ICC-ES Evaluation Report

ESR-2961

Reissued September 1, 2011
This report is subject to renewal in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fasteners

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composites Fastenings

REPORT HOLDER:

JAACO CORPORATION
18080 NE 68TH STREET, SUITE C-130
REDMOND, WASHINGTON 98052
(425) 952-4205
www.jaaco.com
Jaaco@qwestoffice.net

ADDITIONAL LISTEE:

PAC FAST, INC.
23307 LA PALMA AVENUE
YORBA LINDA, CALIFORNIA 92887

EVALUATION SUBJECT:

POWER-DRIVEN PINS FOR SHEAR WALL AND DIAPHRAGM ASSEMBLIES WITH STEEL FRAMING AND WOOD STRUCTURAL PANELS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

Jaaco NailPro hardened ballistic pins are used to attach oriented strand board (OSB) wood structural panels to cold-formed steel (CFS) framing for site-built shear wall and horizontal diaphragm applications under the IBC to resist in-plane wind or seismic forces; and are limited to locations not exposed to the weather or damp environment. Shear walls are limited to use in Seismic Design Categories A and B. The pins may also be used to attach OSB to CFS framing for general purposes, such as sheathing. The pins may be used in structures regulated by the IRC, when an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESRIPTION

3.1 Jaaco NailPro Hardened Ballistic Pins:

3.1.1 General: The pins are nail-shaped fasteners with a flat head. The pins are manufactured from steel wires complying with ASTM A 510, Grade 1060 (UNS 10600), and are heat-treated to provide case and core hardness of 52 to 55 HRC. The pins have either electrodeposited zinc coatings with chromate finish or mechanically deposited zinc coatings complying, respectively, with ASTM B 633, Type II, SC 1, or ASTM B 695, Type 1 Class 12. The pins have a ballistic point with either a knurled or smooth shank, and are available loose in bulk containers; bundled in wire and plastic sheet coils; and in collated strips. Figure 1 shows the typical pins with knurled and smooth shank, and pin head marking.

3.1.2 Knurled Shank Pins: The knurled shank pins (item number NP100K) have a nominal knurled shank diameter of 0.100 inch (2.69 mm), a nominal head diameter of 0.245 inch (6.20 mm), and a minimum length of $1^1/_2$ inches (38 mm).

3.1.3 Smooth Shank Pins: The smooth shank pins (item number NP145S) have a nominal smooth shank diameter of 0.145 inch (3.66 mm), a nominal head diameter of 0.300 inch (7.60 mm), and a minimum length of 1.5 inches (38 mm).

3.2 Wood Structural Panels (OSB):

Wood structural panels must be Structural I, Exposure I, OSB panels complying with DOC PS-2. The span rating and nominal thickness of the rated OSB sheathing panels are given in Table 2.

3.3 Cold-formed Steel (CFS) Framing Members:

3.3.1 Shear Walls: CFS framing members must be recognized in a current ICC-ES evaluation report and must be manufactured from steel complying with ASTM A 1003, Grade 33, Type H, or with ASTM A 653 SS, Grade 33 for wall studs; and ASTM A 653, SS, Grade 50 steel for wall tracks, with a minimum G60 galvanization coating designation in accordance with ASTM A 653.

CFS wall studs must be C-shaped members with a designation thickness of 43 mils (1.092 mm) [a minimum 0.0428-inch (1.087 mm) uncoated base-steel thickness], a minimum flange width of $1^5/_8$ inches (41.3 mm), an overall depth of $3^5/_8$ inches (92.1 mm), and a minimum flange stiffener (lip) length of $^1/_2$ inch (12.7 mm).

CFS wall tracks must be channel-shaped members with a designation thickness of 54 mils (1.372 mm) [a minimum 0.0538 inch (1.367 mm) uncoated base-steel thickness], a minimum flange width of $1^1/_2$ inches (38 mm), and an inside depth equal to the overall depth of the CFS wall studs.

