



**Force Engineering & Testing Inc.**

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Humble, Texas 77338  
Phone: (281) 540-6603  
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Project Number : 13-0022T-08A

Test Report Date : April 3, 2008

Test Report Revision: Revision I, March 3, 2009

Test Material : 8" x 2.5" ZEE w/ Tophat

Test Procedure : AISI Gravity Load Base Test

Test Location : Force Engineering & Testing Inc.  
19530 Ramblewood Drive  
Humble, Texas 77338

Dade County Lab Certification No: 05-1122.13

## **16 GA. TOPHAT GRAVITY TEST**

Report Prepared by:

Brandon Jasek, P.E.

Report Reviewed by:

Terrence E. Wolfe, P.E.

Project Number : 13-0022T-08A

**PURPOSE:**

The purpose of this test was to analyze the bracing effects on the purlins that the Tophat adds to a through fastened panel system when subjected to a positive loading.

**TEST DATES:**

January 18 - February 13, 2008

**TEST ASSEMBLY:**

**Panel & Purlin Manufacturer**

Manufacturer: Whirlwind Steel Buildings, Inc.  
8234 Hansen Road  
Houston, TX 77075

Roof Panel: 26 Ga. Super Span X, 36" Coverage, 1 ¼" tall Corrugations.

Panel Fastener: #12-14 x 1" HWH @ 12"-12"-12" Fastener Pattern  
¼-14 x 7/8" Lap Tek @ 20" O.C. in panel side lap

Panel Length: 7'-0"

Purlin: 8" x 2.5" ZEE 16 Ga. & 12 Ga.

Purlin Length: 25'-7 ½", Span = 25'-0"

**Tophat Manufacturer**

Manufacturer: TopHat Framing Systems  
8660 Lambright  
Houston, TX 77075

Tophat: 16 Ga. 3 ½" Tall Hat section, 0.062" Material Thickness, R Panel punch out pattern

Tophat Fastener: (2) #12-14 x 1" HWH per foot

Tophat Splice: A tophat splice occurred on each purlin. The splice was 5'-0" from one end of the purlin. A 1 ½" x 2" 16 Ga. angle was attached to the tophats on each side with (6) #12-14 x 1-1/4" HWH fasteners. The splices were staggered on the two purlins.

Tophat Length: 20'-0"

**TESTING APPARATUS:**

High Pressure Blower: New York Blower, 15 hp, 900 cfm.

Test Chamber: 26' x 8' steel chamber.

Mounting Frame: W8x10 Steel Beams

Pressure Indicator: Heise Digital Pressure Indicator Model #901B, (+/-) 300-psf range, with max./min. hold features.

Deflection Indicators: aluminum rulers calibrated to 1/64".

**INTRODUCTION:**

The purpose of this test series was to obtain the moment amplification factor used in determining the nominal flexural strength of a purlin in positive bending supporting a through fastened panel system with a tophat added. The moment amplification factor reflects the ability of existing through fastened panel system with the added tophat to provide lateral and torsional bracing to the purlins to which it is attached. This test is based on the base test procedure provided by the 1996 AISI COLD-FORMED STEEL SPECIFICATION SUPPLEMENT NO. 1 APPENDIX A, JULY 30, 1999. This publication contains all variables, definitions, requirements and calculations for The Base Test Method.

**PROCEDURE:**

1. The purlins were installed at 5'-0" O.C. upon the steel supporting frames within the pressure chamber simulating recommended field attachment. The purlin clips were slotted on one end to eliminate any centenary forces that might be induced due to the connection.
2. With purlin installation complete, the Super Span X panels were installed.
3. Tophats were then installed over the panels over each purlin with a tophat splice 5'-0" from one end of each purlin. The tophat splices were staggered.
4. With construction complete, vertical deflection indicators were placed at mid-span of both purlins. A horizontal deflection indicator was placed at the seam nearest to the purlins' mid-span.
5. The test was set at 5 psf and held for minute. After the initial set, a zero reading was taken then negative pressure applied in the increments shown on the data sheets until failure. Deflection readings were taken at each increment and are shown on the data sheets.
6. The above steps were used for the three thinnest purlin profiles and for the three thickest purlin profiles.

**RESULTS/CONCLUSIONS:**

The 8x2.5 x 16 Ga. Zee failed at -51.0 psf, -53.0 psf and -57.0 psf. The mode of failure was buckling of the purlin top stiffener lip and top flange in all three tests. The 8x2.5 x 12 Ga. Zee failed at -74.0 psf, -71.0 psf and -69.0 psf. The mode of failure was buckling of the top flanges of the Tophat in all three tests. From the calculation pages, the amplification factors are shown in Table A below.

