

<b>TEST TYPE:</b>	<b>ASTM 1592</b>
<b>TESTING AUTHORITY:</b>	<b>ASTM</b>
<b>TEST NAME:</b>	<b>WIND UPLIFT</b>
<b>TEST DATE:</b>	<b>OCTOBER 1, 2000</b>
<b>TEST COMPLETED BY:</b>	<b>TOM SHINGLER REGISTERED STRUCTURAL ENGINEER</b>
<b>TESTING LABORATORY</b>	<b>DESIGN DYNAMICS</b>
<b>PANEL TYPE:</b>	<b>1 1/2" STANDING SEAM</b>
<b>PANEL WIDTH:</b>	<b>18.25" WIDE X 22 GA.</b>
<b>CLIP SPACING:</b>	<b>2.0 TO 5.0 FT SPACING</b>
<b>DECKING CONSTRUCTION:</b>	<b>PURLINS</b>

**PURPOSE:** TO DETERMINE THE ULTIMATE WIND UPLIFT CAPACITY OF THE SUBMITTED METAL ROOF SYSTEM WHEN FASTENED AT VARIOUS PANEL CLIP SPACINGS.

**TEST DATE:** SEPTEMBER 28, 2000, (3 SPANS @ 2.0 FT. O/C)  
SEPTEMBER 29, 2000, (3 SPANS @ 5.0 FT O/C)

**TEST SPECIMEN:**

1 1/2" STANDING SEAM PANEL @ 18.25" WIDE X 22 GA. STEEL WITH TWO (2) PIECE STEEL SLIDING CLIP.

**TEST CHAMBER:**

COMPOSED OF A FLOOR MOUNTED REINFORCED WOODEN FRAME CAPPED WITH A REINFORCED WOODEN FRAME/PURLIN SYSTEM DESIGNED TO SUPPORT THE TEST SPECIMEN.

THE TEST PRESSURES WERE APPLIED TO THE SPECIMEN VIA A 6 MIL PLASTIC FILM DESIGNED TO ACCURATELY CONFIGURE TO THE PANEL PROFILE AND GIVE BOTH THE PANEL SHAPE AND THE SIDEJOINT ELEMENTS FULL DEGREE OF FREEDOM DURING THE LOADING PROCESS.

**PURLIN MEMBERS:**

2" X 6" WOOD I-JOIST FRAME WITH 2" X 4" TOP & BOTTOM FLANGE ELEMENTS. PURLIN MEMBERS WERE SPACED EITHER 2.0 FT OR 5.0 FT ON CENTERS AND REPRESENT THE MINIMUM AND MAXIMUM PURLIN SPACING EXTREMES FOR THE ROOF PANEL BEING TESTED.

**PRESSURE INDICATOR:**

HEISE MODEL 901 B DIGITAL PRESSURE TRANSDUCER WITH A (+/-) 300 PSF PRESSURE RANGE AND A MIN/MAX HOLD FEATURE WHICH "LOCKS" AT ULTIMATE TEST PRESSURE. ACCURACY IS (+/-) 0.10 PSF AND TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS (NBS).

**DIGIMATIC CALIPER:**

MITUTOYO SERIES 500 WITH A FULL-RANGE ACCURACY OF 0.001 IN.

**INSTALLATION:**THE SYSTEM WAS INVERTED AND PANELS WERE INSTALLED WITH TWO (2) PIECE SLIDING CLIPS WHICH WERE SCREW-ATTACHED TO THE TOP FLANGES OF THE WOOD I-JOIST FRAMING USING TWO (2) #12 X 2" LONG WOOD SCREWS.

SIDE JOINTS CONSISTED OF MATING MALE/FEMALE INTERLOCKING RIBS.

CONTINUITY FASTENERS WERE LOCATED AT THE EXTREME ENDS OF PANELS AND CONSISTED OF SINGLE SELF-DRILLING SCREWS DRIVEN INTO THE PANEL WEBS.

TRANSPARENT/FLEXIBLE PLASTIC FILM (VISQUEEN @ 6 MILS THICK) WAS APPLIED OVER PANELS AND SEALED WITH DUCT TAPE TO EVERY CONFIGURATION TO CREATE A VACUUM SEAL. THE VISQUEEN WAS PLEATED AT EACH PANEL TO PREVENT RESTRICTIONS OF PANEL PROFILE CHANGE AS PRESSURE WAS APPLIED TO THE TEST ASSEMBLY.

