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Legacy report on the 1997 Uniform Building Code™, the 2000 International Building Code®, and the 2000 International Residential Code®

DIVISION: 06—WOOD AND PLASTICS
Section: 06095—Nails

PNEUMATICALLY, MECHANICALLY AND MANUALLY DRIVEN ROUND-HEAD AND MODIFIED ROUND-HEAD NAILS

MID CONTINENT NAIL CORPORATION,
A DIVISION OF LIBLA INDUSTRIES, INC.
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POPLAR BLUFF, MISSOURI 63901

1.0 SUBJECT

Pneumatically, Mechanically and Manually Driven Round-head and Modified Round-head Nails.

2.0 DESCRIPTION

2.1 General:

The nails are formed from plain AISI C1008 through C1030 grades of steel wire, with either standard-diameter round heads or modified round heads. Nails are assembled in strips or coils, or are in bulk form. They are available with a corrosion-resistant zinc coating complying with ASTM A 641, Class 1, coating weight, or ASTM A 641, Class 2, coating weight, or ASTM B 633, Type II with a 5 µm coating thickness; or with a thin film of plastic-polymer or vinyl coating. The plastic or vinyl coating is not a substitute for zinc coating where zinc coating is required. Nails are either driven with pneumatic or mechanical devices or are manually driven.

2.2 Dimensions and Fastener Tolerances:

Nails described in this report conform with the dimensions and tolerances specified in ASTM F 1667, "Standard Specification for Driven Fasteners: Nails, Spikes, and Staples."

2.3 Design:

Nails formed from wire having a nominal diameter of 0.135 inch (3.4 mm) or less have a minimum bending yield strength, Fyb, of 100,000 psi (689 MPa). Nails with diameters greater than 0.135 inch (3.4 mm), and up to 0.162 inch (4.1 mm), have a minimum bending yield strength, Fyb, of 90,000 psi (620 MPa).

Allowable loads for nails are as specified for nails having the same dimensions in Part XII of the National Design Specification (NDS). The ANSI/NFoPA NDS-1991 is

referenced in Section 2316 of the 1997 Uniform Building Code™ (UBC). The ANSI/AF&PA NDS-1997 is referenced in Section 2306.1 of the 2000 International Building Code® (IBC), and in Sections R502.2, R602.3 and R802.2 of the 2000 International Residential Code® (IRC).

The allowable lateral load design values (Z) specified in Table 1 of this report are under the conditions described in the table footnotes. The required nail size and depth of penetration must comply with the UBC, IBC and IRC as applicable to the design requirements for the intended use.

Allowable withdrawal capacity of the nails is specified in Table 2. Allowable shears for horizontal wood structural panel diaphragms for nails with a diameter of 0.148 inch (3.76 mm) are as specified for 10d nails shown in Table 3; and the allowable shears for wind or seismic forces for wood structural panel shear walls for nails with a diameter of 0.148 inch (3.76 mm) are as specified for 10d nails shown in Table 4.

The design values in Tables 1 and 2 are for ten-year duration of load. Design values in all tables are for dry conditions of use. Tabulated design values must be multiplied by all applicable adjustment factors in accordance with the provisions set forth in Chapter 23, Division III, Part I, of the UBC, and Section 1605.3.1.1 and Chapter 23 of the IBC.

2.4 Installation:

Edge distances, end distances, and spacings shall be sufficient to prevent splitting of the wood, and shall comply with the design requirements and with UBC Section 2318, IBC Section 2304.9, or Part 12.4 of the applicable NDS.

2.5 Identification:

Nails are packaged in containers or cartons bearing the Mid Continent Nail Corporation name and address; the evaluation report number (ER-4570); and the nail brand name and description (type, length, and diameter or gage).

Coated nails are identified on the nail carton or other packaging material by the word "coated," or by language indicating "plastic-coated," "vinyl-coated," "electrogalvanized," or "mechanically galvanized."

