



# ICBO Evaluation Service, Inc.

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## EVALUATION REPORT

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ER-5667

Issued December 1, 2000

Filing Category: ROOF, WALL AND FLOOR PANELS—Wood (216)

**AEROSMITH U-NOPUL FASTENERS  
AEROSMITH FASTENING SYSTEMS  
5050 SOUTH 40<sup>TH</sup> STREET  
PHOENIX, ARIZONA 85040**

### 1.0 SUBJECT

Aerosmith U-Nopul Fasteners.

### 2.0 DESCRIPTION

#### 2.1 General:

Aerosmith U-Nopul fasteners are steel drive pins used to attach plywood sheathing to steel framing for horizontal diaphragms and shearwalls. The fasteners also may attach lumber or plywood to steel members. The pins are installed with a pneumatically actuated tool. The pins pierce the material being fastened and protrude through the steel member.

#### 2.2 Materials:

**2.2.1 Fasteners:** The U-Nopul fasteners are manufactured from AISI 1566 steel, heat-treated to a Rockwell C hardness between 52 and 56, and have a minimum tensile strength of 240 ksi (1655 MPa) and a bending yield strength of 250 ksi (1724 MPa). The fasteners are electro-zinc plated with a chromate rinse or are mechanically zinc-plated. They are produced in 0.190-, 0.165-, 0.144- and 0.100-inch (4.83, 4.19, 3.66 and 2.54 mm) diameters having  $\frac{3}{8}$ -,  $\frac{21}{64}$ -,  $\frac{5}{16}$ - and  $\frac{1}{4}$ -inch-diameter (9.52, 8.33, 7.94 and 6.35 mm) heads, respectively. The fasteners with a diameter of 0.190 inch (4.83 mm) have a smooth shank and a product designation of BZS. The 0.100-, 0.144- and 0.165-inch-diameter (2.54, 3.66 and 4.19 mm) fasteners have a helical shaped shank and a product designation of BZH.

**2.2.2 Steel Members:** The steel and steel framing members shall comply with ASTM A 653 SS Grade 33, with the gages noted in this report correlating to the following minimum base-metal thicknesses:

No. 11 gage: 0.125 inch (3.18 mm).  
No. 14 gage: 0.0747 inch (1.90 mm).  
No. 16 gage: 0.0598 inch (1.52 mm).  
No. 18 gage: 0.0478 inch (1.21 mm).  
No. 20 gage: 0.0359 inch (0.91 mm).  
No. 22 gage: 0.0299 inch (0.76 mm).

**2.2.3 Sheathing:** The sheathing shall be plywood complying with the United States Department of Commerce Product Standard PS1-95 or PS2-92 (UBC Standards 23-2 or 23-3). The plywood thickness and span rating shall comply with the applicable code requirements based on the spacing of the framing members.

### 2.3 Horizontal Diaphragms:

Allowable shear values shown in Tables 1 and 2 are for horizontal diaphragms of plywood attached to steel framing with 0.100- and 0.144-inch-diameter (2.54 and 3.66 mm) Aerosmith U-Nopul fasteners, respectively. The maximum framing spacing is 24 inches (610 mm) on center. The maximum span-to-width ratio of the diaphragm is 4:1. The deflection of blocked diaphragms uniformly nailed throughout shall be calculated by use of the following formula:

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

For SI:

$$\Delta = \frac{52vL^3}{EAb} + \frac{vL}{4Gt} + 0.614Le_n + \frac{\Sigma_c X}{2b}$$

where:

- A = Area of chord cross section, square inches (mm<sup>2</sup>).
- b = Diaphragm width, feet (mm).
- E = Elastic modulus of chords, pounds per square inch (N/mm<sup>2</sup>).
- e<sub>n</sub> = 0.020 inch (0.508 mm) = fastener deformation, inches (mm).
- G = Modulus of rigidity of sheathing, pounds per square inch (N/mm<sup>2</sup>). (See Table 7 of this report for values of G.)
- L = Diaphragm length, feet (mm).
- t = Thickness of sheathing, inches (mm).
- v = Maximum shear due to design loads in the direction under consideration, pounds per lineal foot (N/mm).
- Δ = Calculated deflection, inches (mm).