8" x 2.5" ZEE 16 Ga.	A =	1.672
8" x 2.5" ZEE 14 Ga.	A =	1.548
8" x 2.5" ZEE 12 Ga.	A =	1.240

Table A: Amplification Factor, A\* Revised 3-3-09

Note: During this test, tape and plastic were used to seal against air leakage. The tape and plastic had no restrictive influence on the test.

**STATEMENT OF INDEPENDENCE:**

Force Engineering & Testing, Inc. or any persons employed by them do not have any financial interest in Whirlwind or TopHat Framing Systems.

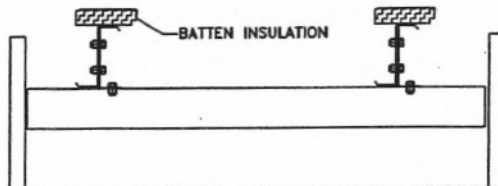
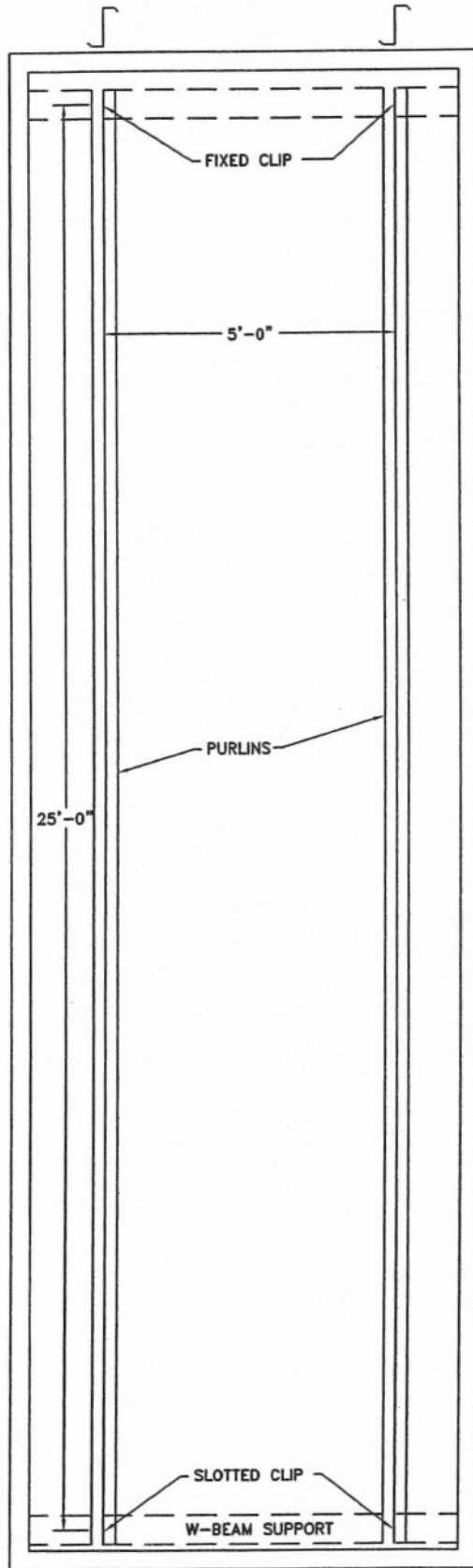
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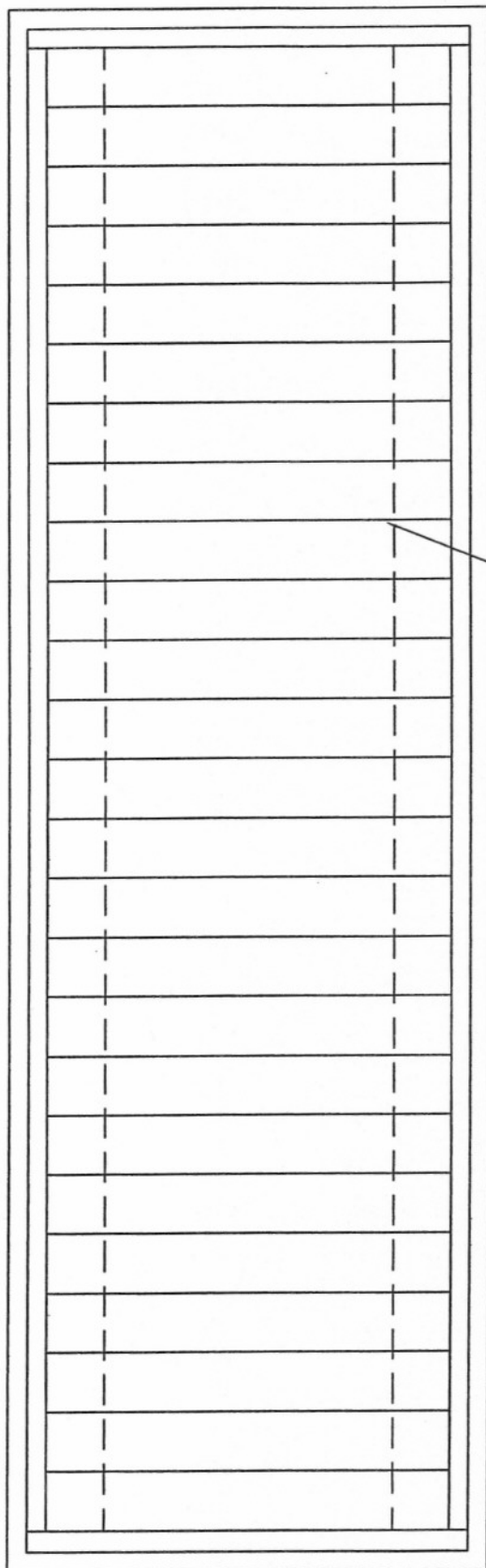
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## Appendix

