

ICC-ES Evaluation Report

ESR-1118

Reissued January 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: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 17 53—Shop-Fabricated Wood Trusses

REPORT HOLDER:

ITW BUILDING COMPONENTS GROUP, INC.
 1950 MARLEY DRIVE
 HAINES CITY, FLORIDA 33844
 (863) 422-8685
www.alpeng.com

EVALUATION SUBJECT:

ALPINE WAVE, H, S, K, TRULOX, AND HINGE PLATE METAL CONNECTOR PLATES FOR WOOD TRUSSES

1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2009 *International Building Code*®
- 2009 *International Residential Code*®

Property evaluated:

Structural

2.0 USES

Alpine Truss Plate Connectors are used as joint connector components of light wood frame trusses.

3.0 DESCRIPTION
3.1 Alpine Wave Plate™ Truss Plate Connector:

The Wave Plate™ metal truss connector plates are manufactured from No. 20 gage [minimum 0.0356 inch (0.904 mm) total thickness] steel complying with ASTM A 653 SS Grade 40, with a G60 galvanization coating [0.0005 inch (0.013 mm) thickness on each side], and a minimum base-metal thickness of 0.0346 inch (0.879 mm). Pairs of teeth are punched forming slots which are 0.12 inch (3.0 mm) wide and 0.50 inch (12.7mm) long, are aligned parallel to the plate length, and are spaced 0.25 inch (6.35 mm) on center across the width of the plate and 1.0 inch (25.4 mm) on center along the length of the plate. Adjacent teeth are staggered along the length of the plate 0.06 inch (1.52 mm) from each other in a double alternating pattern, resulting in three slot positions: centered in the row; +0.06 inch (1.52 mm) from the center of the row; and -0.06 inch (1.52 mm) from the center of the row, resulting in an undulating or “wave” pattern within each row of slots. The Wave Plate™ is available in 1-inch (25.4 mm) increments of both width and length. See Figure 1 for details.

3.2 Alpine H and S Connector Plates:

Alpine H and S Connector Plates are manufactured in two forms known as H (High Strength) and S (Super High Strength) from No. 20 gage [minimum 0.0356 inch (0.904 mm) total thickness] and No. 18 gage [minimum 0.0466 inch (1.18 mm) total thickness], respectively, steel complying with ASTM A 653 HSLAS Grade 60, with a G90 galvanization coating [0.00075 inch (0.019 mm) thickness on each side], and minimum base-metal thicknesses of 0.0341 inch (0.866 mm) and 0.0451 inch (1.146 mm), respectively. Pairs of 0.115-by-0.327-inch (2.92 by 8.31 mm) teeth are punched perpendicular to the plane of the plate, each pair leaving a 0.115-by-0.49-inch (2.92 by 12.45 mm) slot in the plate. The slots are spaced 0.875 inch (22.23 mm) apart on center lengthwise. Slots are grouped in sets of four, with each set consisting of four slots spaced 0.3125 inch (7.94 mm) apart on center widthwise. Adjacent slots across the width are staggered 0.4375 inch (11.11 mm) lengthwise. Sets of slots are spaced 1.3125 inches (33.34 mm) apart on center widthwise. There are 6.97 teeth per square inch (1.08 teeth/cm²) of plate. Teeth are pointed on the end and V-shaped in cross section. See Figure 2 for details.

3.3 Alpine K Connector Plate:

Alpine K connector plates are manufactured from No. 16 gage [minimum 0.0575 inch (1.46 mm) total thickness] steel complying with ASTM A 653 SS Grade 37, with a G60 galvanization coating [0.0005 inch (0.013 mm) thickness on each side], and a minimum base-metal thickness of 0.0565 inch (1.44 mm). Pairs of 0.144-by-0.375-inch (3.66 by 9.53 mm) teeth are punched perpendicular to the plane of the plate, each pair leaving a 0.144-by-0.540-inch (3.66 by 13.72 mm) slot in the plate. The slots are in rows spaced 1.3125 inches (33.34 mm) on center lengthwise and 0.333 inch (8.46 mm) on center across the width, leaving 4.57 teeth per square inch (0.71 teeth/cm²). Adjacent slots across the width are offset 0.25 inch (6.35 mm) lengthwise. Teeth are pointed on the end and V-shaped in cross section. See Figure 3 for details.