Σ(Δ<sub>c</sub>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 Shear Walls:

Allowable shear values shown in Tables 3 and 4 are for shear walls of plywood attached to steel framing with 0.100- and 0.144-inch-diameter (2.54 and 3.66 mm) Aerosmith U-Nopul fasteners, respectively. The maximum framing spacing is 24 inches (610 mm) on center, unless noted otherwise in the tables. The maximum allowable height-to-width ratio of the shear wall is 3.5:1 for panels fastened along all edges, and 2:1 where blocking is omitted at intermediate joints. Shear wall chords and hold-downs shall be designed by a registered design professional. The deflection of blocked shear walls uniformly nailed throughout shall be calculated by use of the following formula:

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$$\Delta + \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a$$

For SI:

$$\Delta + \frac{2000vh^3}{3EAb} + \frac{hv}{Gt} + 2.46he_n + d_a$$

where:

- $A$  = Area of boundary element cross section (vertical member at shear wall boundary), square inches (mm<sup>2</sup>).
- $b$  = Wall width, feet (mm).
- $d_a$  = Deflection due to anchorage details (rotation and slip at tie down bolts).
- $E$  = Elastic modulus of boundary element (vertical member at shear wall boundary), pounds per square inch (N/mm).
- $e_n$  = 0.020 inch (0.508 mm) = fastener deformation, inches (mm).
- $G$  = Modulus of rigidity of sheathing, pounds per square inch (N/mm). See Table 7 of this report for values of  $G$ .
- $h$  = Wall height, feet (mm).
- $t$  = Thickness of sheathing, inches (mm).
- $v$  = Maximum shear due to design loads at the top of the wall, pounds per lineal foot (N/mm).
- $\Delta$  = Calculated deflection, inches (mm).

### 2.5 Lumber and Plywood Attached to Steel:

Aerosmith U-Nopul fasteners are used to attach lumber and plywood panels to steel. Fastener information, attachment dimensions, required penetrations and allowable lateral and withdrawal loads per fastener are set forth in Tables 5 and 6.

### 2.6 Installation:

Aerosmith U-Nopul fasteners shall be installed in accordance with this report and manufacturer's instructions. The fasten-

ers shall be installed with the fastener head flush with the plywood surface. A maximum 1 out of 10 pins is permitted to be over-driven by up to  $1/16$  inch (1.6 mm) in plywood  $1/2$  inch (12.7 mm) or less in thickness, and by up to  $1/8$  inch (3.2 mm) in plywood thicker than  $1/2$  inch (12.7 mm).

### 2.7 Identification:

The fasteners are identified by the company name (Aerosmith Fastening Systems), the product designation, the catalog number, and the evaluation report number (ICBO ES ER-5667) on the cartons; and by the logo or manufacturer's symbol on the head of the fastener, as shown in Figure 1.

### 3.0 EVIDENCE SUBMITTED

Reports of lateral load and withdrawal tests, and racking shear tests.

### 4.0 FINDINGS

**That the Aerosmith U-Nopul fasteners described in this report comply with the 1997 *Uniform Building Code*<sup>™</sup>, the 2000 *International Building Code*<sup>®</sup>, the BOCA *National Building Code/1999*, and the 1999 *Standard Building Code*<sup>®</sup>, subject to the following conditions:**

- 4.1 Fasteners are manufactured, identified and installed in accordance with this report.
- 4.2 The allowable shear values for the plywood horizontal diaphragms and plywood shear walls noted in Tables 1 through 4 exceed the design loads.
- 4.3 Individual fastener attachment allowable values set forth in Tables 5 and 6 exceed design loads.
- 4.4 Limitations based on deflections of horizontal diaphragms and shear walls must be considered in design.
- 4.5 Shear walls are limited to use in resisting wind forces.
- 4.6 The fasteners are limited to locations not exposed to the weather or damp environments.