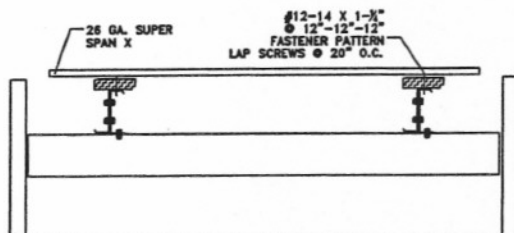
# PURLIN LAYOUT



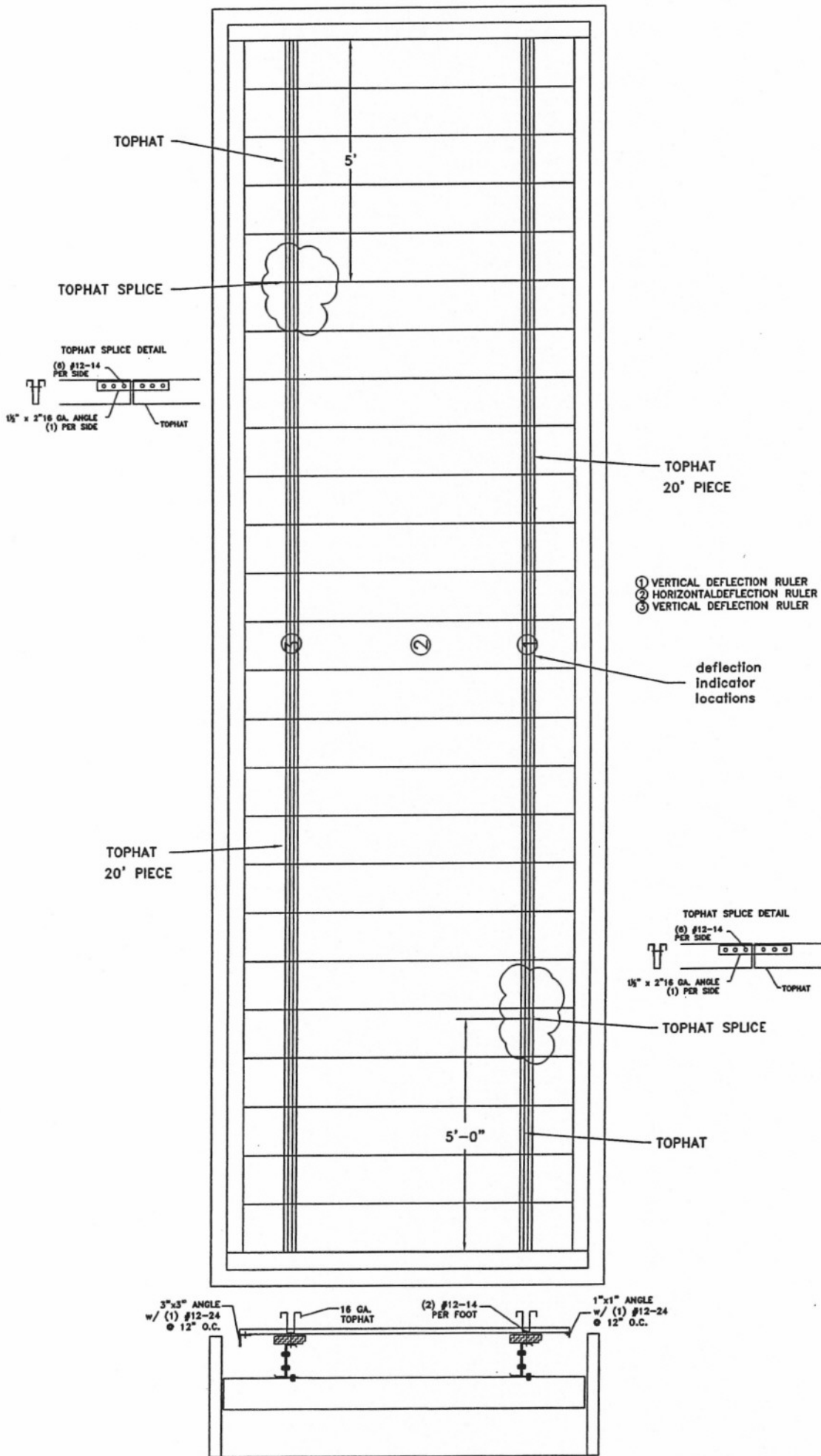
# PANEL LAYOUT



26 GA. SUPER SPAN X PANEL



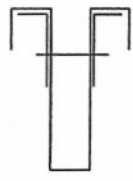
# TOPHAT LAYOUT



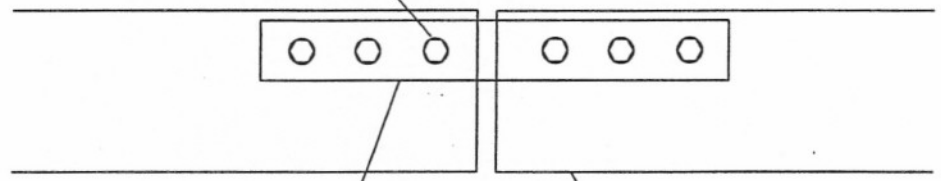


# TOPHAT SPLICE DETAIL

(6) #12-14  
PER SIDE



1 1/2" x 2" 16 GA. ANGLE  
(1) PER SIDE



TOPHAT

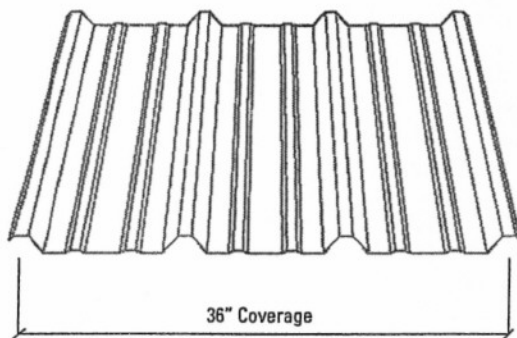
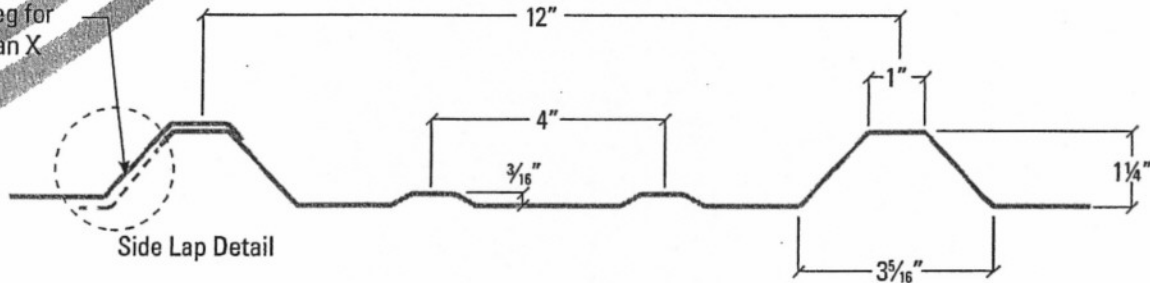


**WHIRLWIND BUILDING COMPONENTS**  
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 (Phone) 713.946.7140 | (Fax) 832.553.4700 | (US Wats) 800.324.9992



**SUPER SPAN-X**

Bearing leg for Super Span X



SUPER SPAN-X DESIGN PROPERTIES						
GAUGE/ THICKNESS	F <sub>y</sub> (KSI)	F <sub>b</sub> (KSI)	TOP IN COMPRESSION		BOTTOM IN COMPRESSION	
			I <sub>x</sub> (In <sup>4</sup> -Ft)	M <sub>a</sub> (Kip-In/Ft)	I <sub>x</sub> (In <sup>4</sup> -Ft)	M <sub>a</sub> (Kip-In/Ft)
26 (t=.0170")	60*	0.83	0.0370	1.2697	0.0323	1.6610
26 (t=.0176")	60*	0.86	0.0380	1.4057	0.0337	1.7230
24	50	1.09	0.0570	1.7500	0.0467	1.8633

