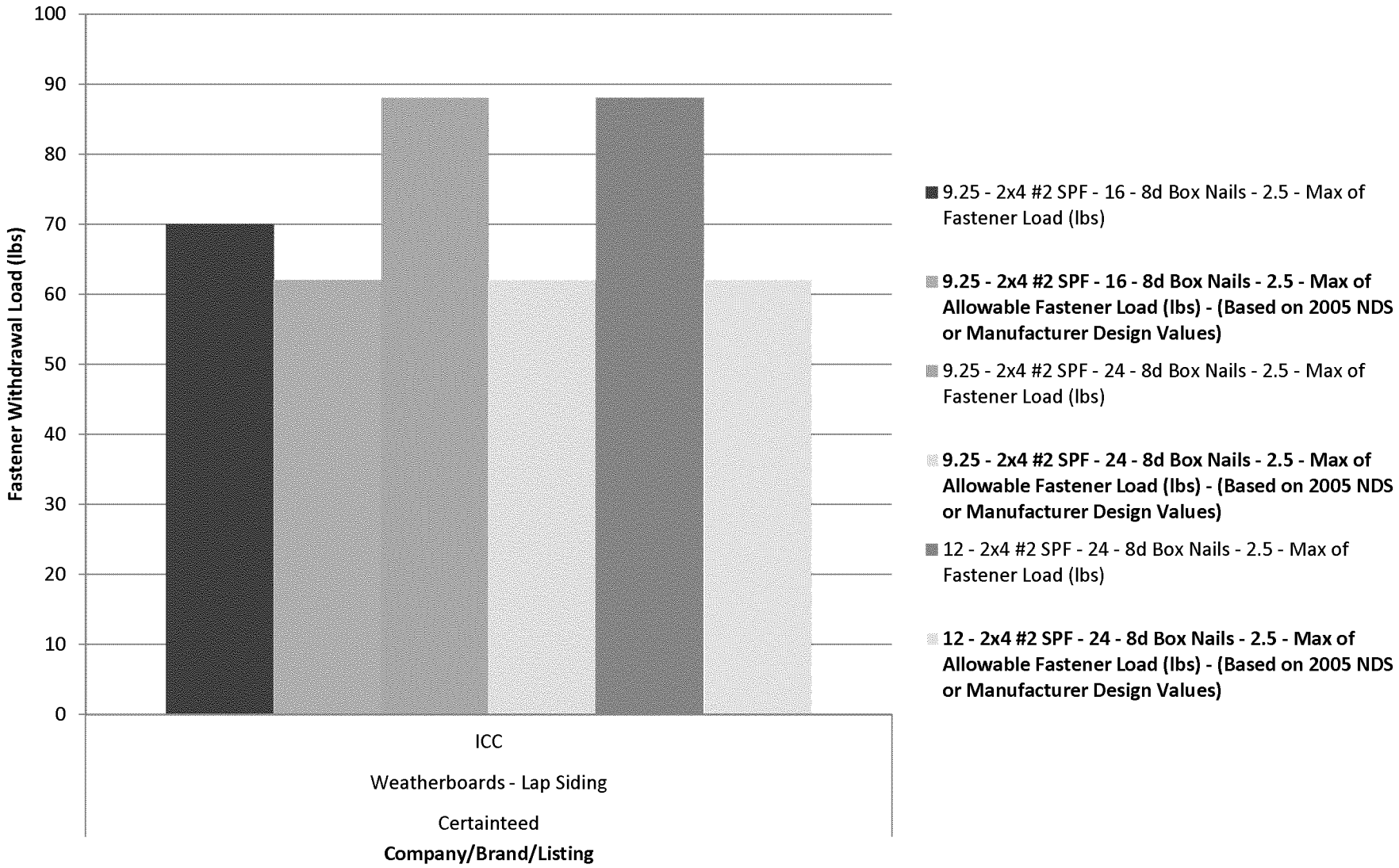
## Figure 9: 8-1/4" - Blind Fastened - 20ga Steel Studs