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

**TABLE 1—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES IN POUNDS PER FOOT FOR HORIZONTAL PLYWOOD DIAPHRAGMS WITH STEEL FRAMING AND AEROSMITH 0.100-INCH-DIAMETER PINS <sup>1,2</sup>**

PLYWOOD GRADE	MINIMUM STEEL GAGE <sup>3,4,5</sup>	MINIMUM PANEL THICKNESS (Inches)	BLOCKED DIAPHRAGM PIN SPACING (Inches) <sup>6,7</sup>				UNBLOCKED DIAPHRAGM PIN SPACING (Inches) <sup>6,7</sup>	
			Pin 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)				Pins spaced 6 inches max. at supported edges	
			6	4	2 1/2	2	Case 1 (no unblocked edges or continuous joints parallel to load)	All other configurations (cases 2, 3, 4, 5 and 6)
			Pin spacing at other panel edges					
Structural I	20	7/16	185	280	420	475	185	140
	16	1 3/32	205	305	460	520	205	150
Grades other than Structural I	20	7/16	165	250	380	430	165	125
	16	1 3/32	185	275	415	470	185	140

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

<sup>1</sup>These values are for short-time loads due to wind or earthquake and shall be reduced by 25 percent for normal loading.

<sup>2</sup>The pin shall be long enough to penetrate through the thickness of the steel a minimum of 1/4 inch.

<sup>3</sup>Minimum width of framing is 1 1/2 inches.

<sup>4</sup>Base metal thickness of steel measured without coatings shall comply with minimum thicknesses specified in Section 2.2.2 of this report.

<sup>5</sup>These shear values also apply to framing made of thicker steel.

<sup>6</sup>Spacing of fasteners along intermediate framing members is 12 inches on center.

<sup>7</sup>The minimum panel edge distance is 3/4 inch.

**TABLE 2—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES IN POUNDS PER FOOT FOR HORIZONTAL PLYWOOD DIAPHRAGMS WITH STEEL FRAMING AND AEROSMITH 0.144-INCH-DIAMETER PINS <sup>1,2</sup>**

PLYWOOD GRADE	MINIMUM STEEL GAGE <sup>3,4,5</sup>	MINIMUM PANEL THICKNESS (Inches)	BLOCKED DIAPHRAGM PIN SPACING (Inches) <sup>7,8</sup>				UNBLOCKED DIAPHRAGM PIN SPACING (Inches) <sup>7,8</sup>	
			Pin 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)				Pins spaced 6 inches max. at supported edges	
			6	4	2 1/2	2	Case 1 (no unblocked edges or continuous joints parallel to load)	All other configurations (cases 2, 3, 4, 5 and 6)
			Pin spacing at other panel edges					
Structural I	16	7/16	235	350	525	600	235	175
	16	1 3/32	330	495	740	840	330	245
Grades other than Structural I	16	7/16	210	315	475	540	210	155
	16	1 3/32	295	445	665	755	295	220
	14	1 9/32	380	565	845	960	380	285

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

<sup>1</sup>These values are for short-time loads due to wind or earthquake and shall be reduced by 25 percent for normal loading.

<sup>2</sup>The pin shall be long enough to penetrate through the thickness of the steel a minimum of 1/4 inch.

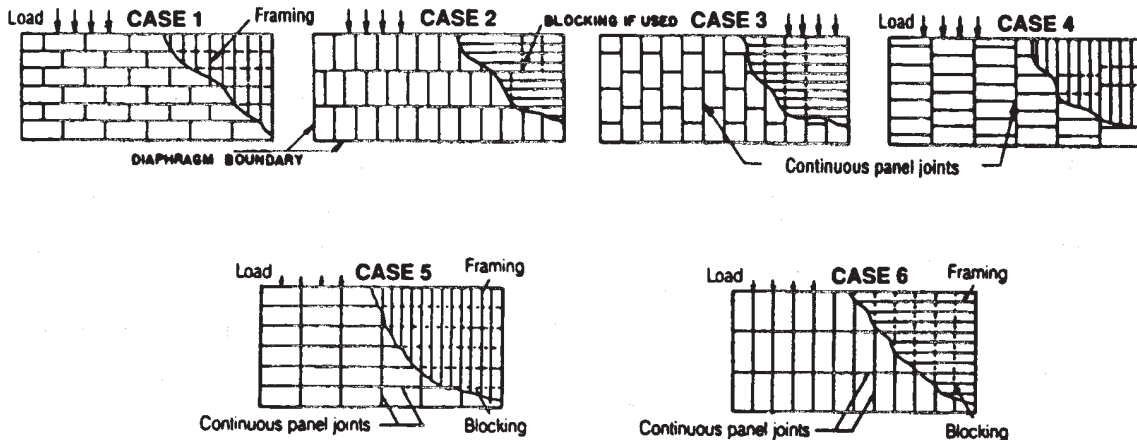
<sup>3</sup>Minimum width of framing is 1 1/2 inches.