3.4 Alpine Trulox Connector Plate:

Trulox nail plates are made from No. 20 gage [minimum 0.0356 inch (0.904mm) total thickness] steel complying with ASTM A 653 SS Grade 40, with a G60 galvanization coating [0.0005 inch (0.013 mm) thickness on each side], and a minimum base-metal thickness of 0.0346 inch (0.879 mm). The Trulox Connector Plate is a flat nailing plate without integral teeth, with 0.131-inch-diameter (3.33 mm) nailing holes spaced 1 inch (25.4 mm) on center lengthwise and 0.667 inch (16.94 mm) on center widthwise. Adjacent holes along the length are staggered 0.333 inch (8.38 mm) widthwise. There are 1.5 holes per

square inch (645.16 mm²) of plate. Plates are connected to wood with separately applied nails, such as 1.375-inch-long (34.93 mm), No. 11 gage diameter [0.1205 inch (3.06 mm)], spiral shank truss nails, or similar. The Trulox nail plate is identified by its hole pattern and the lack of any integral teeth. See Figure 4 for details.

3.5 Alpine Hinge Plate:

Alpine 2-by-8 Hinge Plates are made of No. 18 gage [minimum 0.0466 inch (1.18 mm) total thickness] steel complying with ASTM A 653 SS Grade 37, with a G60 galvanization coating [0.0005 inch (0.013 mm) thickness on each side], and a minimum base-metal thickness of 0.0456 inch (1.16 mm). The Hinge Plate connector consists of two 2-by-4.5-inch (51 by 114 mm) metal plates, overlapped by 1 inch (25.4 mm) and grommetted together with a brass grommet through a punched hole in each plate. For each side of the hinge plate, three rows of eight pairs of teeth per row are punched perpendicular to the plane of the plate, each pair leaving a 0.10-by-0.60-inch (2.5 by 15.2 mm) slot in the plate. The slots are spaced 1 inch (25 mm) apart on center lengthwise and 0.25 inch (4.2 mm) apart on center widthwise, leaving 48 teeth on each side of the hinge, i.e., a total of 96 teeth per plate. Each slot is offset along its length 0.12 inch (3.0 mm) from the adjacent slots. Teeth are pointed on the end and V-shaped in cross section. See Figure 5 for details.

4.0 INSTALLATION

4.1 General:

Alpine Wave, Alpine H, S, K and Hinge Truss Plates are pressed into the wood for the full depth of their teeth by hydraulic presses, pneumatic presses, or roller presses or by passing the unit through a stationary roller press.

Design values shown for hydraulic-plate embedment are valid for hydraulic, pneumatic presses, multiple roller presses that use partial embedment followed by full-embedment rollers, or combinations of partial embedment roller presses and hydraulic-plate presses that feed trusses into a stationary finish roller press. Design values shown for single pass roller presses are valid for rollers 18 inches (457.2 mm) or larger in diameter. Trusses must be assembled within the tolerances provided by TPI's Quality Criteria for Metal Plate Connected Wood Trusses, as shown in Section 4 of ANSI/TPI 1-2002, National Design Standard for Metal Plate Connected Wood Truss Construction.

4.2 Allowable Design Values:

4.2.1 Alpine Wave, Alpine H, S and K Truss Plates:

Allowable design values for Alpine Wave, Alpine (H, S) and K Truss Plate Connectors used in the design of metal plate connected wood roof and floor trusses are shown in Tables 1 and 2. Allowable design values are applicable when the connection is made with identical plates on opposite sides of the joint. The design, manufacture, and installation of trusses employing the truss plates must comply with IBC Section 2303.4 or IRC Sections R502.11 and R802.10, as applicable.

4.2.2 Alpine Trulox Truss Plate Connector: This connector is a nail plate using separately applied nails. Effective steel tension strength ratios must be determined based on accepted design principles for steel. Allowable steel shear design values are shown in Table 2. Lateral resistance values must be determined in accordance with the design values for nails in the AF&PA National Design Specification for Wood Construction. Allowable design values are applicable when the connection is made with identical plates and nailing patterns on opposite sides of the joint.