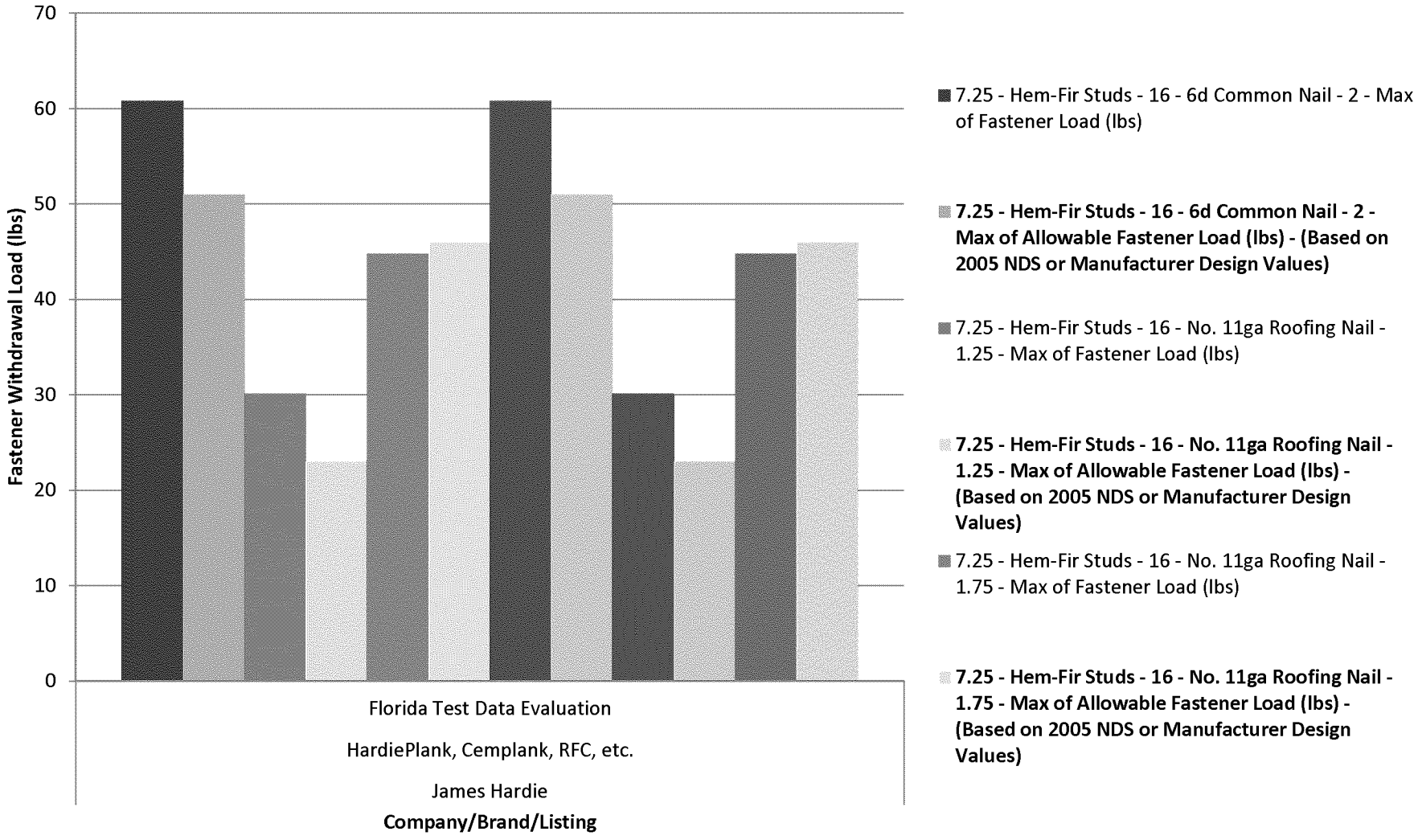
## Figure 10: 8.25" - Blind Fastened - SPF or Hem-Fir Studs