<sup>4</sup>Base metal thickness of steel measured without coatings shall comply with minimum thicknesses specified in Section 2.2.2 of this report.

<sup>5</sup>These shear values also apply to framing made of thicker steel.

<sup>6</sup>Spacing of fasteners along intermediate framing members is 12 inches on center.

<sup>7</sup>The minimum panel edge distance is 3/4 inch.



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

TABLE 3—ALLOWABLE SHEAR FOR WIND FORCES IN POUNDS PER FOOT FOR PLYWOOD SHEAR WALLS WITH STEEL FRAMING AND AEROSMITH 0.100-INCH-DIAMETER PINS<sup>1, 2, 3, 4, 5, 6</sup>

PLYWOOD GRADE	MINIMUM STEEL GAGE <sup>7</sup>	MINIMUM PANEL THICKNESS (inches)	PIN SPACING, ALL PANEL EDGES (inches)			
			6	4	3	2
Structural I	22	$\frac{3}{8}$ "	120	180	240	305
	22	$\frac{7}{16}$ "	130	195	260	330
	22	$\frac{15}{32}$ "	145	215	290	365
	20	$\frac{3}{8}$ "	155	235	310	395
	20	$\frac{7}{16}$ "	170	255	340	435
	20	$\frac{15}{32}$ "	205	305	410	520
Grades other than Structural I	22	$\frac{3}{8}$ "	110	165	215	275
	22	$\frac{7}{16}$ "	120	175	235	300
	22	$\frac{15}{32}$ "	130	195	260	330
	20	$\frac{3}{8}$ "	140	210	280	360
	20	$\frac{7}{16}$ "	155	230	310	390
	20	$\frac{15}{32}$ "	185	275	370	470

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

<sup>1</sup> Values are for loads imposed by wind and shall be reduced by 25 percent for normal loading.

<sup>2</sup> The pin shall be long enough to penetrate through the metal framing a minimum of  $\frac{1}{4}$  inch.

<sup>3</sup> The minimum panel edge distance for pin placement is  $\frac{3}{8}$  inch.

<sup>4</sup> Spacing of fasteners along intermediate framing members is 6 inches on center for  $\frac{3}{8}$ -inch and  $\frac{7}{16}$ -inch panels when studs are 24 inches on center and 12 inches on center when studs are 16 inches on center. For other panel thicknesses, spacing along intermediate framing members is 12 inches on center.

<sup>5</sup> Framing to be spaced 24 inches on center or closer except as provided in Footnote 8.

<sup>6</sup> The track-to-stud connection is permitted to be by means of one 0.100-inch-diameter-by  $\frac{3}{8}$ -inch-long Aerosmith pin at each track-to-stud connection, for a total of two at each end of each stud.

<sup>7</sup> Base metal thickness of steel measured without coatings shall comply with minimum thicknesses specified in Section 2.2.2 of this report.

<sup>8</sup> The values for  $\frac{3}{8}$ -inch and  $\frac{7}{16}$ -inch panels may be increased by 20 percent and 10 percent, respectively, for framing spaced 16 inches on center.

TABLE 4—ALLOWABLE SHEAR FOR WIND FORCES IN POUNDS PER FOOT FOR PLYWOOD SHEAR WALLS WITH STEEL FRAMING AND AEROSMITH 0.144-INCH-DIAMETER PINS<sup>1, 2, 3, 4, 5, 6</sup>

PLYWOOD GRADE	MINIMUM STEEL GAGE <sup>7</sup>	MINIMUM PANEL THICKNESS (inches)	PIN SPACING, ALL PANEL EDGES (inches)			
			6	4	3	2
Structural I	16	$\frac{7}{16}$ "	210	315	420	535
	16	$\frac{15}{32}$ "	330	495	660	840
Grades other than Structural I	16	$\frac{7}{16}$ "	190	285	380	480
	16	$\frac{15}{32}$ "	295	445	595	755
	16	$\frac{19}{32}$ "	320	480	640	815

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

<sup>1</sup> Values are for loads imposed by wind and shall be reduced by 25 percent for normal loading.

<sup>2</sup> The pin shall be long enough to penetrate through the metal framing a minimum of  $\frac{1}{4}$  inch.

<sup>3</sup> The minimum panel edge distance for pin placement is  $\frac{3}{8}$  inch.