**PROCEDURE:** THE INDIVIDUAL PANELS WERE INSTALLED INTO THE TEST CHAMBER AS A FIVE (5) PANEL WIDE ARRAY AND THE SIDE JOINT POWER SEALED USING STANDARD FIELD TECHNIQUES. SPECIFIC DEFLECTION MEASUREMENT TARGETS WERE ESTABLISHED ON KEY PANELS. THESE TARGETS AND THEIR LOCATIONS ARE ILLUSTRATED ON AN ENCLOSED SKETCH. TWO (2) DIFFERENT GAUGES WERE INSTALLED ONTO THE TEST CHAMBER FOR CROSS CHECKING OF TEST PRESSURES AND INSURING ACCURACY OF PRESSURE DATA.

THE PRESSURE-RECORDING INSTRUMENTS WERE AS FOLLOWS...

1. HEISE DIGITAL PRESSURE INDICATOR
2. MPL DIGITAL MANOMETER HAVING A 0 TO (+/-) 14" H<sub>2</sub>O (72.8) PSF RANGE.

**E-1592 TEST RESULTS:**

1 1/2" STANDING SEAM @ 18.25" WIDE X 22 GA. STEEL WITH TWO (2) PIECE STEEL SLIDING CLIP.

SPAN, FT.	ULTIMATE PRESSURE, PSF	ALLOWABLE PRESSURE, PSF
2.0	132.1	80.0
5.0	54.98	33.3

**ALLOWABLE WIND UPLIFT LOAD/SPAN CHART:**

1 1/2" STANDING SEAM @ 18" WIDE X 22 GA. STEEL WITH TWO (2) PIECE STEEL SLIDING CLIP

PANEL SPAN, FEET	ALLOWABLE WIND UPLIFT PRESSURE, PSF
2.0	80.0
2.5	72.2
3.0	64.4
3.5	56.6
4.0	48.8
4.5	41.0
5.0	33.3

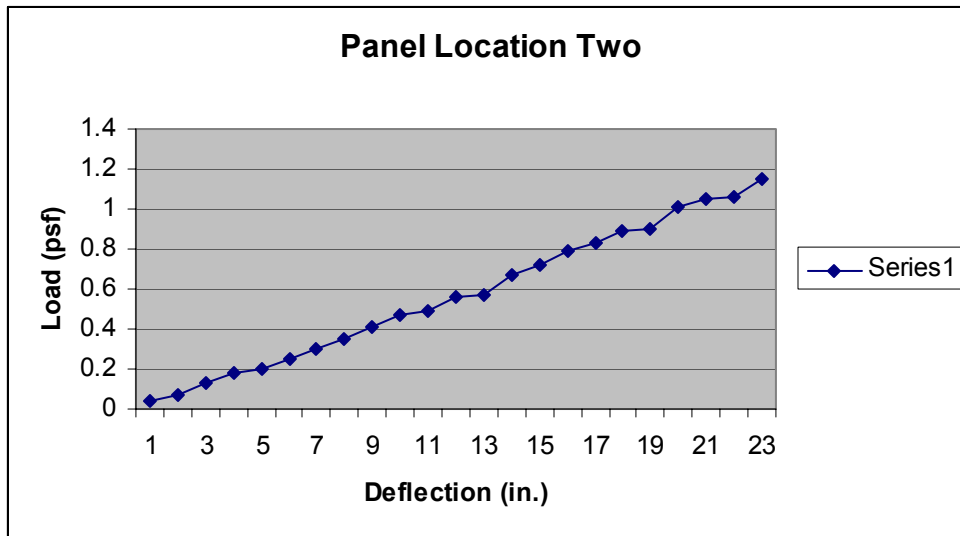
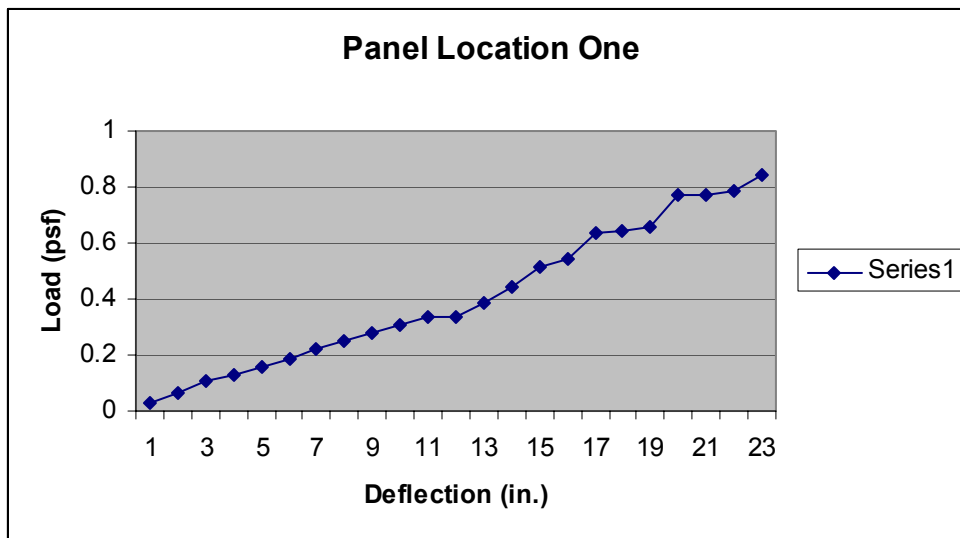
**GENERAL NOTES:**