## Figure 11: WeatherBoards Lap Siding Fastener Data (8d Box Nails)



## Figure 12: HardiePlank Lap Siding Fastener Data (6d Common Nails or 11ga Roofing Nail)



# TEST RESULTS SECTION

**THE FOLLOWING PAGES CONTAIN THE TESTING INFORMATION GATHERED DURING THE COURSE OF THIS PROJECT. ADDITIONALLY PHOTOGRAPHS HAVE BEEN INCLUDED TO PROVIDE A VISUAL AID WHEN REVIEWING THE TEST DATA AND FAILURES.**

**Test Plan Summary:**

The primary purpose of this portion of the project was to evaluate the effect of improper application of the plastic film prescribed in ASTM E330 on blind-nailed lap siding. The secondary purpose was to compare the test results to the published design pressures found during the research portion of this phase. It was determined that 7.25" lap siding was commonly available to PEI for the Nichiha, James Hardie and Certainteed products. *A PEI inspector randomly selected the Nichiha product at the Macon, GA plant and the James Hardie and Certainteed material was purchased by PEI at a local building materials vendor.* This siding size also had a fair amount of published data for comparison purposes. To minimize the influence of the framing and fasteners, steel framing and self-drilling screws were selected for best performance for a given fastener size and frame spacing. The mode of failure is typically siding pull-over or siding breakout at the fasteners. Fastener withdrawal withdrawal is rarely a factor for steel, but often is the control for wood framing. Design pressures for siding attached to wood will only approach the values for steel when the fastener length is relatively long in relation to the specific gravity of the wood framing. Historically, the natural variables with wood framing, including knots, grain direction, splitting, wane, etc.... have resulted in large coefficients of variation with these tests.

Test Sample

An equivalent 20 gauge steel ProStud®, Part No. 65 ksi 362PS125-19, framework was used for all of the test samples. The frame was constructed 49-1/2" wide to provide a "true" 16" o.c. stud spacing and 48" tall to permit a total of seven (7) siding courses without resulting in a failure of the framework. *This method is consistent with ASTM D5206 which is used for testing vinyl siding.* A #8 x 1-5/8" long self-drilling screw, with a .375" diameter ribbed head, was selected as the fastener to provide a repeatable installation with minimal siding damage as compared to nails or pins. Construction was performed as follows for all of the samples:

1. The plastic film was first laid over the test frame in either a loose or tight application.
    a. Tight – The plastic was draped over the frame and no folds were made.
    b. Loose – The plastic was draped over the frame with a 3" to 4" fold placed in each stud bay. A ½" to 1" fold was then made parallel to each piece of siding prior to install. This provided adequate coverage to maintain contact with the siding as it moved.
2. A 1-1/4" siding starter strip was installed along the bottom plate with screws spaced 16" o.c. A 49-1/2" long piece of siding was then positioned with the bottom edge flush with the starter strip and a single screw was installed 1" down from the top edge of the siding

into the center of each stud flange. The screw head was seated tight to the siding but was not permitted to pull the siding tight to the stud to cause a crack or break. *Small fractures were noted at the siding corners on the outer studs. In some cases the siding was slightly loose with the install to prevent cracking or corner breakouts.* Any breakouts or cracks in the face resulted in a new piece of siding being installed.

3. The next siding course was installed in the same manner and overlapped the preceding course by 1-1/4".
4. After the seventh course was installed a piece of ½" OSB was overlapped 1-1/4" over the top course and was fastened to the frame to prevent unrealistic movement of the top course and plastic film failure.

Test Setup

The sample was carefully installed in a horizontal vacuum test chamber as defined in ASTM E330. Setup followed PEI's standard practice for testing to ICC-ES AC90. A 49-1/2" long cross brace, inset 16" from each plate, was fastened across the back of the sample at each stud to reduce stud rotation/rolling during the test. See attached photographs.

Test Procedure

A calibrated pressure sensor connected to a data acquisition system measured and recorded the chamber throughout the test. The load was applied in increments of 10 PSF for all of the samples such that a minimum of six (6) increments were attained prior to failure, except Sample No. NI-7.25-BS-S16-2mL-1 which was tested in 7.5 PSF increments. The load was held for a minimum of 10 seconds and then released to 0 psf for 60 seconds prior to proceeding to the next increment. Failure was considered a complete disengagement of the siding course from the frame.