4.2.3 Alpine Hinge Plate: The allowable design values of Alpine Hinge Truss Plate Connectors in shear, tension and compression are shown in Table 3. Imposed forces at the joint and within the truss containing the joint must be determined using a structural model with a pin at the hinge joint location. Allowable design values are applicable when the connection is made with a 1-inch (25.4 mm), or smaller, gap between the two wood members at the connection. The design load due to combined shear and axial loads must not exceed the allowable load using the Hankinson formula as follows:

$$F_{\theta} \leq P_{\theta}$$

where:

F_{θ} = Imposed combined shear and axial load,
lb = $(F_a^2 + F_v^2)^{0.5}$

P_{θ} = Allowable combined shear and axial load,
lb = $(P_a \times P_v) / ((P_a \times (\sin \theta)^2) + (P_v \times (\cos \theta)^2))$.

F_a = Imposed axial force, lb.

F_v = Imposed shear force, lb.

P_a = Allowable axial force, lb. (In compression or tension corresponding to imposed axial force).

P_v = allowable shear load, lb.

θ (theta) = angle between F_{θ} and the length of the plate.

5.0 CONDITIONS OF USE

The Alpine Engineered Products metal connector plates 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 This evaluation report and the installation instructions, when required by the code official, must be submitted at the time of permit application. In the event of a conflict between the manufacturer's published installation instructions and this report, this report governs.

5.2 Each application for a building permit using these truss plate connectors must be accompanied by calculations, details and other documentation showing that the design, manufacture, and proposed installation conforms with the requirements of the applicable code. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.3 This report establishes plate design values only. For items not covered by this report, such as truss design, fabrication, quality assurance and inspection, refer to ANSI/TPI 1, engineering drawings and the applicable code.

5.4 The design values (lateral resistance values, effective tension strength ratios, and effective shear resistance ratios) used in the design of trusses using Alpine Wave H, S and K metal truss connector plates must not exceed those listed in Tables 1 and 2. The shear resistance ratios used in the design of trusses using Alpine Trulox Truss Plate Connectors must not exceed those listed in Table 2. The shear, tension and compression loads used in the design of trusses using Alpine Hinge Truss Plate Connector must not exceed those listed in Table 3. Load combination reductions must be in accordance with the applicable code. No adjustments for duration of load are permitted.

- 5.5 All lumber used in the fabrication of trusses using Alpine Truss Plate Connectors must be graded in compliance with the applicable building code and must have a moisture content not to exceed 19 percent at the time of assembly. Wet service factors from ANSI/TPI 1-2007 Section 6.4.6 (ANSI/TPI 1-2002 Section 6.4.5) must be applied to the table values when the lumber moisture content exceeds 19 percent. Allowable loads shown in the tables of this report are not applicable to metal connector plates embedded in either fire-retardant-treated lumber or preservative-treated lumber.
- 5.6 Metal truss connector plates and hinge plates must be installed in pairs on opposite faces of truss members.
- 5.7 Galvanized G60 and G90 metal truss plate connectors subject to corrosive environments must be protected in accordance with Section 6.5 of ANSI/TPI 1.

Note: Conditions 5.8 through 5.13 apply to Alpine Hinge Plate metal connectors only:

- 5.8 Allowable load values for the Alpine Hinge Plates are applicable to hinge plate pairs installed on opposite faces and positioned in the 180-degree (unbent) position in the final installation of the truss.
- 5.9 The allowable compression load given in Table 3 is valid for applications where sheathing is attached to the truss chord members containing the metal hinge plates, and lateral translation across the joint is inhibited by the sheathing being installed continuously across the joint as prescribed by code or by other means acceptable to the code official. Hinge plate connectors must not be used to transfer any loads in a direction perpendicular to the plane of the truss, such as for design of load transfer at joints of unblocked diaphragms.
- 5.10 Due to the rotation provided at the joint of the Alpine Hinge Plates, the truss design must be modeled with a pin at the hinge joint location. In the final installed condition, shear loads must be applied within the plane of the hinge plate, at a 90-degree angle to the long axis.