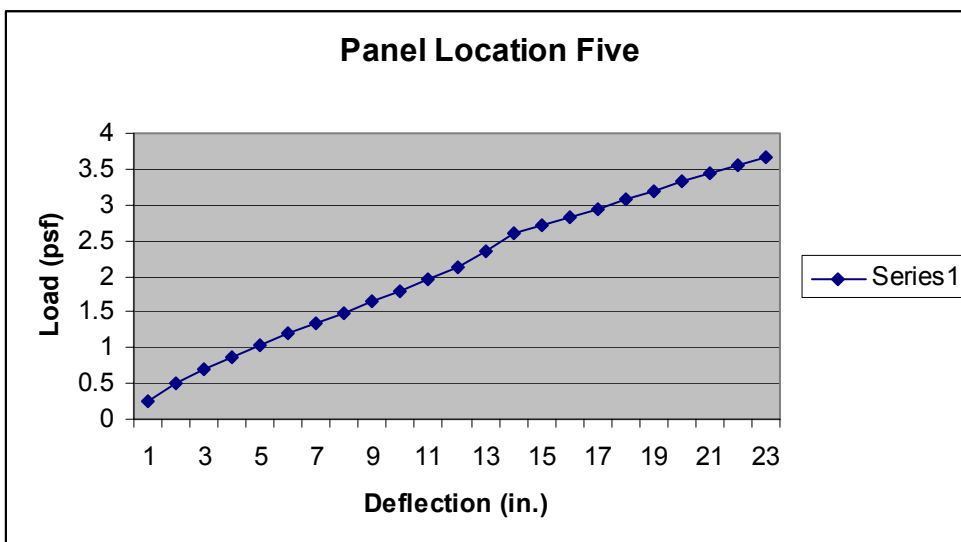
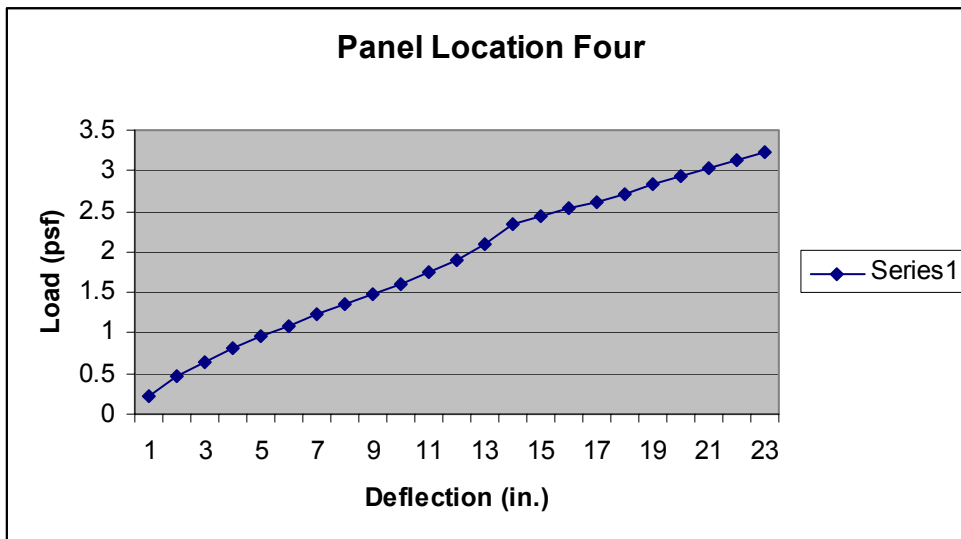
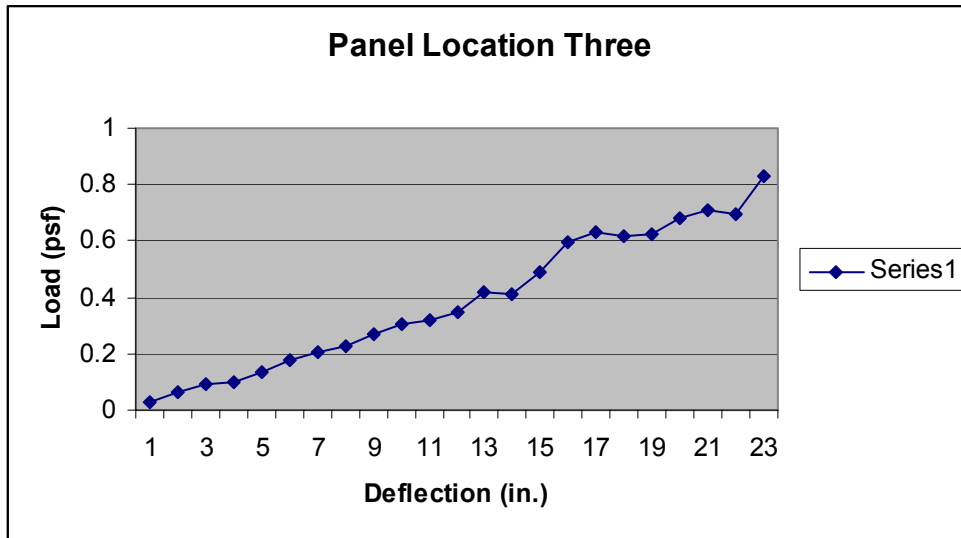
1. THE ALLOWABLE PRESSURE IS THE ULTIMATE TEST PRESSURE DIVIDED BY A FACTORY OF SAFETY (LOAD FACTOR) OF 1.65
2. THE PUBLISHED ALLOWABLE WIND UPLIFT PRESSURE CONSIDERS PANEL BUCKLING STRENGTH, SIDEJOINT DISENGAGEMENT RESISTANCE AND CLIP/SIDEJOINT INTERACTIVE STRENGTH ONLY.
3. THE CLIP-TO-SUBSTRATE FASTENER CAPACITY MUST BE INVESTIGATED BY A DESIGN PROFESSIONAL AND CONSIDER CLIP PRY COEFFICIENT WHERE APPLICABLE.