3.3.2 Horizontal Diaphragms: CFS framing members must be recognized in a current ICC-ES evaluation report and must be manufactured from steel complying with ASTM A 1003, Grade 50, Type H, or ASTM A 653 SS,

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2011

Grade 50, Class I, with a minimum coating designation of G60.

CFS diaphragm joists and blocking members must be C-shaped members with a designation thickness of 68 mils (1.73 mm) [a minimum 0.0677-inch (1.72 mm) uncoated base-steel thickness], a minimum flange width of $1^5/_8$ inches (41.3 mm), a minimum depth of $3^5/_8$ inches (92.1 mm), and a minimum flange stiffener (lip) length of $^1/_2$ inch (12.7 mm).

CFS diaphragm perimeter framing members must be channel-shaped members with a designation thickness of 68 mils (1.73 mm) [a minimum 0.0677-inch (1.72 mm) uncoated base-steel thickness], a minimum flange width of $1^1/_2$ inches (38 mm), and a minimum inside depth equal to the depth of the diaphragm joists.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Single Fastener Connections: Allowable withdrawal and lateral loads for single fastener connections of the OSB panels to the CFS framing members, described, respectively, in Sections 3.2, 3.3.1 and 3.3.2, are given in Table 1. The allowable lateral loads have been determined using a fastener-to-panel edge distance of $^1/_2$ inch (19.1 mm) with loads parallel to the panel edge. Allowable loads in Table 1 are provided for comparison with other types of fasteners, such as tapping screws, and are not recognized for use in determining allowable loads for systems, such as shearwalls and diaphragms

4.1.2 Shear Walls: The shear walls comply as Type I shearwalls as set forth in Section C3 of AISI-Lateral and must conform to all requirements for Type I shearwalls in AISI-Lateral, except as specifically noted in this report. The maximum shearwall height-to-length ratio is 1:1. OSB panels must be installed with the long dimension perpendicular to the CFS studs and attached to the framing with the NailPro NP100K fasteners at the spacings noted in Tables 2 and 3. Blocking may be used at the panel edge joints.

4.1.2.1 Wind Resistance: Allowable racking shear loads are given in Table 2 for wind forces for use with load combinations in IBC Section 1605.3.1. The shearwall deflection due to the applied shear load must be calculated using the following equations, as applicable:

$$\delta = \frac{8vL^3}{E_s A_c b} + \omega_1\omega_2\frac{vL}{\rho G t_{panel}} + \omega_1^{5/4}\omega_2\omega_3\omega_4\left(\frac{2.75v}{\beta}\right)^2 + \frac{h}{b}\delta_v$$

For **SI:**

$$\delta = \frac{2vL^3}{3E_s A_c b} + \omega_1\omega_2\frac{vL}{\rho G t_{panel}} + \omega_1^{5/4}\omega_2\omega_3(\alpha)\left(\frac{2.75v}{0.00290\beta}\right)^2 + \frac{h}{b}\delta_v$$

where:

A_c = Gross cross-sectional area of chord member, in square inches (mm^2)

b = Width of the shear wall, in feet (mm)

E_s = Modulus of elasticity of steel = 29,500,000 psi (203,000 MPa)

Gt_{panel} = OSB panel sheathing rigidity through the thickness = 83,500 lbf/in. of panel depth. See Table 2305.2.2(2) of the IBC.

h = Wall height, in feet (mm)

s = Maximum fastener spacing at panel edge, in inches (mm)

t_{panel} = Nominal panel thickness, in inches (mm)

t_{stud} = Framing designation thickness, in inches (mm)

v = Shear demand (V/2b), in pounds per linear foot (N/mm)

V = Total lateral load applied to the shear wall, in pounds (N)

β = 660 for OSB

ρ = 1.05 for OSB

ω_1 = s/6 (for s in inches), s/152.4 (for s in mm)

ω_2 = $0.033/t_{stud}$ (for t_{stud} in inch) and $0.838/t_{stud}$ (for t_{stud} in mm)

ω_3 = $\sqrt{\frac{h/b}{2}}$

ω_4 = 1 for wood structural panels

δ_v = Vertical deformation of anchorage/attachment details, in inches (mm)

δ = Calculated deflection, in inches (mm)

4.1.2.2 Seismic Resistance: Allowable racking shear loads are given in Table 3 for seismic forces. The response modification coefficient, *R*, the system overstrength factor, Ω_0, and the deflection amplification factor, C_d, must be equal to 3. The shearwall deflection due to the applied shear load must be calculated using the equations given in Section 4.1.2.1.