- 5.11 Design of diaphragms with trusses manufactured with the Alpine Hinge Plate is outside the scope of this report.
- 5.12 Allowable design values given in Table 3 for Alpine Hinge Plate connectors are applicable when the connection is made with a 1-inch (25.4 mm), or smaller, gap between the two wood members at the connection.
- 5.13 Use of the Alpine Hinge Plate is limited to prefabricated trusses. Field installation is prohibited. Compliance with IBC Section 2303.4 or IRC Sections R502.11 and R802.10, as applicable, is required.

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the National Design Standard for Metal Plate Connected Wood Truss Construction, ANSI/TPI 1-for Alpine Wave, H, S, K and Trulox metal truss plate connectors.
- 6.2 Engineering summary of plate properties, table of design values, prepared by Alpine Engineered Products, Inc., signed, sealed and dated September 17, 1999.
- 6.3 Manufacturer's descriptive literature.
- 6.4 Data in accordance with the ICC-ES Acceptance Criteria for Metal Hinge Plate Connectors for Wood Trusses (AC283), dated February 2008 (editorially revised April 2011) for Alpine hinge plate metal connectors.

7.0 IDENTIFICATION

See Figures 1–5 for identifying patterns. Wave Plates™ are identified by the unique double-offset slot pattern. H and S plates are identified by the embossed symbol "Alpine" and either "H20" or "S18" for the H and S plates, respectively. K plates are identified by the embossed symbol "LMK." Hinge plates are identified by the grommetted hinge and the symbols "Alpine" or "HP288.". Each shipping container of Alpine Truss Plate Connectors is marked with the ITW Building Components Group, Inc. name and/or trademark, and the evaluation report number (ESR-1118).

**TABLE 1—ALPINE WAVE PLATE™, H, S AND K PLATES
ALLOWABLE LATERAL RESISTANCE VALUES (lb/in²/PLATE)¹**

ALPINE PLATE	TPI AREA BASIS	LUMBER ²	HYDRAULIC-PLATEN EMBEDMENT VALUES ³				SINGLE-PASS ROLLER EMBEDMENT VALUES ³			
			AA	EA	AE	EE	AA	EA	AE	EE
WAVE	GROSS AREA (0" end & 0" edge distances)	S. Pine	206	158	163	170	179	143	142	153
		Doug. Fir-Larch	206	156	145	153	179	141	126	138
		Hem-Fir	164	109	106	124	134	96.7	86.5	110
		SPF	159	109	106	118	130	96.7	86.5	105
	NET AREA (¹ / ₂ " end & 0" edge distances)	S. Pine	275	195	163	170	239	177	142	153
		Doug. Fir-Larch	275	195	145	153	239	177	126	138
		Hem-Fir	208	134	106	124	170	119	86.5	110
		SPF	208	130	106	118	170	115	86.5	105
H ⁴	NET AREA (⁷ / ₁₆ " or ¹¹ / ₃₂ " end & 0" edge distances)	S. Pine	197	128	122	123	147	116	91	112
		Doug. Fir-Larch	197	128	120	115	147	116	89	104
		Hem-Fir	143	84.7	82.5	92.7	117	81.2	67.1	88.9
		SPF	141	84.1	81.6	92.7	114	80.7	66.4	88.9
S ⁴	NET AREA (⁷ / ₁₆ " or ¹¹ / ₃₂ " end & 0" edge distances)	S. Pine	236	173	156	136	182	133	120	105
		Doug. Fir-Larch	236	173	156	136	182	133	120	105
		Hem-Fir	161	127	117	112	126	99	91	87
		SPF	161	127	117	112	126	99	91	87
K ⁵	NET AREA (²¹ / ₃₂ " or ² / ₃ " end & 0" edge distances)	SPF	145	119	119	103	-	-	-	-

For SI: 1 psi = 6.9 kPa.

¹Values given in Table 1 are allowable lateral resistances of the metal connector plate teeth, expressed in pounds per square inch of plate for a single plate (double for plates on both faces when applying to area on only one face). To achieve values, plates must be installed on opposite sides of joint.