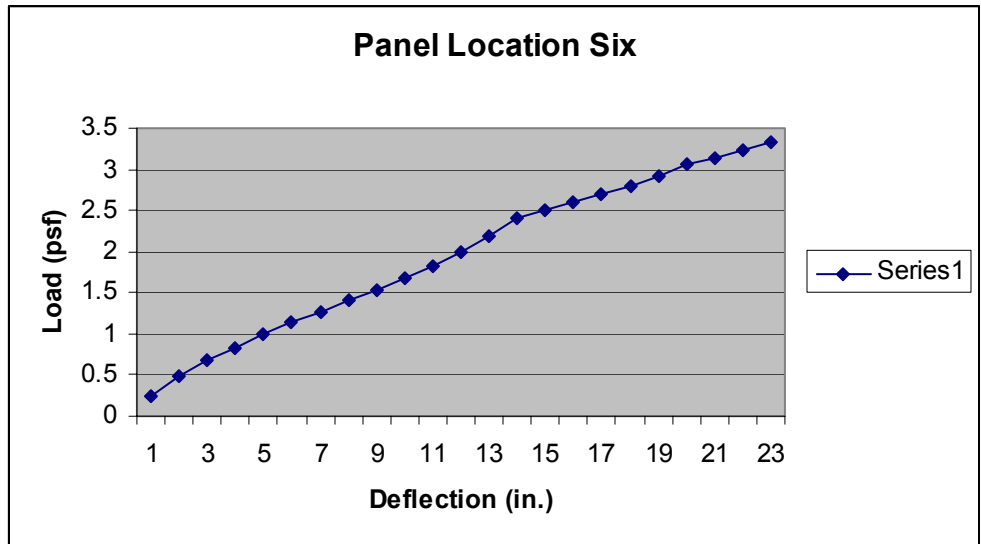
<b>METALFORMING, INC. 1 1/2" STANDING SEAM (1.5" X 18.25"- 22 GA)- FIELD SEAMED TEST SPAN= 2'-0" FAILURE MODE: CLIP DISENGAGEMENT W(ULT): 132.10 PSF</b>						
<b>E-1592</b>	<b>DEFLECTION VALUE @ KEY PANEL LOCATIONS, IN.</b>					
<b>LOAD, PSF</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.0280	0.0400	0.0280	0.2230	0.2430	0.2540
0.00	-0.0020	0.0070	0.0040	-0.0010	-0.0020	0.0040
10.00	0.0630	0.0720	0.0640	0.4590	0.4910	0.4790
0.00	0.0060	0.0080	0.0060	0.0060	0.0030	0.0090
15.00	0.1100	0.1260	0.0900	0.6490	0.6930	0.6710
0.00	-0.0040	0.0060	0.0080	-0.0010	-0.0010	0.0070
20.00	0.1260	0.1840	0.1000	0.8200	0.8750	0.8370
0.00	0.0100	0.0160	0.0060	-0.0010	0.0050	0.0100
25.00	0.1600	0.1960	0.1370	0.9630	1.0380	0.9890
0.00	0.0080	0.0180	0.0130	0.0010	0.0110	0.0090
30.00	0.1860	0.2520	0.1780	1.0950	1.1970	1.1350
0.00	0.0090	0.0120	0.0200	0.0040	0.0050	0.0120
35.00	0.2240	0.3040	0.2080	1.2300	1.3530	1.2760
0.00	0.0200	0.0190	0.0220	0.0150	0.0210	0.0230
40.00	0.2520	0.3480	0.2270	1.3590	1.4910	1.3980
0.00	0.0200	0.0240	0.0290	0.0090	0.0150	0.0290
45.00	0.2800	0.4070	0.2710	1.4790	1.6480	1.5330
0.00	0.0220	0.0280	0.0340	0.0100	0.0210	0.0270
50.00	0.3090	0.4740	0.3030	1.6110	1.8010	1.6710
0.00	0.0280	0.0320	0.0400	0.0090	0.0250	0.0380
55.00	0.3350	0.4940	0.3190	1.7510	1.9650	1.8230
0.00	0.0260	0.0280	0.0340	-0.0030	0.0090	0.0490
60.00	0.3340	0.5600	0.3470	1.9030	2.1340	1.9850
0.00	0.0260	0.0370	0.0450	0.0040	0.0310	0.0950
65.00	0.3860	0.5660	0.4200	2.1000	2.3550	2.1890
0.00	0.0280	0.0420	0.0600	0.0650	0.1070	0.1770
70.00	0.4410	0.6690	0.4080	2.3300	2.5950	2.4070
0.00	0.0520	0.0640	0.0740	0.2920	0.3090	0.3470
75.00	0.5160	0.7180	0.4910	2.4290	2.7140	2.5040
0.00	0.0790	0.0860	0.0930	0.3970	0.3910	0.4090
80.00	0.5420	0.7940	0.5960	2.5290	2.8350	2.6100
0.00	0.1280	0.1160	0.1410	0.6030	0.6130	0.6310
85.00	0.6390	0.8350	0.6320	2.6130	2.9510	2.7040
0.00	0.1600	0.1540	0.1720	0.7870	0.7930	0.7970
90.00	0.6440	0.8880	0.6200	2.7210	3.0740	2.8030
0.00	0.1890	0.1860	0.1920	0.9490	0.9410	0.9390
<b>METALFORMING, INC. 1 1/2" STANDING SEAM (1.5" X 18.25"- 22 GA)-</b>						