4.1.3 Horizontal Diaphragms: The maximum diaphragm span-to-width ratio is $2^1/_2$:1. The OSB panels must be installed with the long dimension perpendicular to CFS joist framing and must be attached to the framing with the NailPro NP145S fasteners at the spacings noted in Table 4. Blocking may be used at the panel edge joints. Allowable shear loads for wind or seismic forces are given in Table 4. OSB panels must be capable of supporting vertical loads based on the panel span rating as indicated in Table 4. Diaphragm blocking may be required. If diaphragm blocking is required, it must be installed in accordance with the applicable code.

The deflection of a blocked OSB panel diaphragm uniformly fastened throughout must be calculated using the following equation, as applicable:

$$\delta = \frac{5vL^3}{8E_s A_c b} + \omega_1\omega_2\frac{vL}{\rho G t_{panel}} + \omega_1^{5/4}\omega_2\omega_3(\alpha)\left(\frac{v}{1.4\beta}\right)^2 + \frac{\sum_{i=1}^{n}\Delta_{ci}X_i}{2b}$$

For **SI:**

$$\delta = \frac{0.052vL^3}{E_s A_c b} + \omega_1\omega_2\frac{vL}{\rho G t_{panel}} + \omega_1^{5/4}\omega_2\omega_3(\alpha)\left(\frac{v}{0.00405\beta}\right)^2 + \frac{\sum_{i=1}^{n}\Delta_{ci}X_i}{2b}$$

where:

A_c = Gross cross-sectional area of chord member, in square inches (mm^2)

b = Diaphragm depth parallel to direction of load, in feet (mm)

E_s = Modulus of elasticity of steel = 29,500,000 psi (203,000 MPa)

Gt_{panel} = OSB panel sheathing rigidity through the thickness = 83,500 lbf/in. of panel depth. See Table 2305.2.2(2) of the IBC.

L = Diaphragm length perpendicular to direction of load, in feet (mm)

n = Number of splices in both diaphragm chords

s = Maximum fastener spacing at panel edge, in inches (mm)

t_{panel} = Nominal panel thickness, in inches (mm)

t_{joist} = Nominal framing thickness, in inches (mm)

v = Shear demand (V/2b), in pounds per linear foot (N/mm)

V = Total lateral load applied to the diaphragm, in pounds (N)

X_i = Distance between the "ith" chord-splice and the nearest support (braced wall line), in feet (mm)

α = Ratio of the average load per fastener based on a non-uniform fastener pattern to the average load per fastener based on a uniform fastener pattern (= 1 for a uniformly fastened diaphragm)

β = 660 for OSB

Δ_{ci} = Deformation value associated with "ith" chord splice, in inches (mm)

ρ = 1.05 for OSB

ω_1 = s/6 (for s in inches), s/152.4 (for s in mm)

ω_2 = $0.033/t_{joist}$ (for t_{joist} in inch) and $0.838/t_{joist}$ (for t_{joist} in mm)

δ = Calculated deflection, in inches (mm)

For an unblocked OSB panel diaphragm, δ must be multiplied by 2.5.