3.0 EVIDENCE SUBMITTED

Data in accordance with the Acceptance Criteria for Nails and Spikes (AC116), dated July 2001, and a quality control manual.

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4.0 FINDINGS

That the fasteners described in this report comply with the 1997 *Uniform Building Code*™ (UBC), the 2000 *International Building Code*® (IBC), and the 2000 *International Residential Code*® (IRC), subject to the following conditions:

- 4.1 Use of these products is in accordance with this report and the manufacturer’s instructions.
- 4.2 Nails conform to the dimensions and tolerances specified in Section 2.2 of this report.
- 4.3 Fasteners that are larger than specified may be used for shear and diaphragm applications, provided consideration is given to avoiding wood splitting, in addition to restrictions on edge distance and spacing of the large-diameter fasteners.

- 4.4 Fasteners used in wood foundation systems comply with Section 1811.3 of the UBC, Section 2304.9.5 of the IBC and Section R402.1 of the IRC.
- 4.5 Fasteners used in pressure-preservative- and fire-retardant-treated wood comply with Section 2304.3 of the UBC, Section 2304.9.5 of the IBC and Chapters 4, 5, and 6 of the IRC.
- 4.6 Calculations demonstrating that the applied loads are less than the design values in this report are submitted to the building official for approval.

This report is subject to re-examination in two years.

TABLE 1—NAIL LATERAL DESIGN VALUES (Z) FOR SINGLE SHEAR CONNECTIONS^{1,2,3}

FASTENER DESCRIPTION		NAIL DIAMETER, D (inch)	NAIL LENGTH, L (inches)	SIDE MEMBER THICKNESS, t _s (inches)	Z (lbs)			
					G = 0.55 Southern pine	G = 0.50 Douglas fir-larch	G = 0.43 Hem-fir	G = 0.42 Spruce-pine-fir
Box nail	6d	0.099	2	1/2	55	48	39	38
				5/8	61	55	44	42
				3/4	61	55	48	47
	8d	0.113	2 1/2	1/2	67	59	49	47
				5/8	76	66	53	52
				3/4	79	72	58	57
	16d	0.135	3 1/2	1	79	72	63	61
				1/2	89	79	66	65
				5/8	98	86	71	69
				3/4	108	94	76	74
				1 1/4	113	103	89	88
				1 1/2	113	103	89	88
Common wire nail	6d	0.113	2	1/2	67	59	49	47
				5/8	76	66	53	52
	8d	0.131	2 1/2	1/2	85	76	63	61
				5/8	94	82	67	65
				3/4	104	90	73	70
	10d	0.148	3	1/2	101	90	75	73
				5/8	110	97	80	77
				3/4	121	105	85	83
				1	128	118	99	96
	12d	0.148	3 1/4	1/2	101	90	75	73
				5/8	110	97	80	77
				3/4	121	105	85	83
				1	128	118	99	96
				1 1/4	128	118	102	100
				1 1/2	128	118	102	100
	16d	0.162	3 1/2	1/2	117	105	89	87
				5/8	126	112	93	90
				3/4	138	121	99	96
1				154	141	113	109	
1 1/4				154	141	122	120	
1 1/2				154	141	122	120	

TABLE 1—NAIL LATERAL DESIGN VALUES (Z) FOR SINGLE SHEAR CONNECTIONS^{1,2,3} (Continued)

