LEGACY REPORT

ER-5426

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ICC Evaluation Service, Inc.
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Business/Regional Office ■ 5360 Workman Mill Road, Whittier, California 90601 ■ (562) 699-0543
Regional Office ■ 900 Montclair Road, Suite A, Birmingham, Alabama 35213 ■ (205) 599-9800
Regional Office ■ 4051 West Flossmoor Road, Country Club Hills, Illinois 60478 ■ (708) 799-2305

Legacy report on the 1997 *Uniform Building Code*™

DIVISION: 05—METALS
Section: 05090—Metal Fastenings

DIVISION: 06—WOOD AND PLASTICS
Section: 06090—Wood and Plastic Fastenings

STANLEY BALLISTIC POINT NAIL FASTENER SYSTEM FOR PLYWOOD PANEL SHEAR WALLS AND DIAPHRAGMS ATTACHED TO STEEL FRAMING

STANLEY FASTENING SYSTEMS
ROUTE 2, BRIGGS DRIVE
EAST GREENWICH, RHODE ISLAND 02818

1.0 SUBJECT

Stanley Ballistic Point Nail Fastening System for Plywood Panel Shear Walls and Diaphragms Attached to Steel Framing.

2.0 DESCRIPTION

2.1 General:

Stanley ballistic point nails are pneumatically driven fasteners used to attach plywood structural panels to light-gage steel framing for shear wall and horizontal diaphragm applications. Fasteners are limited to locations not exposed to the weather or damp environments.

2.2 Materials:

2.2.1 Stanley Fasteners: The ballistic point nails are manufactured from SAE 1038 steel, and are heat-treated to a Rockwell hardness, R_c, of 49 to 53. The fasteners are zinc-plated with a chromate finish and have a tapered helical point and a spiraled shank. Fasteners are 1.375 inches (35 mm) long and 0.100 inch (2.5 mm) in diameter, and have a 0.23-inch-diameter (5.8 mm) head.

2.2.2 Plywood Sheathing: Plywood panels must comply with UBC Standard 23-2, and must be capable of supporting vertical loads in accordance with the panel span rating shown in the code. Plywood panels used for walls must have span ratings appropriate for the spacing of the wall framing.

2.2.3 Steel Framing: In this report, gage numbers for steel framing members refer to the following minimum design base-metal thicknesses:

No. 14 gage: 0.0713 inch (1.8 mm)
No. 16 gage: 0.0566 inch (1.4 mm)
No. 18 gage: 0.0451 inch (1.1 mm)
No. 20 gage: 0.0346 inch (0.8 mm)
No. 22 gage: 0.0283 inch (0.7 mm)

Steel studs for shear walls must be C-shaped, with a minimum depth of $3^5/_8$ inches (92 mm) and a minimum flange width of $1^5/_8$ inches (41 mm), except No. 22 gage [0.0283 inch (0.7 mm)] studs have a minimum flange width of $1^1/_4$ inches (32 mm). Minimum yield strength and tensile strength for the Nos. 14 and 16 gage [0.0713 inch (1.8 mm) and 0.0566 inch (1.4 mm)] steel studs is 50 ksi (345 kPa) and 65 ksi (450 kPa), respectively. Minimum yield strength and tensile strength is 33 ksi (228 kPa) and 52 ksi (359 kPa), respectively, for the No. 18, No. 20 and No. 22 gage [0.0451 inch (1.1 mm), 0.0346 inch (0.8 mm), and 0.0283 inch (0.7 mm)] steel studs.

Steel joists for diaphragms must comply with the 1997 *Uniform Building Code*™ (UBC) and must be suitable for the direct support of floors and roof decks. The Stanley ballistic point nails are limited for use with diaphragms framed with cold-formed framing members complying with Division VII, Chapter 22, of the UBC. Ballistic point nails are limited for use with steel thicknesses specified in this report. Use of the nails with heavier steel thicknesses, such as that of steel common to open-web steel joists referenced in Division IX, Chapter 22, of the UBC, is beyond the scope of this report.

2.3 Design:

2.3.1 General: Allowable pull-out and lateral loads for the Stanley ballistic point nail fastening system attaching wood-based structural sheathing to light-gage steel framing members are specified in Table 1.