<sup>4</sup> Spacing of fasteners along intermediate framing members is 6 inches on center for  $\frac{7}{16}$ -inch panels when studs are 24 inches on center and 12 inches on center when studs are 16 inches on center. For other panel thicknesses, spacing along intermediate framing members is 12 inches on center.

<sup>5</sup> Framing to be spaced 24 inches on center or closer except as provided in Footnote 8.

<sup>6</sup> The track-to-stud connection is permitted to be by means of one 0.144-inch-diameter-by  $\frac{3}{8}$ -inch-long Aerosmith pin at each track-to-stud connection, for a total of two at each end of each stud.

<sup>7</sup> Base metal thickness of steel measured without coatings shall comply with minimum thicknesses specified in Section 2.2.2 of this report.

<sup>8</sup> The values for  $\frac{7}{16}$ -inch panels are permitted to be increased by 10 percent when framing is spaced 16 inches on center.

**TABLE 5—ALLOWABLE LATERAL LOADS IN POUNDS PER FASTENER DUE TO WIND OR SEISMIC FORCES FOR STRUCTURAL I PLYWOOD AND LUMBER ATTACHED TO STEEL FRAMING WITH AEROSMITH PINS<sup>1,2,3,4,7</sup>**

PIN DIAMETER (inches)	MINIMUM STEEL THICKNESS <sup>5</sup> (gage or inches)	MINIMUM THICKNESS OF PLYWOOD (inches)						2-INCH NOMINAL LUMBER <sup>6</sup>
		$\frac{3}{8}$	$\frac{7}{16}$	$\frac{15}{32}$	$\frac{19}{32}$	$\frac{23}{32}$	$1\frac{1}{8}$	
0.100	22	80	80	80	80	80	80	—
0.100	20	105	105	115	115	115	115	—
0.100	16	105	105	115	170	170	170	—
0.144	16	105	130	185	200	200	200	200
0.144	11	105	175	190	235	240	240	240
0.144	$\frac{5}{16}$	—	175	190	235	240	255	270
0.165	11	—	—	195	235	310	310	310
0.165	$\frac{5}{16}$	—	—	195	235	310	330	330
0.190	11	—	—	—	—	—	310	310
0.190	$\frac{3}{16}$	—	—	—	—	—	330	380
0.190	$\frac{1}{4}$	—	—	—	—	—	365	380

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

<sup>1</sup> Plywood shall be Structural I rated. For other grades, values shall be reduced by 10 percent.

<sup>2</sup> These values are for loads due to wind or earthquake and shall be reduced by 25 percent for other applications.

<sup>3</sup> Minimum panel edge distance for placement is 1 inch from the fastener to the sheathing edge measured in the direction of the load and  $\frac{3}{8}$  inch measured perpendicular to the direction of the load.

<sup>4</sup> The pin shall be long enough to penetrate through the metal a minimum of  $\frac{1}{4}$  inch.

<sup>5</sup> Values for 16 gage also apply to 14 gage.

<sup>6</sup> Base metal thickness of steel measured without coatings shall comply with the minimum thicknesses specified in Section 2.2.2 of this report.

<sup>7</sup> The above values apply to groups of at least five fasteners. For fewer fasteners in a group, use one-half of the tabulated value.

<sup>8</sup> The values in this table are applicable to wood with a specific gravity of 0.51 or greater. For wood with a specific gravity less than 0.51, but greater than 0.42, multiply the values shown in the table by 0.82.

**TABLE 6—ALLOWABLE WITHDRAWAL LOADS IN POUNDS PER FASTENER DUE TO WIND OR SEISMIC FORCES FOR PLYWOOD AND LUMBER ATTACHED TO STEEL FRAMING WITH AEROSMITH PINS<sup>1,2,3,4</sup>**