4.2 Installation:

The Jaaco NailPro hardened ballistic pins must be installed using pneumatic or fuel-powered tools recommended by Jaaco Corporation. The pins must be installed such that the pins' tips pierce the OSB panels being fastened and protrude through the CFS framing members a minimum of $^1/_2$ inch (12.7 mm). The pins must be installed a minimum of $^1/_2$ inch (12.7 mm) from the edge of OSB panels. The spacing of the pins must be a maximum of 6 inches (152 mm) on center in the field of the sheathing panel. The spacing of the pins at the panel edges must be a minimum of 2 inches (51 mm) and a maximum of 6 inches (152 mm), as specified by a registered design professional, based on Tables 2 through 4.

The CFS wall studs and diaphragm joists must be fastened, respectively to the wall and diaphragm tracks, with one No. 10 by $^3/_4$-inch-long (19.1 mm), modified truss head, zinc-coated screws complying with ASTM C1513, through each flange.

5.0 CONDITIONS OF USE

The Jaaco NailPro hardened ballistic pins described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The pins must be installed in accordance with the manufacturer's installation instructions and this report. In the event of a conflict between this report and the manufacturer's installation instructions, the more restrictive governs.

5.2 The other components of the shear wall and diaphragm assemblies must comply with this report, the applicable code and current ICC-ES evaluation reports.

5.3 Use of shear wall assemblies is limited to Seismic Design Categories A and B.

5.4 The design wind and seismic loads to be resisted by the shear wall or diaphragm assemblies described in this report must not exceed the allowable shear loads noted in Tables 2 through 4 of this report. The design values in this report are applicable to structures classified as Occupancy Categories I and II in accordance with IBC Table 1604.5.

5.5 Calculations demonstrating that the applied in-plane shear loads are less than the available shear wall or diaphragm strength must be submitted to the code official for approval. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is constructed.

5.6 Transverse load capacity of the OSB panels and CFS framing members of the shear wall and diaphragm assemblies must be justified to the satisfaction of the code official. Calculation and/or data used to justify the transverse load capacities must address the capacity of the OSB panels, the capacity of the CFS framing, and the attachment of the OSB panels to the CFS framing. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction on which the project is constructed.

5.7 Where the shear wall assemblies are used to support gravity loads, the axial load capacity of the shear wall assemblies must also be justified to the satisfaction of the code official. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is constructed.

5.8 Use of the pins described in this report is limited to dry, interior locations.

5.9 Use of the pins described in this report in contact with preservative-treated or fire-retardant-treated wood members is outside scope of this report.

5.10 An approved water-resistive barrier and exterior wall covering must be installed over the wood structural panels when the panels are considered to be a weather-exposed wall surface, as defined by the applicable code.

5.11 An approved exterior roof covering must be installed over the wood structural panels when the panels are considered to be a weather-exposed roof surface, as defined by the applicable code.

5.12 The pins are manufactured at the Jaaco Corporation's manufacturing plant (Shanghai Curvet Hardware Co., Ltd.) in Shanghai, China, and identified in accordance with this report.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Power-driven Pins for Shear Wall Assemblies with Cold-formed Steel Framing and Wood Structural Panels (AC230), dated October 2008.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Horizontal Diaphragms Consisting of Wood Structural Panel Sheathing Attached to Cold-formed Steel Framing (AC262), dated October 2004 (editorially revised September 2010).

7.0 IDENTIFICATION

7.1 Hardened Ballistic Pins:

Each carton and packaging unit of the hardened ballistic pins described in this report must be identified by a label bearing the name and address of the report holder (Jaaco Corporation) or the additional listee (Pac Fast, Inc.), as indicated in Table 5 of this report; the product brand name and item number; nominal pin size and length; coating type; and the ICC-ES evaluation report number (ESR-2961). Each pin head must bear a marking as shown in Figure 1.

7.2 Cold-formed Steel Framing :

Each cold-formed steel framing member must be identified in accordance with the applicable ICC-ES evaluation report.

7.3 Wood Structural Panels (OSB):

Wood structural panels must be identified in accordance with DOC PS-2.