Test Results

The test results supported the idea that installation of the plastic film would change the outcome of the test quite drastically. The affect of the loose vs. tight plastic film was two times higher in ultimate test pressure for one of the sample sets. The loose film application, consistent with ASTM E330 and ICC-ES AC90, permitted the lap siding to move and pry over or break around the fasteners. The tight application resulted in less siding movement with less contact area to the siding as the load was increased. The contact area shifted away from the bottom, loose edge, of the siding and resulted in less prying action (moment) at the fasteners. The use of 4 mil vs. 2 mil plastic, installed loose, was also evaluated and did not appear to affect the ultimate test pressure.

Table 4 shows the ultimate test pressure that resulted from each test sample tested.

| Table 4: ASTM E330 Windload Test Results | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Company** | **Sample No.** | **Framing Type** | **Frame Spacing (in)** | **Fastening** | **Plastic Film Install.** | **Ultimate Test Pressure (psf)** | **Failure Mode** |
| Nichiha | NI-7.25-BS-S16-2mL-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Loose (2 mil) | 98 | a |
| Nichiha | NI-7.25-BS-S16-4mL-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Loose (4 mil) | 92 | b |
| Nichiha | NI-7.25-BS-S16-2mT-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Tight (2 mil) | 147 | c |
| Certainteed | CT-7.25-BS-S16-2mL-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Loose (2 mil) | 66 | a |
| Certainteed | CT-7.25-BS-S16-2mT-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Tight (2 mil) | 132 | d |
| James Hardie | JH-7.25-BS-S16-2mL-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Loose (2 mil) | 71 | e |
| James Hardie | JH-7.25-BS-S16-2mT-1 | 20 Ga. Steel | 16 | No. 8 Screw – Blind | Tight (2 mil) | 122 | f |

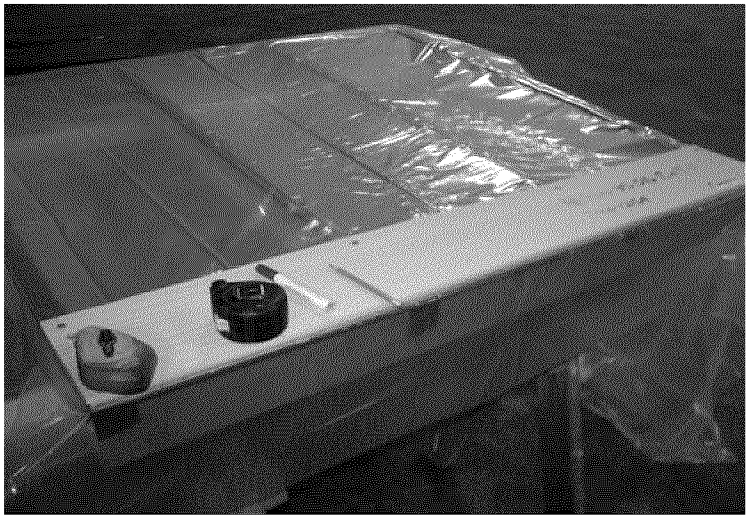
Failure Modes: (see photographs for more details)

a - The siding courses pried open and course #4 & #5 cracked and broke out around the fasteners.
b – The siding courses pried open and course #2 & #3 cracked and broke out around the fasteners at five locations and pulled over the fasteners at two locations. Fastener withdrawal occurred at one location on course #2.
c – The siding courses started to open and stud ends crumpled in the track. Fastener withdrawal occurred on course #6 at one of the field studs.
d - The siding courses started to open and stud ends crumpled in the track. Fastener withdrawal occurred on course #6 at one of the field studs and then the siding pulled over the other field fastener and broke the corners off at each end.
e - The siding courses pried open and course #5 & #6 cracked and broke out around the fasteners at six locations and pulled over the fasteners at two locations.
f - The siding courses pried open and course #2, & #3 pulled over the fasteners at four locations and broke off all of the corners.