FASTENER DESCRIPTION		NAIL DIAMETER, D (inch)	NAIL LENGTH, L (inches)	SIDE MEMBER THICKNESS, t _s (inches)	Z (lbs)			
					G = 0.55 Southern pine	G = 0.50 Douglas fir-larch	G = 0.43 Hem-fir	G = 0.42 Spruce-pine-fir
F1667-NLBXA-06 B ⁴ (Box nail)	7d	0.099	2 ¹ / ₄	1/2	55	48	39	38
				5/8	61	55	44	42
				3/4	61	55	48	47
				1	61	55	48	47
F1667-NLBXB-07 ⁴ (Box nail)	8d	0.099	2 ³ / ₈	1/2	55	48	39	38
				5/8	61	55	44	42
				3/4	61	55	48	47
				1	61	55	48	47
F1667-NL BXA-09B (Box nail)	10d	0.131	3	1/2	85	76	63	61
				5/8	94	82	67	65
				3/4	104	90	73	70
				1	106	97	84	82
F1667-NL BXA-10B (Box nail)	12d	0.131	3 ¹ / ₄	1/2	85	76	63	61
				5/8	94	82	67	65
				3/4	104	90	73	70
				1	106	97	84	82
F1667-NLCMA-01 ⁴ (Common nail)	4d	0.099	1 ¹ / ₂	1/2	55	48	39	38
				5/8	61	55	44	42
F1667-NLCMS-04-B ⁴ (Common nail)	5d	0.099	1 ³ / ₄	1/2	55	48	39	38
				5/8	61	55	44	42
F1667 NL CM MS-22 Z ⁴ (Common nail)	-	0.099	1 ⁷ / ₈	1/2	55	48	39	38
				5/8	61	55	44	42
F1667-NLCMS-06-B ⁴	7d	0.113	2 ¹ / ₄	1/2	67	59	49	47
				5/8	76	66	53	52
				3/4	79	72	58	57
F1667-NLCM MS-37 Z ⁴ (Common nail)	-	0.131	3 ¹ / ₂	1/2	85	76	63	61
				5/8	94	82	67	65
				3/4	104	90	73	70
				1	106	97	84	82
				1 ¹ / ₄	106	97	84	82
F1667-NLCL-07 ⁴ (Cooler nail)	8d	0.113	2 ³ / ₈	1/2	67	59	49	47
				5/8	76	66	53	52
				3/4	79	72	58	57
				1	79	72	63	61
F1667-NLSK 07 ⁴ (Sinker nail)	10d	0.121	2 ⁷ / ₈	1/2	74	65	54	53
				5/8	83	72	59	57
				3/4	89	80	64	62
				1	89	81	71	69

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

¹Tabulated lateral design values (Z) for nailed connections shall be multiplied by all applicable adjustment factors in accordance with the NDS.

²Tabulated lateral design values (Z) are for the nails inserted in side grain with nail axis perpendicular to wood fibers and with the following nail bending yield strengths (F_{yb}):

F_{yb} = 100,000 psi (690 N/mm²) for 0.099-, 0.113-, 0.121-, 0.131-, and 0.135-inch-diameter (2.5, 2.9, 3.06, 3.3 and 3.4 mm) nails.

F_{yb} = 90,000 psi (621 N/mm²) for 0.148- and 0.162-inch-diameter (3.8 and 4.1 mm) nails.

³Applied to both members of identical species.

⁴ASTM F1667 nail designation.

TABLE 2—NAIL WITHDRAWAL DESIGN VALUES (*W*)^{1,2}
 [Tabulated Withdrawal Design Values (*W*) Are in Pounds per Inch of Penetration into Side Grain of Main Member]

LUMBER	SPECIFIC GRAVITY, <i>G</i>	NAIL DIAMETER, <i>D</i> (inch)						
		0.099	0.113	0.121	0.131	0.135	0.148	0.162
Southern pine	0.55	31	35	37	41	42	46	50
Douglas fir–larch	0.50	24	28	30	32	33	36	40
Hem-fir	0.43	17	19	20	22	23	25	27
Spruce-pine-fir	0.42	16	18	19	21	21	23	26

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

¹Tabulated lateral withdrawal design values (*W*) for nail connections shall be multiplied by all applicable adjustment factors in accordance with the NDS.

²For other species and configurations, see Division III, Part I, of the UBC; Section 2306 of the IBC; and Sections R502.2, R602.3 and R802.2 of the IRC.