FIELD SEAMED TEST SPAN= 2'-0" FAILURE MODE: CLIP DISENGAGEMENT W(ULT): 132.10 PSF						
E-1592	DEFLECTION VALUE @ KEY PANEL LOCATIONS, IN.					
LOAD, PSF	1	2	3	4	5	6
95.00	0.6600	0.8980	0.6210	2.8250	3.1910	2.9170
0.00	0.2480	0.2140	0.2220	1.1390	1.1330	1.1290
100.00	0.7700	1.0080	0.6820	2.9350	3.3290	3.0530
0.00	0.2500	0.2200	0.2840	1.2840	1.2780	1.2710
105.00	0.7720	1.0540	0.7110	3.0290	3.4420	3.1350
0.00	0.2980	0.2480	0.2600	1.4010	1.3950	1.3870
110.00	0.7860	1.0630	0.6970	3.1290	3.5650	3.2380
0.00	0.2910	0.2720	0.2500	1.4280	1.4260	1.4270
115.00	0.8440	1.1510	0.8330	3.2360	3.6780	3.3330
0.00	0.2890	0.2710	0.2980	1.4410	1.4470	1.4390

**LOAD VS. DEFLECTION**  
**1 1/2" STANDING SEAM (1 1/2" X 18 1/2")**  
**METALFORMING, INC.**  
**DESIGN DYNAMICS, INC**  
**DRAWN BY: CGN 9-25-00**