## Sample Details

Typical folds in each stud bay - Loose Film

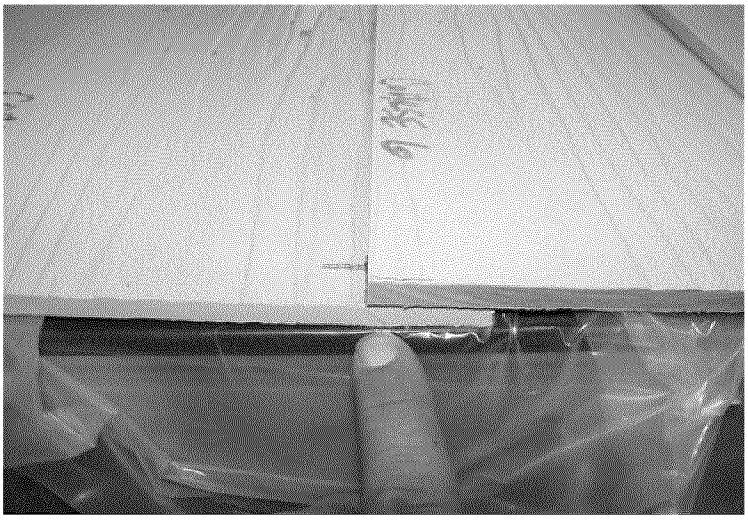
Typical folds at each siding course - Loose Film



Tight Film installation - Typical

Corner Fastener Installation - Typical

Typical fracture noted at siding ends



Typical fracture noted at siding ends

## Windload Testing

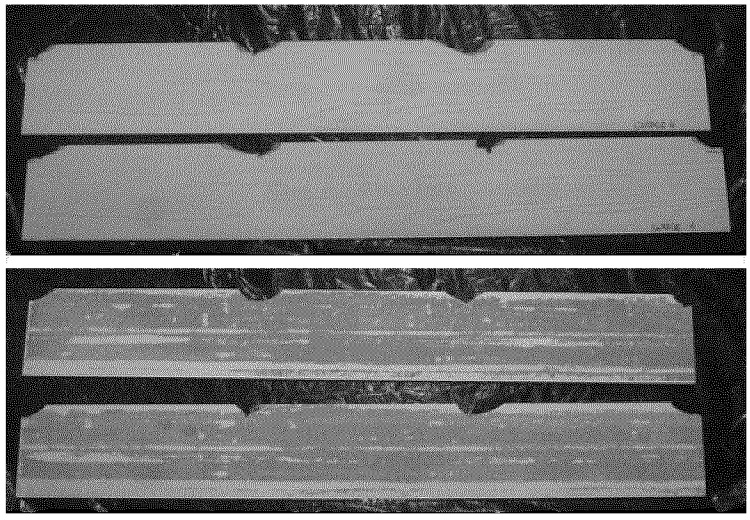
Typical Test Setup


Typical Test Setup (with bracing)