²Values given in Table 1 are based on the following assigned specific gravities for the lumber species combinations listed: S. Pine G = 0.55, Doug fir-larch G = 0.50, hem-fir G = 0.43, SPF G = 0.42.

³Plate orientation designations:

- AA = Plate slots parallel to load, wood grain parallel to load.
- EA = Plate slots perpendicular to load, wood grain parallel to load.
- AE = Plate slots parallel to load, wood grain perpendicular to load.
- EE = Plate slots perpendicular to load, wood grain perpendicular to load.

⁴Alpine H and S plates: an end distance of ⁷/₁₆ inch applies for the AA orientation, and an end distance of ¹¹/₃₂ inch applies for the EA orientation.

⁵Alpine K plate: An end distance of ²¹/₃₂ inch applies for the AA orientation, and an end distance of ²/₃ inch applies for the EA orientation.

**TABLE 2—ALPINE WAVE PLATE™, H, S, K AND TRULOX PLATES
EFFECTIVE TENSION AND SHEAR RESISTANCE ALLOWABLE DESIGN VALUES**

PROPERTY & FORCE DIRECTION	ALPINE WAVE PLATE™		ALPINE H PLATE		ALPINE S PLATE		ALPINE K PLATE		ALPINE TRULOX PLATE	
	Effic'y Ratio	pli/pair of Plates	Effic'y Ratio	pli/pair of Plates	Effic'y Ratio	pli/pair of Plates	Effic'y Ratio	pli/pair of Plates	Effic'y Ratio	Pli/pair of Plates
Tension @ 0°	0.512	895	0.710	1784	0.735	2444	0.581	1534	-	-
Tension @ 30°	-	-	-	-	0.411	1367	0.521	1376	-	-
Tension @ 60°	-	-	-	-	0.289	961	0.393	1038	-	-
Tension @ 90°	0.486	849	0.300	754	0.269	894	0.456	1204	-	-
Shear @ 0°	0.563	656	0.435	656	0.568	1133	0.539	949	0.711	829
Shear @ 30°	0.739	861	0.720	1086	0.752	1500	0.506	891	0.632	737
Shear @ 60°	0.832	969	0.810	1223	0.941	1877	0.508	894	0.708	825
Shear @ 90°	0.487	567	0.517	780	0.642	1281	0.552	972	0.665	775
Shear @ 120°	0.454	529	0.330	498	0.515	1027	0.475	836	0.227	265
Shear @ 150°	0.477	556	0.412	622	0.418	834	0.464	817	0.147	171

For SI: 1 lb/inch = 0.175 N/mm, 1 inch = 25.4 mm.

TABLE 3—ALPINE HINGE PLATE ALLOWABLE DESIGN VALUES

PROPERTY	ALLOWABLE DESIGN VALUE (lb)
Shear	566
Tension	810
Compression	810

For SI: 1 lb = 4.448 N.

NOTE: Design values determined using SPF lumber.