PIN DIAMETER (inches)	MINIMUM STEEL THICKNESS <sup>5</sup> (gage or inches)	MINIMUM THICKNESS OF PLYWOOD (inches)						2-INCH NOMINAL LUMBER <sup>6</sup>
		$\frac{3}{8}$	$\frac{7}{16}$	$\frac{15}{32}$	$\frac{19}{32}$	$\frac{23}{32}$	$1\frac{1}{8}$	
0.100	22	15	15	—	—	—	—	—
0.100	20	20	25	25	25	—	—	—
0.100	18	30	35	40	40	—	—	—
0.100	16	40	45	60	60	—	—	—
0.144	16	—	50	65	65	80	100	—
0.144	14	—	50	65	70	85	100	—
0.144	11	—	50	65	75	85	100	—
0.144	$\frac{5}{16}$	—	50	65	75	85	100	—
0.165	11	—	—	—	—	100	100	—
0.165	$\frac{3}{16}$	—	—	—	—	100	100	120
0.165	$\frac{1}{4}$	—	—	—	—	100	120	120
0.190	14	—	—	—	—	100	100	120
0.190	11	—	—	—	—	100	120	120
0.190	$\frac{3}{16}$	—	—	—	—	100	120	160

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

<sup>1</sup> Plywood shall be Structural I rated. For other grades, values shall be reduced by 10 percent.

<sup>2</sup> These values are for loads due to wind or earthquake and shall be reduced by 25 percent for other applications.

<sup>3</sup> Minimum panel edge distance is  $\frac{3}{8}$  inch.

<sup>4</sup> The pin shall long enough to penetrate through the metal a minimum of  $\frac{1}{4}$  inch.

<sup>5</sup> Base metal thickness of steel measured without coatings shall comply with the minimum thicknesses specified in Section 2.2.2 of this report.

<sup>6</sup> The values in this table for 2-inch nominal lumber are applicable to wood with a specific gravity of 0.51 or greater. For wood with a specific gravity of less than 0.51, but greater than 0.42, multiply the values in the table by 0.82.

TABLE 7—MODULUS OF RIGIDITY OF PLYWOOD, G (psi)

PLYWOOD PANEL GRADE	THICKNESS (inches)	MINIMUM SPAN RATING	MINIMUM NUMBER OF PLYWOOD PLYES	G (psi)
Structural I	3/8	24/0	3	86,500
	7/16	24/16	4	105,000
	15/32	32/16	5	98,000
	19/32	40/20	5	81,500
	23/32	48/24	5	73,000
Panel grades other than Structural I	3/8	24/0	3	66,500
	7/16	24/16	3	62,000
	15/32	32/16	3	57,500
	19/32	40/20	3	48,000
	23/32	48/24	4	56,000

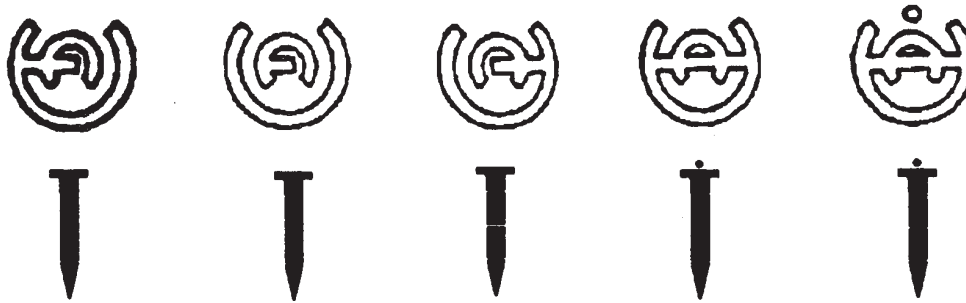


FIGURE 1—MANUFACTURER'S SYMBOLS (LOGOS) FOR FASTENER HEADS

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**Filing Category: ROOF, WALL AND FLOOR PANELS—Wood**

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### AEROSMITH U-NOPUL FASTENERS

**AEROSMITH FASTENING SYSTEMS**  
5050 SOUTH 40<sup>TH</sup> STREET  
PHOENIX, ARIZONA 85040

#### 1.0 SUBJECT

Aerosmith U-Nopul Fasteners. (Issued November 2001.)

Extend the period until re-examination from one year to two years.

#### 2.0 DESCRIPTION

No change.

#### 3.0 EVIDENCE SUBMITTED

No change.

#### 4.0 FINDINGS

That the changes noted herein comply with the 1997 *Uniform Building Code*™, the 2000 *International Building Code*®, the *BOCA National Building Code/1999*, and the 1999 *Standard Building Code*®, subject to the following conditions:

**4.1 through 4.6: No change.**

**Unless specifically noted in this report supplement, the master report remains valid and unchanged.**

**This report and the master report expire concurrently two years from the date of issuance (December 1, 2000).**

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