NI-7.25-BS-S16-2mL-1 siding prying open

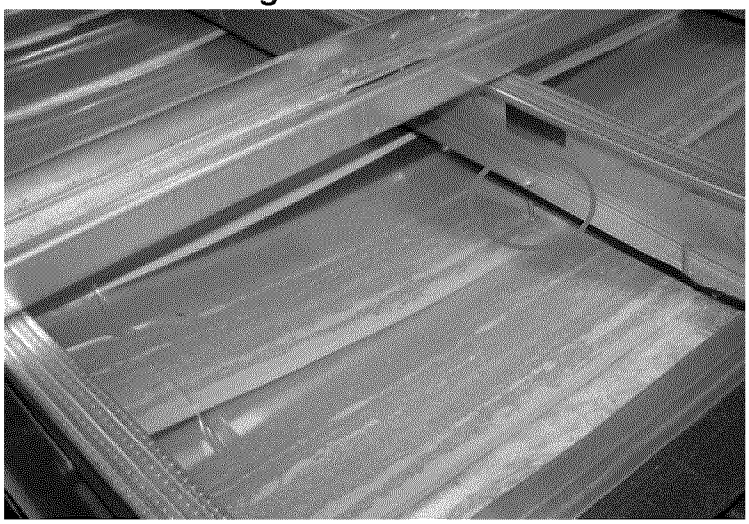
NI-7.25-BS-S16-2mL-1 Failure


NI-7.25-BS-S16-2mL-1 Failure

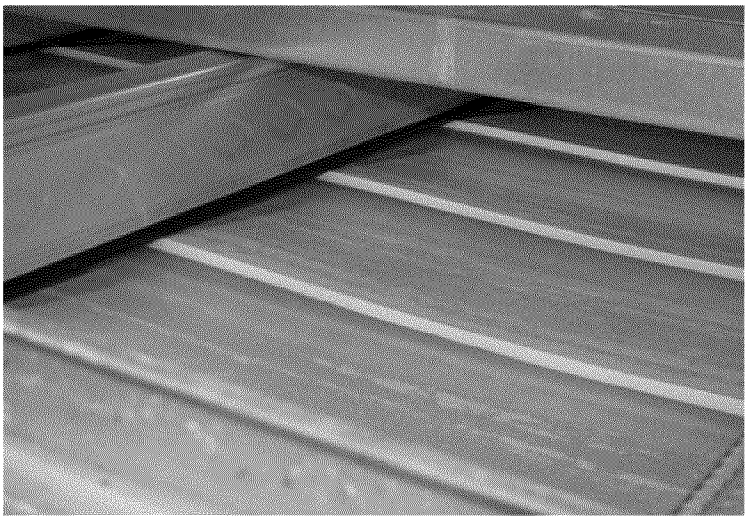


NI-7.25-BS-S16-2mL-1 Failed pieces (front and back)

## Windload Testing



NI-7.25-BS-S16-2mT-1 Failure (fastener withdrawal)



NI-7.25-BS-S16-2mT-1 siding prying open

NI-7.25-BS-S16-2mT-1 stud ends crumpling

NI-7.25-BS-S16-4mL-1 Failure

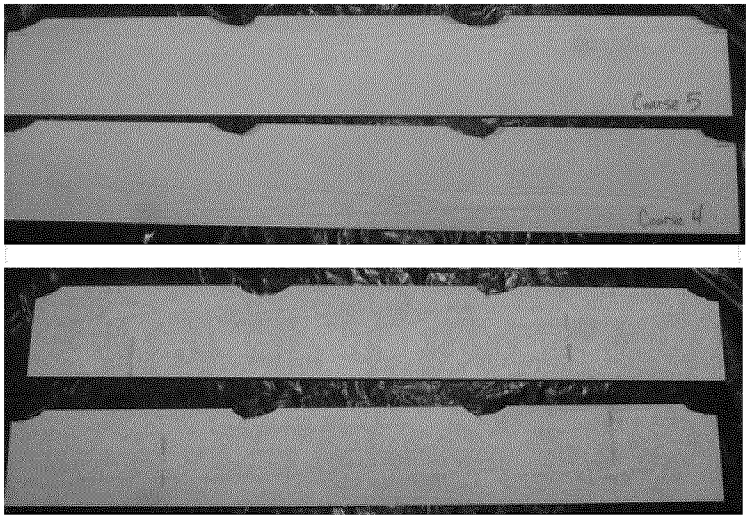
NI-7.25-BS-S16-4mL-1 Failure

NI-7.25-BS-S16-4mL-1 Failed pieces (front and back)