2.3.2 Shear Walls: Allowable shear, for wind forces, for shear walls using the ballistic point nail fastening system to attach plywood structural panels to light-gage studs is shown in Table 3. The maximum shear-wall height-to-width ratio is $3^1/_2$:1, provided panels are fastened along all edges. The deflection of blocked panel shear walls uniformly fastened throughout is calculated by use of the following formula:

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75(h)\,(e_n) + d_a$$

$$\text{For SI: } \Delta = \frac{2000vh^3}{3EAb} + \frac{vh}{Gt} + 2.46(h)\,(e_n) + d_a$$

where:

A = Area of boundary element cross-section (vertical member at shear-wall boundary), square inches (mm^2).

b = Wall width, feet (mm).

d_a = Deflection due to anchorage details (rotation and slip at tie-down bolts), inches (mm).

E = Elastic modulus of boundary element (vertical member at shear wall boundary), pounds per square inch (N/mm^2).

e_n = Fastener deformation, inches (mm). (See Table 2.)

G = Modulus of rigidity of plywood, pounds per square inch (N/mm^2). (See Table 23-2-J of UBC Standard 23-2.)

h = Wall height, feet (mm).

t = Effective thickness of plywood sheathing for shear, inches (mm). (See Tables 23-2-H and 23-2-I of UBC Standard 23-2.)

v = Maximum shear due to design loads at the top of the wall, pounds per lineal foot (N/mm).

Δ = The calculated deflection, inches (mm).

2.3.3 Diaphragms: Allowable shear for wind or seismic forces is shown in Table 4 for diaphragms using the ballistic point nail fastening system to attach structural plywood sheathing to steel framing members. The maximum span-to-width ratio of the diaphragm is 4:1. The deflection of blocked panel diaphragms uniformly fastened throughout is calculated by use of the following formula:

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

$$\text{For SI: } \Delta = \frac{52vL^3}{EAb} + \frac{vL}{4Gt} + 0.614Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

where:

A = Area of chord cross-section, square inches (mm^2).

b = Diaphragm width, feet (mm).

E = Elastic modulus of chords, pounds per square inch (N/mm^2).

e_n = Fastener deformation, inches (mm). (See Table 2.)

G = Modulus of rigidity of sheathing, pounds per square inch (N/mm^2). (See Table 23-3-J of UBC Standard 23-2 for values of G.)

L = Diaphragm length, feet (mm).

t = Effective thickness of wood-based sheathing for shear, inches (mm). (See Tables 23-2-H and 23-2-I of UBC Standard 23-2 for values of t for plywood.)

v = Maximum shear due to design loads in the direction under consideration, pounds per lineal foot (N/mm).

Δ = Calculated deflection, inches (mm).

$\Sigma(\Delta_c X)$ = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance from the nearest support.

2.4 Installation:

Fasteners are installed using pneumatic tools available from the Stanley Fastening Systems Company. Installation must be in accordance with this report and the manufacturer's published installation instructions. The fasteners are installed in such a manner that they pierce the plywood panels being fastened and protrude through the steel framing members a minimum of $^1/_4$ inch (6.4 mm). The fasteners must be installed with the heads flush to the panel surface. If overdriving occurs, no more than 20 percent of the fasteners are permitted to be overdriven more than $^1/_{16}$ inch (1.6 mm). Minimum edge distance for fasteners attaching plywood to steel members is $^3/_8$ inch (9.5 mm) for $1^1/_2$-inch-thick (38 mm) framing members and $^1/_2$ inch (12.7 mm) for thicker framing members.

2.5 Identification:

The Stanley fasteners are identified on the carton by the manufacturer's name and product name, the evaluation report number (ER-5426) and the manufacturer's catalog number (C4DCSBALG).

3.0 EVIDENCE SUBMITTED

Reports of static load shear wall tests and individual fastener pull-out and pull-through tests, a quality control manual and descriptive literature.

4.0 FINDINGS

That the Stanley Ballistic Point Nail Fastening System for Plywood Panel Shear Walls and Diaphragms Attached to Steel Framing, described in this report, complies with the 1997 *Uniform Building Code*™, subject to the following conditions:

4.1 Fasteners are manufactured, identified and installed in accordance with this report.

4.2 Individual fastener allowable values for attachment of wood-based panels to light-gage steel are limited to the values noted in Table 1.

4.3 Allowable shear values for shear walls and horizontal diaphragms are limited to those noted in Table 3 and are for resisting wind loads only. Allowable shear values for horizontal diaphragms are limited to those noted in Table 4.

4.4 Limitations based on deflections of shear walls and horizontal diaphragms must be considered in design.

This report is subject to re-examination in one year.