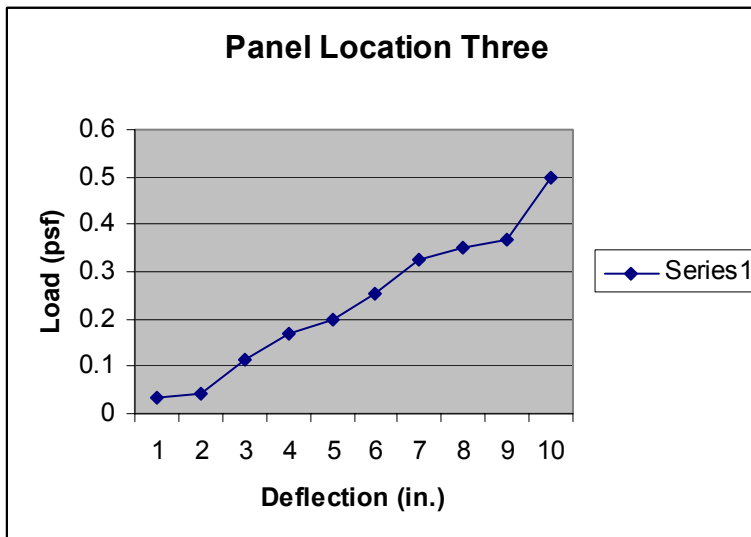
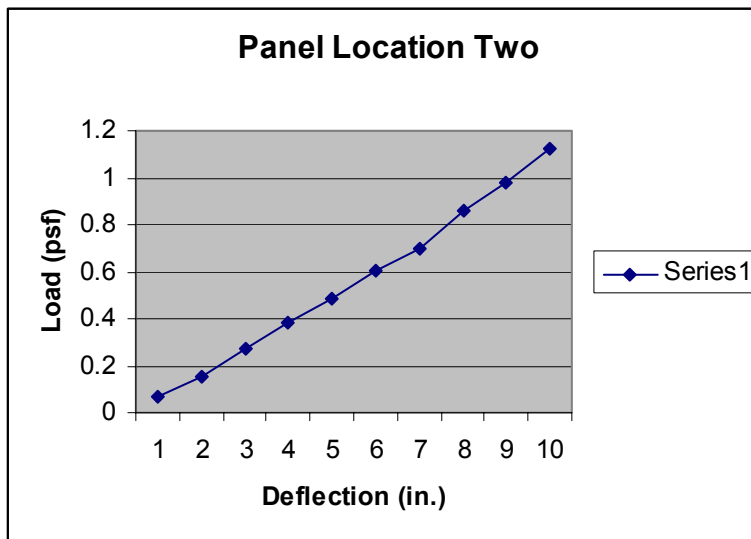
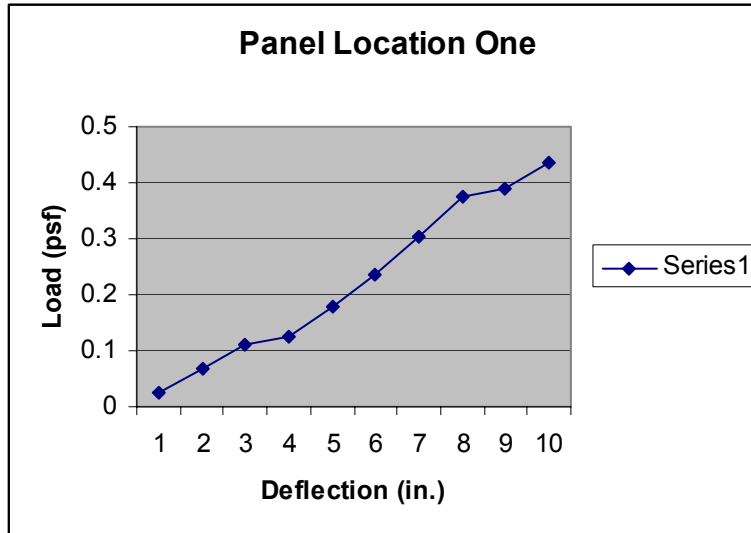