TABLE 3—ALLOWABLE SHEAR IN POUNDS PER FOOT FOR HORIZONTAL WOOD STRUCTURAL PANEL DIAPHRAGMS WITH FRAMING OF DOUGLAS FIR–LARCH OR SOUTHERN PINE^{1,a}

PANEL GRADE	NAIL DESCRIPTION			MINIMUM NOMINAL WIDTH OF FRAMING MEMBER (inches)	PANEL THICKNESS (inch)		BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
	Nail Type	Nail Diameter ^d (inch)	Nail Length (inches)				Nail 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) ^b (inches)				Nails spaced 6 inches maximum at supported edges ^b	
							6	4	2 1/2 ^c	2 ^c	Case 1 (No unblocked edges or continuous joints parallel to load)	All other configurations (Cases 2, 3, 4, 5 and 6)
							Nail spacing at other panel edges (Cases 1, 2, 3 and 4) ^b (inches)					
Min.	Max.											
Structural I	10d	0.148	2 1/8	2 3	15/32	1/2	320 360	425 480	640 720	730 820	285 320	215 240
		0.148	2 1/4	2 3	15/32	5/8	320 360	425 480	640 720	730 820	285 320	215 240
		0.148	2 3/8	2 3	15/32	3/4	320 360	425 480	640 720	730 820	285 320	215 240
		0.148	2 1/2	2 3	15/32	7/8	320 360	425 480	640 720	730 820	285 320	215 240
C-D, C-C, Sheathing, and other grades covered in UBC Standard 23-2 or 23-3 or in IBC DOC PS 1 and PS 2		0.148	2 1/8	2 3	15/32	1/2	290 325	385 430	575 650	655 735	255 290	190 215
		0.148	2 1/4	2 3	15/32	5/8	290 325	385 430	575 650	655 735	255 290	190 215
		0.148	2 3/8	2 3	15/32	3/4	290 325	385 430	575 650	655 735	255 290	190 215
		0.148	2 1/2	2 3	15/32	7/8	290 325	385 430	575 650	655 735	255 290	190 215
		0.148	2 1/4	2 3	19/32	5/8	320 360	425 480	640 720	730 820	285 320	215 240
		0.148	2 3/8	2 3	19/32	3/4	320 360	425 480	640 720	730 820	285 320	215 240
		0.148	2 1/2	2 3	19/32	7/8	320 360	425 480	640 720	730 820	285 320	215 240

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

For UBC:

¹These values are for short-time loads due to wind or earthquake and must be reduced 25 percent for normal loading. Space nails 12 inches (305 mm) on center along intermediate framing members. Allowable shear values for nails in framing members of other species set forth in Division III, Part III, of the UBC, shall be calculated for all other grades by multiplying the shear capacities for nails in Structural I by the following factors: 0.82 for species with specific gravity greater than or equal to 0.42 but less than 0.49, and 0.65 for species with specific gravity less than 0.42.

²Framing at adjoining panel edges shall be 3-inch (76 mm) nominal or wider and nails shall be staggered where nails are spaced 2 inches (51 mm) or 2 1/2 inches (64 mm) on center.

³Framing at adjoining panel edges shall be 3-inch (76 mm) nominal or wider and nails shall be staggered where nails having penetration into framing of more than 1 5/8 inches (41 mm) are spaced 3 inches (76 mm) or less on center.