TABLE 1—ALLOWABLE WITHDRAWAL AND LATERAL LOADS IN POUNDS PER FASTENER DUE TO WIND OR SEISMIC FORCES FOR OSB WOOD STRUCTURAL PANELS ATTACHED TO COLD-FORMED STEEL (CFS) FRAMING MEMBERS WITH NAILPRO PIN FASTENERS[1,2,3,4]

FASTENER TYPE	SHANK TYPE	SHANK DIAMETER (in.)	MINIMUM CFS THICKNESS (mils)	NOMINAL THICKNESS OF WOOD STRUCTURAL PANELS (in.)					
				Withdrawal Loads			Lateral Loads		
				$^{15}/_{32}$	$^{19}/_{32}$	$^{23}/_{32}$	$^{15}/_{32}$	$^{19}/_{32}$	$^{23}/_{32}$
NP100K	Knurled	0.100	43	25	-	-	-	-	-
NP145S	Smooth	0.145	68	45	-	-	95	-	-

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]The tabulated values are for short-term loading due to wind or seismic forces. For shear loads of normal and permanent load duration as defined by the AF&PA NDS, the tabulated values must be multiplied by 0.63 and 0.56, respectively.
[2]The pins must be long enough to penetrate the steel framing members a minimum of $^1/_2$ inch.
[3]The minimum edge distance from a pin to the panel edge must be $^1/_2$ inch.
[4]The tabulated values are for OSB panels described in Section 3.2. For OSB panels other than the OSB panels described in Section 3.2, covered in DOC PS-2, reduce loads by 10 percent.

TABLE 2—ALLOWABLE RACKING SHEAR, FOR WIND FORCES, FOR SHEAR WALLS CONSISTING OF OSB WOOD STRUCTURAL PANELS ATTACHED TO COLD-FORMED STEEL (CFS) FRAMING MEMBERS WITH NAILPRO 1.5-INCH-LONG NK100K PIN FASTENERS[1,2,3,4,5]

WALL SHEATHING (span rating, thickness and type)	MAXIMUM CFS STUD SPACING	ALLOWABLE SHEAR (plf): FASTENER SPACING AT PANEL EDGES (in.)			
		6	4	3	2
32/16, $^{15}/_{32}$-inch OSB on one side	24	165	165	165	165

For **SI:** 1 inch = 25.4 mm, 1 lb/ft = 0.0146 N/mm.

[1]The tabulated values are for short-term loads due to wind forces. For shear loads of normal and permanent load duration as defined by the AF&PA NDS, the tabulated values must be multiplied by 0.63 and 0.56, respectively.
[2]The pins must be long enough to penetrate the steel framing members a minimum of $^1/_2$ inch.
[3]Wood structural panels must be installed with the long dimension perpendicular to steel stud framing. The minimum edge distance from a pin to the panel edge must be $^1/_2$ inch. Fastener spacing must be 6 inches on center in the field of the wood structural panels.
[4]The tabulated values are for wood structural panels installed on one side of a wall. Values may be increased for panels installed to both sides of a wall in accordance with applicable code.
[5]Thicker wood structural panels may be used, but provide no increase in allowable shear loads. The fastener penetration must comply with Footnote 2.

TABLE 3—ALLOWABLE RACKING SHEAR, FOR SEISMIC FORCES, FOR SHEAR WALLS CONSISTING OF OSB WOOD STRUCTURAL PANELS ATTACHED TO COLD-FORMED STEEL (CFS) FRAMING MEMBERS WITH NAILPRO 1.5-INCH-LONG NP100K PIN FASTENERS[1,2,3,4,5]

WALL SHEATHING (span rating, thickness and type)	MAXIMUM CFS STUD SPACING (in.)	ALLOWABLE RESISTANCE (plf): FASTENER SPACING AT PANEL EDGES (in.)			
		6	4	3	2
32/16, $^{15}/_{32}$-inch OSB on one side	24	135	135	135	135

For **SI:** 1 inch = 25.4 mm, 1 lb/ft = 0.0146 N/mm.