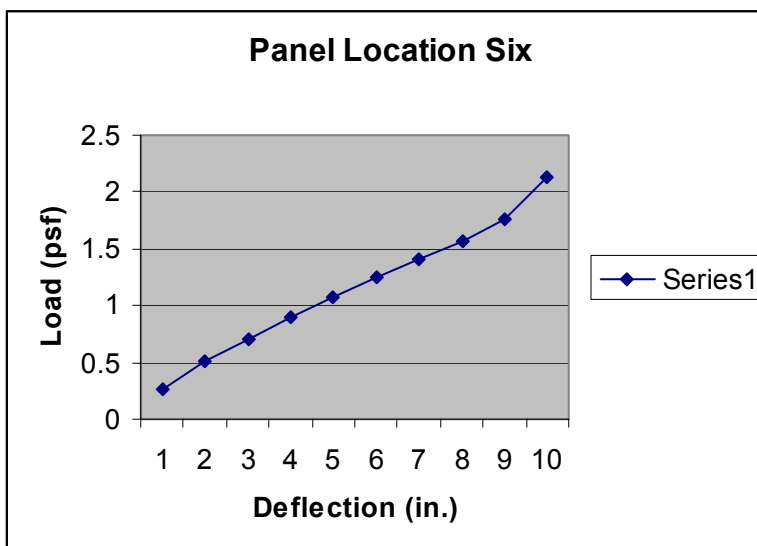
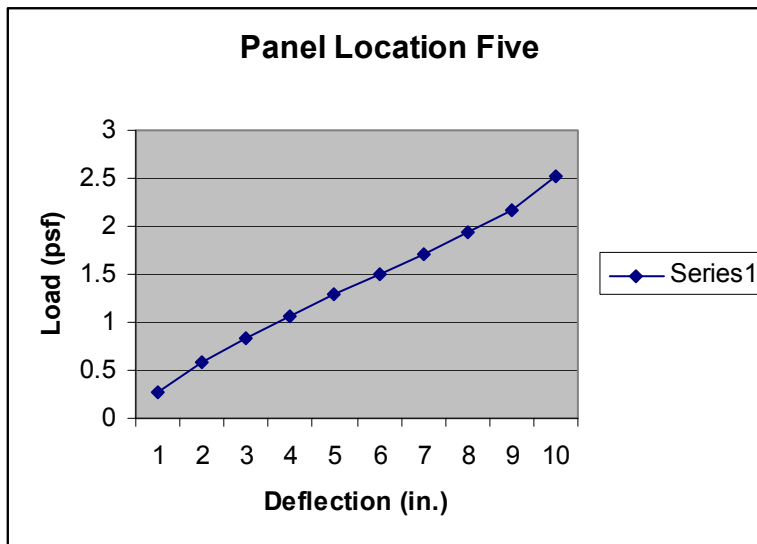
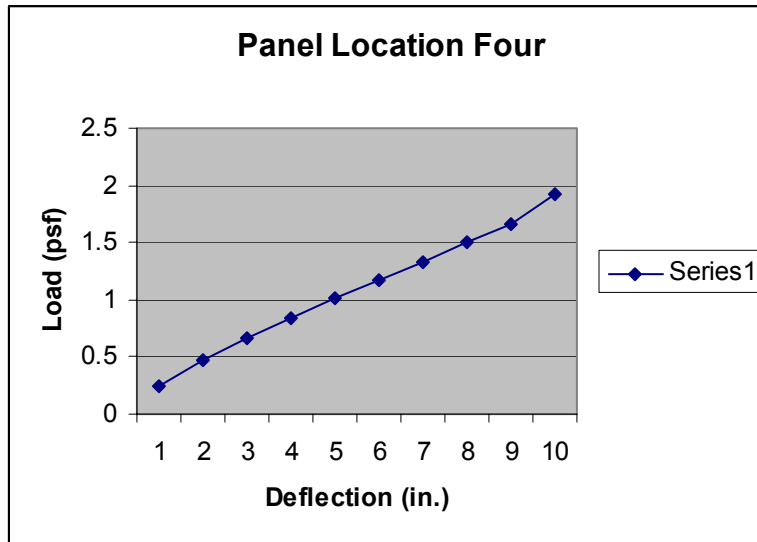