TABLE 1—ALLOWABLE WITHDRAWAL AND LATERAL LOADS FOR STALNEY BALLISTIC POINT NAILS USED TO ATTACH STRUCTURAL PLYWOOD PANELS TO COLD-FORMED STRUCTURAL STEEL FRAMING MEMBERS[1,2,3]

MAXIMUM STEEL THICKNESS (gage)[4]	MINIMUM THICKNESS OF STRUCTURAL PANELS									
	$^3/_8$ inch	$^7/_{16}$ inch	$^{15}/_{32}$ inch	$^{19}/_{32}$ inch	$^{23}/_{32}$ inch	$^3/_8$ inch	$^7/_{16}$ inch	$^{15}/_{32}$ inch	$^{19}/_{32}$ inch	$^{23}/_{32}$ inch
	Withdrawal Loads (pounds)					Lateral Loads (pounds)				
14	84	93	97	115	120	112	131	140	178	200
16	84	91	91	91	91	112	131	140	159	159
18	68	69	69	69	69	112	127	127	127	127
20	50	50	50	50	50	97	97	97	97	97
22	38	38	38	38	38	79	79	79	79	79

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.448 N.

[1]Tabulated values are for loads due to wind or earthquake, and must be reduced by 25 percent for other applications.
[2]Tabulated values allow for no more than 20 percent of the fasteners to be overdriven more than $^1/_{16}$ inch.
[3]Minimum edge distance and spacing are $^3/_8$ inch and 3 inches, respectively.
[4]Section 2.2.3 describes minimum design base-metal thicknesses associated with gages.

TABLE 2—*K* VALUES FOR e_n DETERMINATION[1,2,3]

GAGE OF STRUCTURAL STEEL MEMBER[3]	MAXIMUM LOAD (pounds/fastener)	*K*[4]
14	200	1,100
16	159	700
18	127	400
20	97	325
22	79	300

For **SI:** 1 pound = 4.448 N.

[1]The maximum load per fastener includes a one-third increase for short-term loading, and must not be exceeded. Lower values may be used.
[2]The load per fastener is determined by dividing the shear per foot by the number of fasteners per foot.
[3]The e_n value is permitted to be increased 20 percent for panel grades other than Structural I.
[4]The *K* values are used in the following formula to determine e_n:

$$e_n = \left(\frac{Load\ per\ fastener}{K} \right)^{2.5}$$

TABLE 3—ALLOWABLE SHEAR, FOR WIND FORCES, FOR STRUCTURAL PLYWOOD SHEAR WALLS ATTACHED TO LIGHT GAGE STEEL STUDS WITH STANLEY FASTENERS (pounds per foot)[1,2,3]

PANEL TYPE	MINIMUM PANEL THICKNESS (inch)	FRAMING		FASTENER SPACING[4,5] AT PANEL EDGES AND ALL FRAMING MEMBERS (inches on center)			
		Minimum Gage[6]	Spacing (inches on center)	6	4	3	2
Structural I	3/8	22	24	115	175	230	295
			16	140	210	285	360
		20	24	140	215	285	360
			16	175	260	345	440
		18	24	165	245	330	420
			16	200	300	400	510
	7/16	18	24	205	310	410	525
			16	225	340	450	575
		16	24	210	320	425	540
			16	235	350	465	595
	15/32	16	16 or 24	250	375	500	640
Rated Sheathing and Siding	3/8	22	26	105	155	210	265
			16	125	190	255	325
		20	24	130	190	255	325
			16	155	235	310	395
		18	24	150	220	295	375
			16	180	270	360	460
	7/16	18	24	185	275	370	470
			16	205	305	405	520
		16	24	190	285	380	485
			16	210	315	420	535
	15/32	16	16 or 24	225	340	450	575
	19/32	16	16 or 24	225	380	510	650
		14	16 or 24	285	430	570	725

For **SI:** 1 inch = 25.4 mm, 1 pound/linear foot = 0.0146 N/mm.