## Windload Testing

CT-7.25-BS-S16-2mL-1 siding prying open

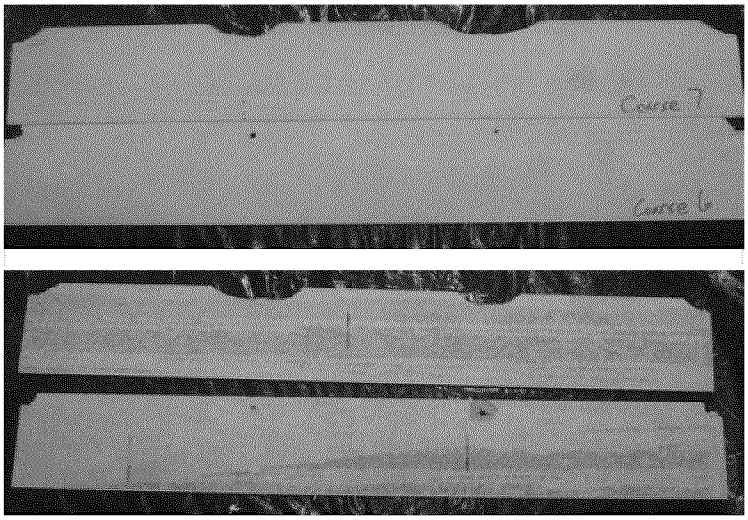

CT-7.25-BS-S16-2mL-1 Failure




CT-7.25-BS-S16-2mL-1 Failed pieces (front and back)

CT-7.25-BS-S16-2mT-1 Failure (fastener withdrawal)

CT-7.25-BS-S16-2mT-1 Failure

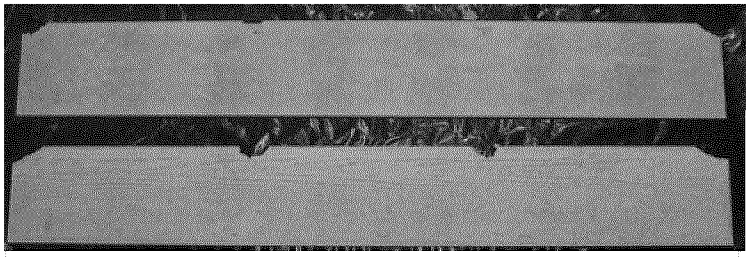


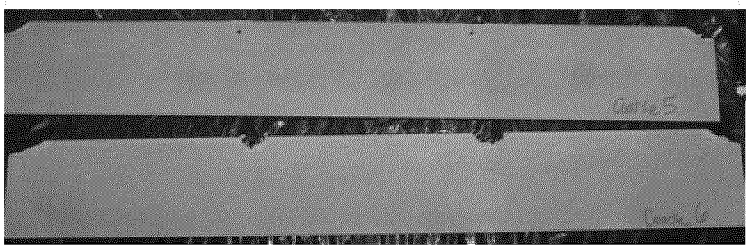

CT-7.25-BS-S16-2mT-1 Failed pieces (front and back)