<b>METALFORMING, INC. 1 1/2" STANDING SEAM (1.5" X 18.25"- 22 GA.)- FIELD SEAMED TEST SPAN = 5'- 0"</b>						
<b>FAILURE MODE: CLIP DISENGAGEMENT      W(ULT): 54.98 PSF</b>						
<b>E-1592</b>	<b>DEFLECTION VALUE @ KEY PANEL LOCATIONS, IN.</b>					
<b>LOAD, PSF</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.00	0.0240	0.0650	0.0320	0.2440	0.2680	0.2560
0.00	0.0030	-0.0010	0.0080	-0.0140	-0.0130	-0.0060
10.00	0.0690	0.1570	0.0440	0.4660	0.5740	0.5110
0.00	0.0090	-0.0100	0.0000	-0.0110	-0.0180	-0.0080
15.00	0.1100	0.2760	0.1160	0.6600	0.8260	0.7060
0.00	0.0060	0.0060	0.0140	-0.0060	-0.0100	-0.0100
20.00	0.1250	0.3860	0.1680	0.8390	1.0680	0.8900
0.00	0.0200	0.0200	0.0220	0.0060	-0.0020	0.0140
25.00	0.1780	0.4830	0.2000	1.0080	1.2900	1.0690
0.00	0.0420	0.0420	0.0460	0.0080	0.0090	0.0190
30.00	0.2360	0.6060	0.2540	1.1720	1.5100	1.2470
0.00	0.0680	0.0700	0.0780	0.0320	0.0350	0.0460
35.00	0.3020	0.7020	0.3250	1.3300	1.7140	1.4080
0.00	0.0980	0.0960	0.0950	0.0540	0.0740	0.0840
40.00	0.3760	0.8560	0.3520	1.5120	1.9380	1.5740
0.00	0.1340	0.1310	0.1260	0.0880	0.1000	0.0930
45.00	0.3900	0.9780	0.3660	1.6640	2.1620	1.7580
0.00	0.1470	0.1710	0.1600	0.1220	0.1260	0.1460
50.00	0.4340	1.1220	0.5000	1.9200	2.5220	2.1340
0.00	0.2460	0.3520	0.3240	0.3780	0.5920	0.7840

**LOAD VS. DEFLECTION**  
**1 1/2" STANDING SEAM (1 1/2" X 18 1/2")**  
**METALFORMING, INC.**  
**DESIGN DYNAMICS, INC**  
**DRAWN BY: CCN 9-25-00**







**OCTOBER 2, 2000**

**REPORT OF: TENSILE TESTS**

**REPORT TO: DESIGN DYNAMICS, INC.  
777 SOUTH CENTRAL EXPRESSWAY  
SUITE 1-M  
RICHARDSON, TEXAS 75080**

**DATE RECEIVED: SEPTEMBER 29, 2000**

**IDENTIFICATION: 3 EA. METAL SHEETS, METALFORMING, INC., 22 GA;  
STANDING SEAM, 24-GAGE STEEL, GALVANIZED AND  
PAINTED ON BOTH SIDES; LAB-IDENTIFIED AS SAMPLES  
A, B, & C**

**PROCEDURES: LONGITUDINAL TENSILE TESTING WAS PERFORMED PER  
ASTM A 370-94 PARALLEL TO THE SAMPLE ROLLING  
DIRECTIONS (MARKED BY CLIENT) FOLLOWING  
MECHANICAL AND CHEMICAL REMOVAL OF THE PAINT  
AND ZINC COATINGS, RESPECTIVELY. A BALDWIN  
UNIVERSAL TEST MACHINE, MODEL TEG (S/N: 044-  
1004, CALIBRATION DUE: JULY 26, 2001) WAS USED  
FOR THE MECHANICAL TESTING.**

**RESULTS:**

***TENSILE TESTS- 2" GAGE LENGTH, 0.2% OFFSET***

<b>SQR DIMENSIONS INCHES</b>				<b>ULTIMATE STRENGTH</b>		<b>YIELD STRENGTH</b>		<b>ELON G%</b>
<b>ID</b>	<b>WIDTH</b>	<b>THICKNESS</b>	<b>AREA</b>	<b>LOAD, LBS</b>	<b>PSI</b>	<b>LOAD, LBS</b>	<b>PSI</b>	
<b>A</b>	<b>0.5095</b>	<b>0.0280</b>	<b>0.01427</b>	<b>819</b>	<b>57,500</b>	<b>699</b>	<b>49,000</b>	<b>32</b>
<b>B</b>	<b>0.5060</b>	<b>0.0280</b>	<b>0.01417</b>	<b>814</b>	<b>57,500</b>	<b>696</b>	<b>49,100</b>	<b>32</b>
<b>C</b>	<b>0.5070</b>	<b>0.0280</b>	<b>0.01420</b>	<b>831</b>	<b>58,500</b>	<b>704</b>	<b>49,600</b>	<b>32</b>

***THESE RESULTS ARE BASED ON THE TESTS PERFORMED AND ARE SUBJECT TO  
CHANGE UPON THE RECEIPT OF NEW OR ADDITIONAL INFORMATION.***

**RESPECTFULLY SUBMITTED,**

**DOUGLAS A. STOLK  
PRESIDENT  
METALLURGICAL ENGINEERING SERVICES, INC.**