TABLE 3—ALLOWABLE SHEAR IN POUNDS PER FOOT FOR HORIZONTAL WOOD STRUCTURAL PANEL DIAPHRAGMS WITH FRAMING OF DOUGLAS FIR–LARCH OR SOUTHERN PINE^{1,a}—(Continued)

For IBC:

- a. For framing of other species: (1) Find specific gravity for species of lumber in AFPA National Design Specification. (2) For staples, find shear value from table above for Structural I panels (regardless of actual grade) and multiply value by 0.82 for species with specific gravity of 0.42 or greater, or 0.65 for all other species. (3) For nails, find shear value from table above for nail size for actual grade and multiply value by the following adjustment factor: Specific Gravity Adjustment Factor = [1 – (0.5 – SG)], where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
- b. Space nails a maximum of 12 inches o.c. along intermediate framing members (6 inches o.c. where supports are spaced 48 inches o.c.).
- c. Framing at adjoining panel edges shall be 3 inches (nominal) or wider, and nails shall be staggered where nails are spaced 2 inches o.c. or 2½ inches o.c.
- d. Framing at adjoining panel edges shall be 3 inches (nominal) or wider, and nails shall be staggered where both of the following conditions are met: (1) 10d nails having penetration into framing of more than 1½ inches, and (2) nails are spaced 3 inches o.c. or less.

TABLE 4—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES^{b,f,g,h} IN POUNDS PER FOOT FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS FIR–LARCH OR SOUTHERN PINE^{1,2,3,a}

PANEL GRADE	NAIL DESCRIPTION			PANEL THICKNESS (inch)		PANELS APPLIED DIRECTLY TO FRAMING			
	Nail Type	Nail Diameter	Nail Length (inches)	Min.	Max.	Nail Spacing at Panel Edges (inches)			
						6	4	3 ^d	2 ^c
Structural I	10d	0.148	2 1/8	15/32	1/2	340	510	665	870
		0.148	2 1/4	15/32	5/8	340	510	665	870
		0.148	2 3/8	15/32	3/4	340	510	665	870
		0.148	2 1/2	15/32	7/8	340	510	665	870
C-D, C-C, Sheathing, and other grades covered in UBC Standard 23-2 or 23-3, or in IBC, DOC PS 1 and PS 2 for Sheathing, Plywood Siding ^e except Group 5 Species	10d	0.148	2 1/8	15/32	1/2	310	460	600	770
		0.148	2 1/4	15/32	5/8	310	460	600	770
		0.148	2 3/8	15/32	3/4	310	460	600	770
		0.148	2 1/2	15/32	7/8	310	460	600	770
		0.148	2 1/4	19/32	5/8	340	510	665	870
		0.148	2 3/8	19/32	3/4	340	510	665	870
		0.148	2 1/2	19/32	7/8	340	510	665	870
		0.148	2 1/2	19/32	7/8	340	510	665	870

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

For UBC:

¹All panel edges backed with 2-inch (51 mm) nominal or wider framing. Panels installed either horizontally or vertically. Space nails 12 inches (305 mm) on center along intermediate framing members. These values are for short-time loads due to wind or earthquake and must be reduced 25 percent for normal loading. Allowable shear values for nails in framing members of other species set forth in Division III, Part III, of the UBC, shall be calculated for all other grades by multiplying the shear capacities for nails in Structural I by the following factors: 0.82 for species with specific gravity greater than or equal to 0.42, but less than 0.49, and 0.65 for species with specific gravity less than 0.42.

²Where panels are applied on both faces of a wall and nail spacing is less than 6 inches (152 mm) on center on either side, panel joints shall be offset to fall on different framing members, or framing shall be 3-inch (76 mm) nominal or thicker and nails on each side shall be staggered.