[1]The tabulated values are for short-term loads due to wind forces. For shear loads of normal and permanent load duration as defined by the AF&PA NDS, and the tabulated values must be multiplied by 0.63 and 0.56, respectively.
[2]The pins must be long enough to penetrate the steel framing members a minimum of $^1/_2$ inch.
[3]Wood structural panels must be installed with the long dimension perpendicular to steel stud framing. The minimum edge distance from a pin to the panel edge must be $^1/_2$ inch. Fastener spacing must be 6 inches on center in the field of the wood structural panels.
[4]The tabulated values are for wood structural panels installed on one side of a wall. Values may be increased for panels installed to both sides of a wall in accordance with applicable code.
[5]Thicker OSB wood structural panels may be used, but provide no increase in allowable shear loads. The fastener penetration must comply with Footnote 2.

TABLE 4—ALLOWABLE SHEAR, FOR WIND OR SEISMIC FORCES, FOR HORIZONTAL DIAPHRAGMS CONSISTING OF OSB WOOD STRUCTURAL PANELS ATTACHED TO COLD-FORMED STEEL (CFS) FRAMING MEMEBR WITH NAILPRO 1.5-INCH-LONG NP145S PIN FASTENERS[1,2,3,4,5]

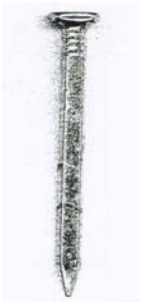
WOOD STRUCTURALPANEL (32/16 OSB)		CFS FRAMING		BLOCKED DIAPHRAGM: FASTENER SPACING AT DIAPHRAGM BOUNDARIES (ALL CASES), AT CONTINUOUS PANEL EDGES PARALLEL TO LOAD (CASES 3 and 4) AND AT ALL PANEL EDGES (CASES 5 and 6)				UNBLOCKED DIAPHRAGM: FASTENER SPACED 6 INCHES MAXIMUM AT SUPPORTED EDGES	
Grade	Nominal Thickness (in.)	Minimum Thickness (mils)	Framing Width (in.)	6	4	$2^1/_2$	2	Case 1 (no unblocked edges or continuous joints to load)	All Other Cases (Cases 2 through 6)
				Fastener Spacing at Other Panel Edges					
				6	6	4	3		
Structural I	$^{15}/_{32}$	68	$1^5/_8$	265	350	560	700	235	175
Rated Sheathing	$^{15}/_{32}$	68	$1^5/_8$	235	315	505	630	210	160

For **SI:** 1 inch = 25.4 mm, 1 lb/ft = 14.6 N/m.

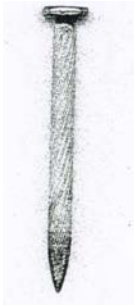
[1]The tabulated values are for short-duration loads due to wind and seismic forces. For shear loads of normal and permanent load duration as defined by the AF&PA NDS, the tabulated values must be multiplied by 0.63 and 0.56, respectively.
[2]The pins must be long enough to penetrate through the steel framing a minimum of $^1/_2$ inch.
[3]Wood structural panels must be installed with the long dimension perpendicular to steel joist framing. Blocking may be used at the panel edge joints. The minimum edge distance from the pin to the wood structural panel edge must be $^1/_2$ inch. Fastener spacing must be 6 inches on center in the field of the wood structural panels.
[4]Framing is permitted to be oriented in either direction for diaphragms, provided sheathing is designed for vertical loads.
[5]Thicker OSB wood structural panels may be used, but provide no increase in allowable shear loads. The fastener penetration must comply with Footnote 2.
[6]For fastener spacing and case description, see Table 2306.3.1 of the IBC.

TABLE 5—COMPANY NAME/PRODUCT NAME CROSS-REFERENCE

COMPANY NAME	PRODUCT TRADE NAME
Jaaco Corporation	NailPro
Pac Fast Inc.	Preferred Fasteners



a. Smooth Shank Pin



b. Knurled Shank Pin

c. Pin Head Marking

FIGURE 1—JAACO NAILPRO HARDENED BALLISTIC PINS AND PIN HEAD MARK