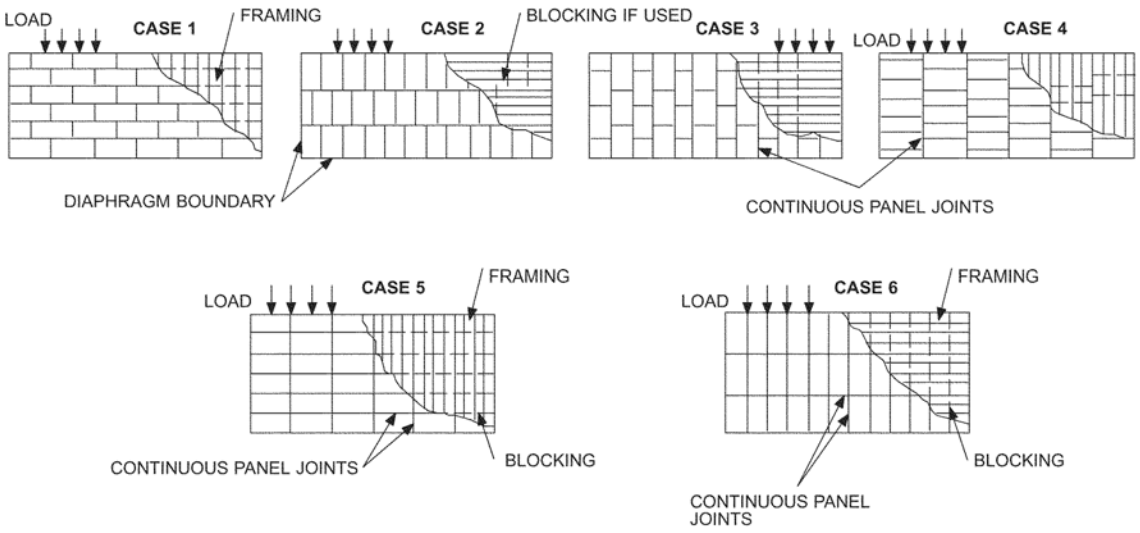
[1]These values are for short-term loads due to wind, and must be reduced 25 percent for normal loading. See Table 1.
[2]The ballistic point nails must be long enough to penetrate through the metal framing a minimum of 1/4 inch.
[3]Tabulated values allow for a maximum of 20 percent of the fasteners to be overdriven more than 1/16 inch.
[4]All panel edges must be blocked with minimum 2-inch nominal framing. Panels are permitted to be installed either horizontally or vertically. Fasteners must be spaced a maximum of 6 inches on center along intermediate framing members for 3/8-inch-thick and 7/16-inch-thick panels installed on framing spaced 24 inches on center, and 12 inches on center for all framing members 16 inches on center.
[5]Tabulated values are for structural plywood panels applied to one side of a wall. Values cannot be increased for panels attached to both sides of a wall.
[6]Section 2.2.3 describes minimum design base-metal thicknesses associated with gages.

TABLE 4—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES FOR STRUCTURAL PLYWOOD HORIZONTAL DIAPHRAGMS SUPPORTED BY LIGHT-GAGE STEEL FRAMING ATTACHED WITH STANLEY FASTENERS (pounds per foot)[1]

SHEATHING PANEL	MINIMUM PANEL THICKNESS (inch)	SUPPORTING STEEL MEMBER FLANGE DIMENSIONS		BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
				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)[2,3,4,5]				Nails Spaced Maximum 6 Inches at Supported Edges	
		Width (inches)	Minimum Gage[6]	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	$^3/_8$	1.5	18	225	300	450	600	200	150
		2.5		255	335	505	675	225	170
	$^7/_{16}$	1.5	18	255	340	505	675	225	170
		2.5		285	380	570	760	255	190
		1.5	16	202	270	405	459	180	135
		2.5		227	303	455	515	202	152
	$^{15}/_{32}$	1.5	16	280	375	565	750	250	190
		2.5		315	420	630	845	280	210
Rated Sheathing	$^3/_8$	1.5	18	205	270	405	540	180	135
		2.5		230	305	455	605	200	150
	$^7/_{16}$	1.5	18	230	305	455	601	205	150
		2.5		255	340	515	685	230	170
		1.5	16	235	315	475	630	210	160
		2.5		265	355	530	710	235	175
	$^{15}/_{32}$	1.5	16	255	340	505	675	225	170
		2.5		285	380	570	760	255	190
	$^{19}/_{32}$	1.5	16	285	380	575	765	255	190
		2.5		320	430	645	860	285	215
		1.5	14	320	430	640	855	285	215
		2.5		360	480	720	960	320	240

For **SI:** 1 inch = 25.4 mm, 1 pound/linear foot = 0.0146 N/mm.

[1]These values are for short-term loads due to wind or earthquake, and must be reduced 25 percent for normal loading.
[2]The ballistic point nails must be long enough to penetrate through the metal framing a minimum of $^1/_4$ inch.
[3]Fasteners are spaced a maximum of 12 inches on center along intermediate framing members.
[4]Tabulated values allow for a maximum of 20 percent of the fasteners to be overdriven more than $^1/_{16}$ inch.
[5]Framing is permitted to be oriented in either direction for diaphragms, provided sheathing is designed for vertical loads.
[6]Section 2.2.3 describes minimum design base-metal thicknesses associated with gages.



NOTE: Framing may be oriented in either direction for diaphragms, provided sheathing is properly designed for vertical loading.