## Windload Testing

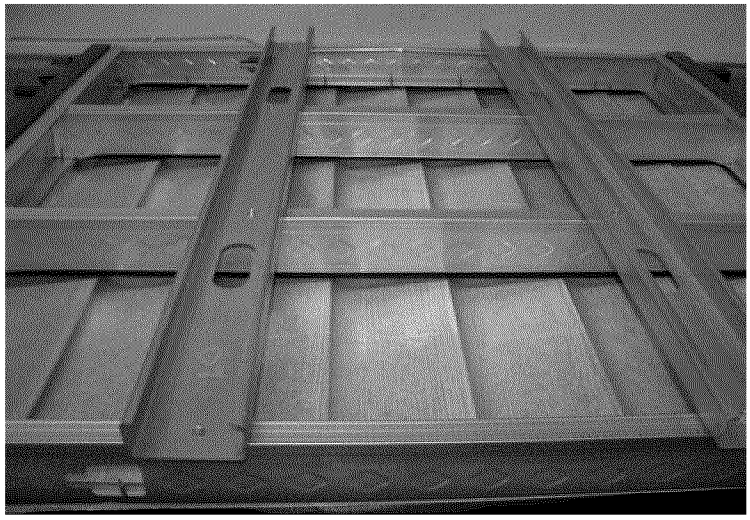
JH-7.25-BS-S16-2mL-1 siding prying open


JH-7.25-BS-S16-2mL-1 Failure



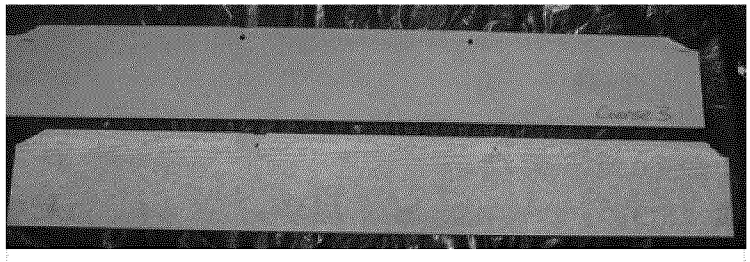


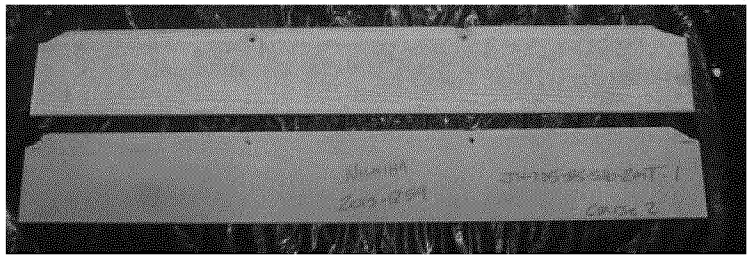
JH-7.25-BS-S16-2mL-1 Failed pieces (front and back)



JH-7.25-BS-S16-2mT-1 siding prying open

JH-7.25-BS-S16-2mT-1 Failure





JH-7.25-BS-S16-2mT-1 Failed pieces (front and back)

# REFERENCES

## Test Methods

- *ASTM C1186-08(2012) Standard Specification for Flat Fiber-Cement Sheets*
- *ASTM D3679 - 13 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding*
- *ASTM D5206 - 13 Standard Test Method for Windload Resistance of Rigid Plastic Siding*
- *ASTM E330 - 02(2010) Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.*
- *ICC-ES: AC37 Acceptance Criteria for Vinyl Siding, Approved October 2008*
- *ICC-ES: AC90 Acceptance Criteria for Fiber Cement Siding used as Exterior Wall Siding, Approved June 2011*

## Code Evaluation Reports

- *ICC-ES: ESR-2894 For NichiBoard™, Reissued March 1, 2012 (Nichiha USA)*
- *ICC-ES: ESR-1668 For WeatherBoards™, Reissued October 1, 2013 (Certainteed Corporation)*
- *ICC-ES: ESR-2290 For HardiePlank™, Reissued March 1, 2013 (James Hardie Building Products)*
- *TDI: EC-59 For NichiBoard™, Revised August 1, 2011 (Nichiha USA)*
- *TDI: EC-16 For WeatherBoards™, Revised August 1, 2013 (Certainteed Corporation)*
- *TDI: EC-23 For HardiePlank™, Revised December 1, 2012 (James Hardie Building Products)*
- *TDI: EC-55 For Artisan®, Effective March 1, 2013 (James Hardie Building Products)*
- *Miami-Dade: NOA No. 09-0511.01 For NichiBoard™, Approved July 22, 2009 (Nichiha USA)*
- *Miami-Dade: NOA No. 13-0212.02 For WeatherBoards™, Approved July 22, 2009 (Certainteed Corporation)*
- *Miami-Dade: NOA No. 12-0214.14 For HardiePlank ™, Approved May 3, 2012 (James Hardie Building Products)*

## Test Reports and Calculations

- *Progressive Engineering, Inc.: ICC-ES AC90 Windload Test Reports and Calculations for NichiBoard™, PEI Project No. 2009-773, 2009-981, & 2012-0078. (Florida P.E. sealed)*
- *Ronald I. Ogawa Associates, Inc.: Engineering Evaluation Report For Attaching James Hardie® Brand Fiber-Cement Planks to Wood or Metal Framed Walls With Various Fasteners, Project No. RIO-2300-11 (Florida P.E. sealed)*