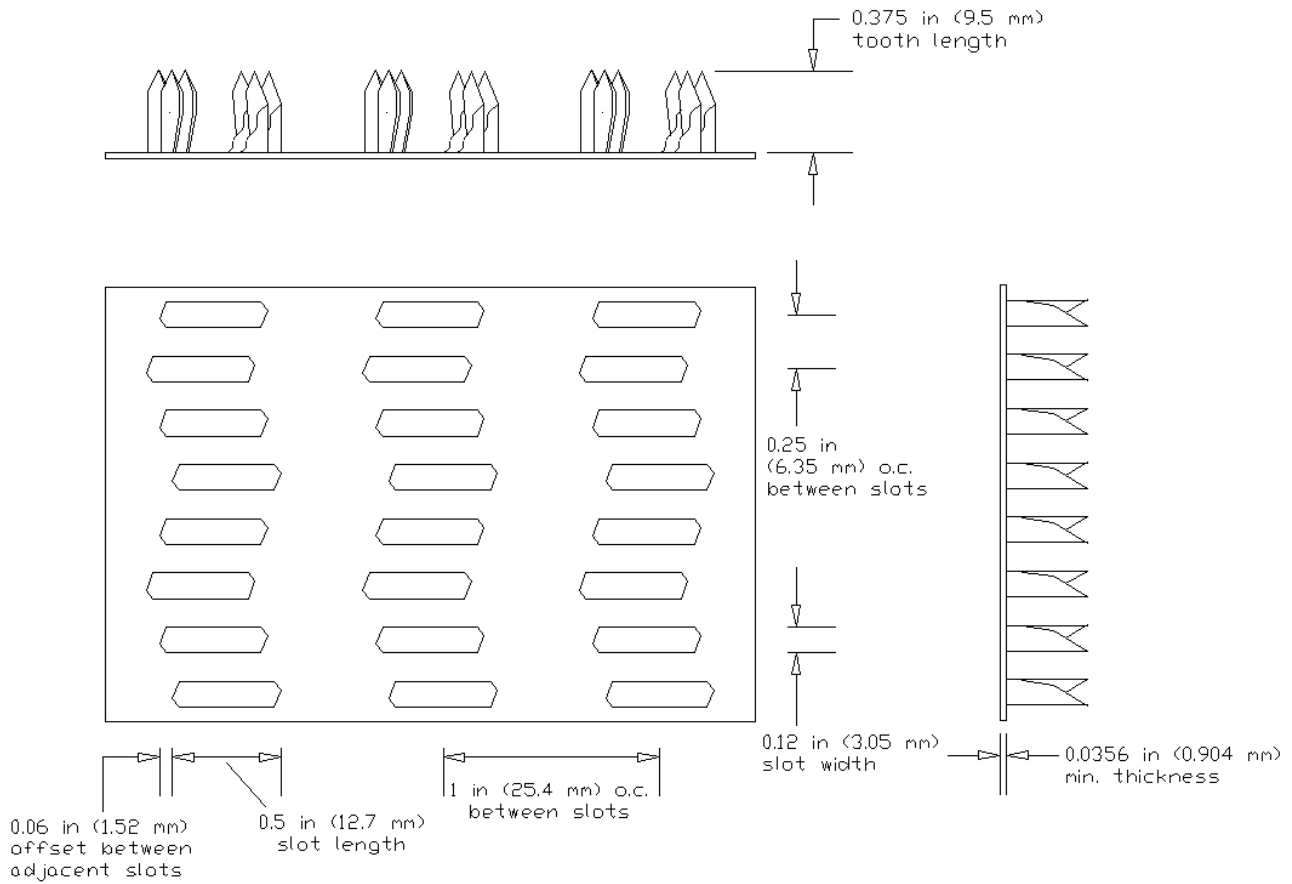
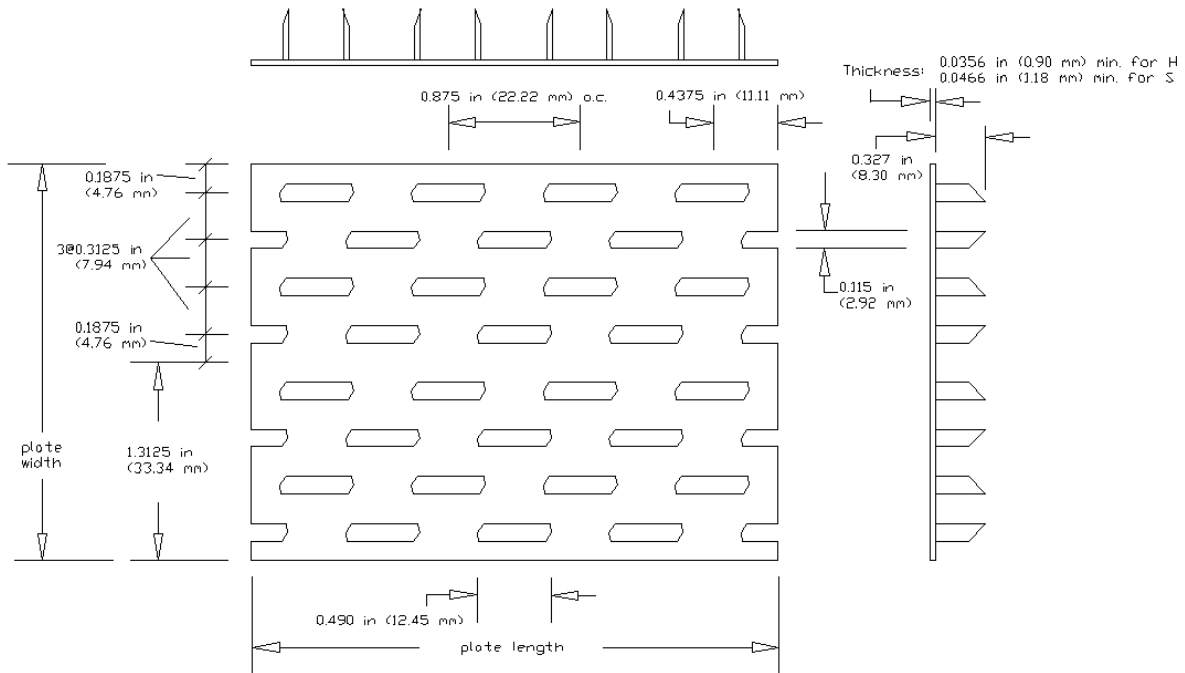