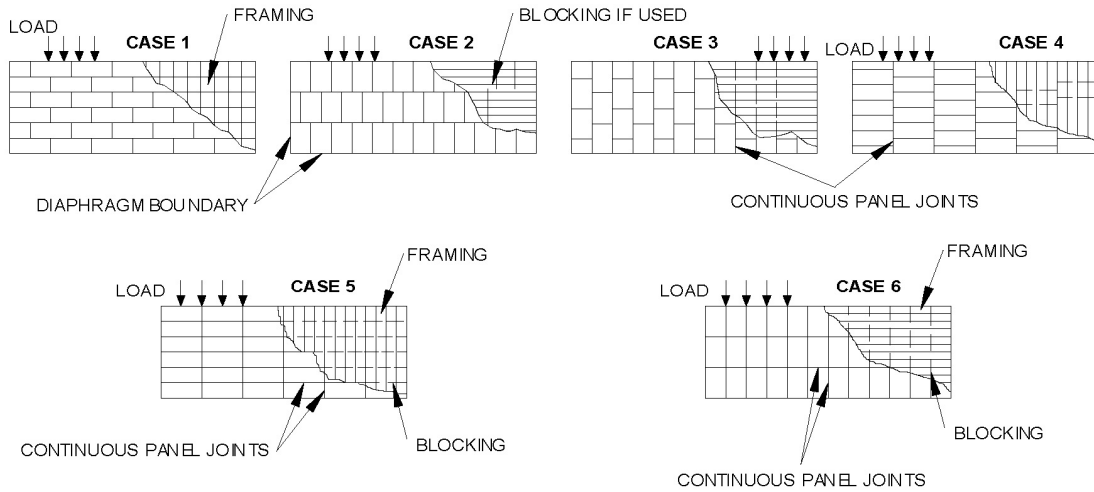
³In Seismic Zones 3 and 4, where allowable shear values exceed 350 pounds per foot (5.11 N/mm), foundation sill plates and all framing members receiving edge nailing from abutting panels shall not be less than a single 3-inch (76 mm) nominal member and foundation sill plates shall not be less than a single 3-inch (76 mm) nominal member. In shear walls where total wall design shear does not exceed 600 pounds per foot (8.76 N/mm), a single 2-inch (51 mm) nominal sill plate may be used, provided anchor bolts are designed for a load capacity of 50 percent or less of the allowable capacity and bolts have minimum 2-inch-by-2-inch-by-3/16-inch-thick (51 mm by 51 mm by 5 mm) plate washers. Plywood joint and sill plate nailing shall be staggered in all cases.

For IBC:

- a. For framing of other species: (1) Find specific gravity for species of lumber in NDS. (2) For nails, find shear value from table above for nail size for actual grade and multiply value by the following adjustment factor: Specific Gravity Adjustment Factor = [1 – (0.5 – SG)], where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
- b. Panel edges backed with 2-inch (nominal) or wider framing. Install panels either horizontally or vertically. Space nails a maximum of 6 inches o.c. along intermediate framing members for 3/8-inch and 7/16-inch panels installed on studs spaced 24 inches o.c. For other conditions and panel thickness, space nails a maximum of 12 inches o.c. on intermediate supports.
- c. Framing at adjoining panel edges shall be 3-inch (nominal) or wider, and nails shall be staggered where nails are spaced 2 inches o.c.
- d. Framing at adjoining panel edges shall be 3-inch (nominal) or wider, and nails shall be staggered where both of the following conditions are met: (1) 10d nails having penetration into framing of more than 1½ inches, and (2) nails are spaced 3 inches o.c.
- e. Values apply to all-veneer plywood. Thickness at point of nailing on panel edges governs shear values.
- f. Where panels are applied on both faces of a wall and nail spacing is less than 6 inches o.c. on either side, panel joints shall be offset to fall on different framing members; or framing shall be 3-inch (nominal) or thicker and nails on each side shall be staggered.

TABLE 4—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES^{b,f,g,h} IN POUNDS PER FOOT FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS FIR–LARCH OR SOUTHERNPINE^{1,2,3,a}—(Continued)

- g. In Seismic Design Category D, E or F, where shear design values exceed 490 plf (LRFD) or 350 plf (ASD), all framing members receiving edge nailing from abutting panels shall not be less than a single 3-inch (nominal) member. Plywood joint and sill plate nailing shall be staggered in all cases. See Section 2305.3.10 for sill plate size and anchorage requirements.
- h. Galvanized nails shall be hot-dipped or tumbled.



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