PLATE AVAILABLE IN INCREMENTS OF 1 IN (25.4 mm).
 PLATE SHOWN ABOVE IS A 2X3 (2 IN X 3 IN, 50.8 mm X 76.2 mm).

FIGURE 1—ALPINE WAVE PLATE



The Alpine H and S plates are available in width increments of $1\frac{5}{16}$ inch (33.3 mm) and length increments of 1.75 inches (44.4 mm). This drawing shows size H0203 or S0203 (2.625 x 3.5 inches) (67 x 89 mm).

FIGURE 2—ALPINE H AND S PLATES

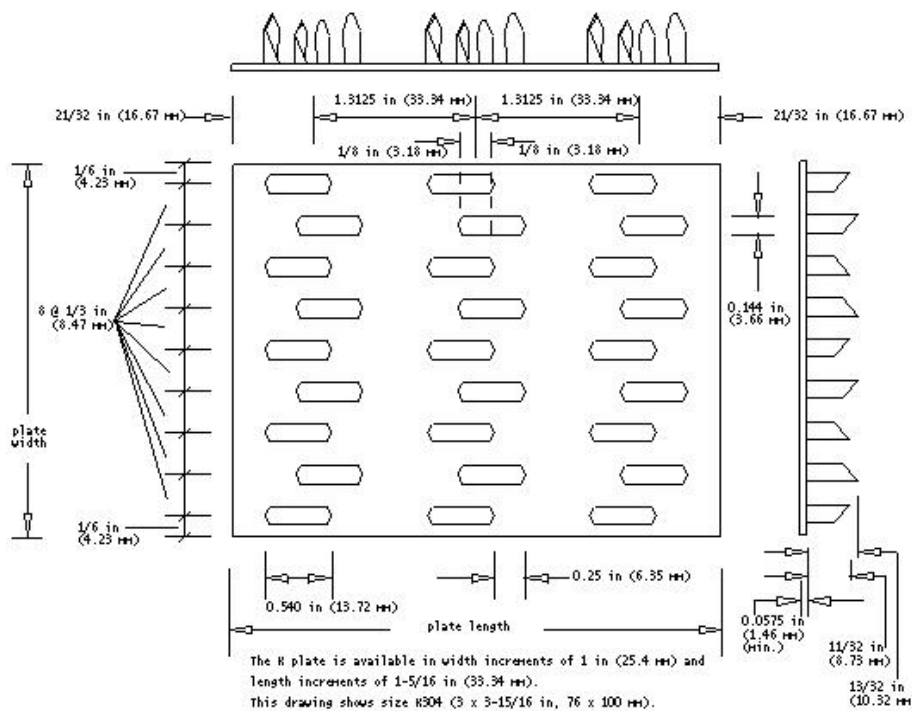


FIGURE 3—ALPINE K PLATE

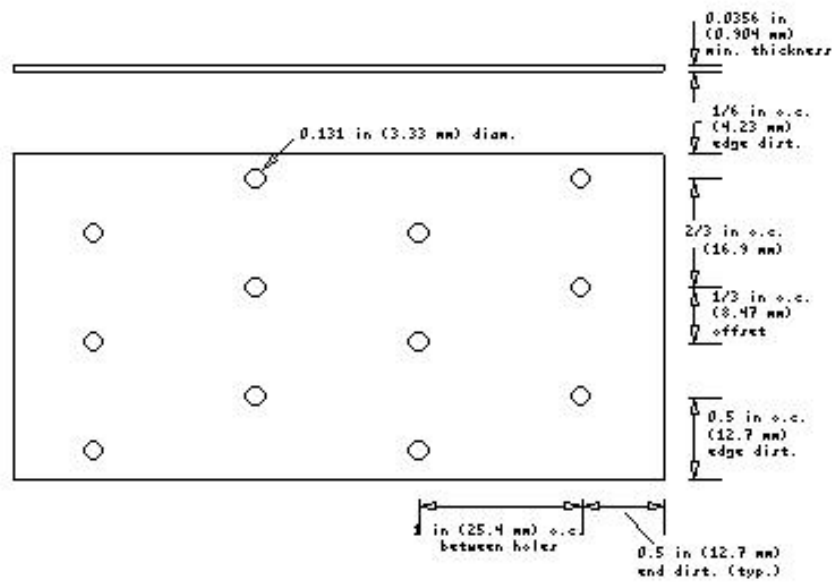


FIGURE 4—ALPINE TRULOX PLATE

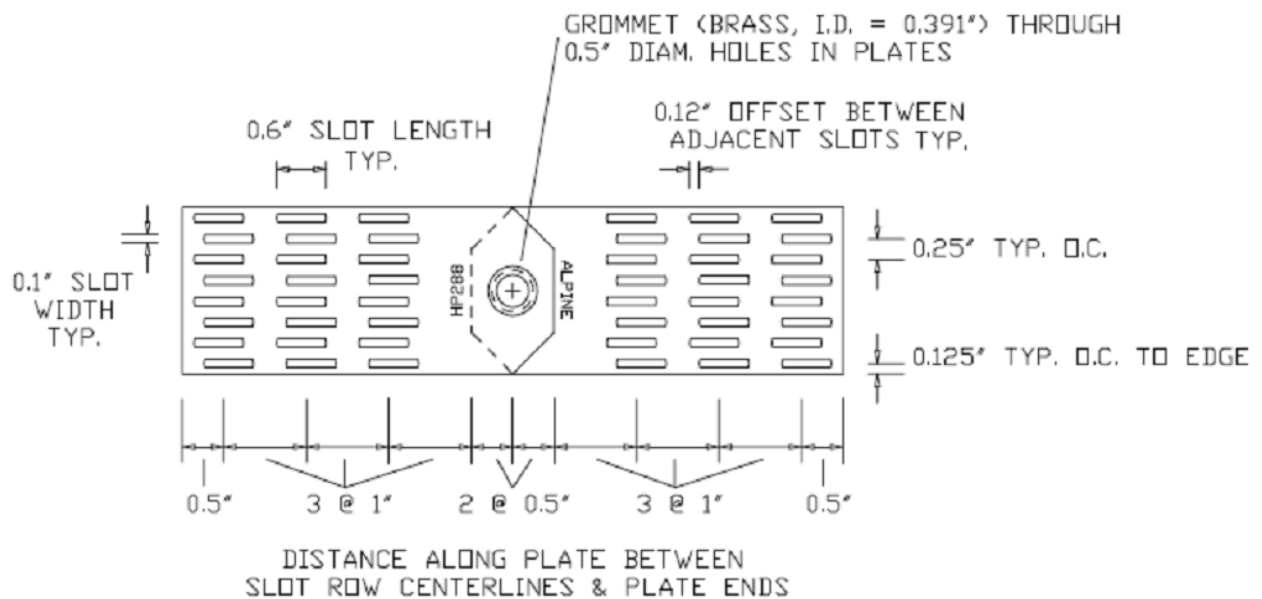


FIGURE 5—ALPINE HINGE PLATE