\* F<sub>y</sub> is 80-ksi reduced to 60-ksi in accordance with the 2001 edition of the *North American Specification For Design Of Cold-Formed Steel Structural Members - A2.3.2*

**NOTES:**

1. All section properties are calculated in accordance with the 2001 edition of the *North American Specification For Design Of Cold-Formed Steel Structural Members*.
2. I<sub>x</sub> is for deflection determination.
3. M<sub>x</sub> is allowable bending moment.

**MATERIALS**

Unless otherwise specified, the exposed surfaces of all panels shall be either clear acrylic coated or factory painted GALVALUME®. GALVALUME® is a zinc-aluminum alloy coating that is applied to the base steel material. Acrylic coated GALVALUME® shall have a Coating Class AZ55 (0.55 ounces (combined total of both sides) per square foot). Factory painted GALVALUME® shall have a minimum Coating Class AZ50 (0.50 ounces (combined total of both sides) per square foot). GALVALUME® coated steel for panels shall conform to ASTM A792, Structural Quality. The 26 gauge panel shall conform to Grade 80 (80 ksi minimum yield strength); the 24 gauge panel shall conform to Grade 50 (50 ksi minimum yield strength). All material shall be ordered to a minimum decimal thickness. Minimum ordered thickness for coated steel products always includes the thickness of the coating.

**PAINTED FINISH**

All painted GALVALUME® shall be factory coated by a firm which coats coil products exclusively. The coater shall be responsible for ensuring color consistency, paint film hardness, and paint film thickness. Each side of the GALVALUME® will be coated with 0.2 mils baked-on primer before the color coating. The 26 gauge panel shall receive a baked-on silicone polyester finish coat on the exposed side. The 24 gauge panel shall receive a KYNAR 500® Fluoropolymer finish coat on the exposed side. Thickness of the finish coat will be a nominal 1.0 mils (including the primer coat). A baked-on straight polyester wash coat will be applied on the non-exposed side. Thickness of the wash coat will be a nominal 0.5 mils (including the primer coat).

**LIMITED MATERIAL WARRANTY**

Specific conditions concerning each finish shall be covered in detail on the written warranty issued, on request, with each order. Minimum roof slope - 1/2:12. GALVALUME® panels shall have a twenty-five year limited warranty providing that GALVALUME® panels will not rupture, fail structurally, or perforate within a period twenty-five years after shipment due to exposure to normal atmospheric corrosion. The clear acrylic finish does not carry a warranty. The 26 gauge factory coated GALVALUME® panel shall have a thirty-year limited color finish warranty from peeling and cracking, and a twenty-five year limited color finish warranty from excessive chalking and color change (fading). The 24 gauge factory coated GALVALUME® panel shall have a thirty-year limited color finish warranty from excessive chalking and color change (fading), peeling and cracking. The wash coat does not carry a warranty.

**PANELS**

Panel coverage will be 36" to the weather. Maximum panel length shall be 40'-0". Where endlaps are required, they shall be a minimum of 4" and shall occur at a purlin. A roof installed as listed in UL Construction No. 167 shall meet the requirements of Underwriters Laboratories standard UL 580 Class 90 for uplift resistance. All installations shall be in accordance with standard industry practices. Before securing, all laps of roof panels shall be sealed with a continuous ribbon of tape sealant. A closure strip shall be installed at the eave. Panels shall be secured to intermediate framing members with sheet metal screws at a maximum spacing of 12" on center. At endlaps, the maximum screw spacing shall be 6" on center. Sheet metal stitch screws at a maximum of 20" on center shall be installed at sidelaps. The panel must not rest on the concrete foundation; the panel must sit 1/8" above the concrete. Panels shall be furnished square cut.

- **UL CONSTRUCTION NO. 167**
- **UL 580 UP-LIFT TESTED CLASS 90 RATED**
- **UL 2218 HAIL IMPACT RESISTANT TESTED**
- INCLINED: UNLIMITED IMPACT: CLASS 4**
- **FLORIDA PRODUCT APPROVAL FL# 1845.3**

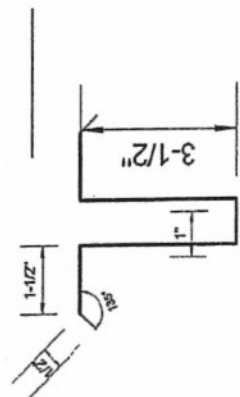
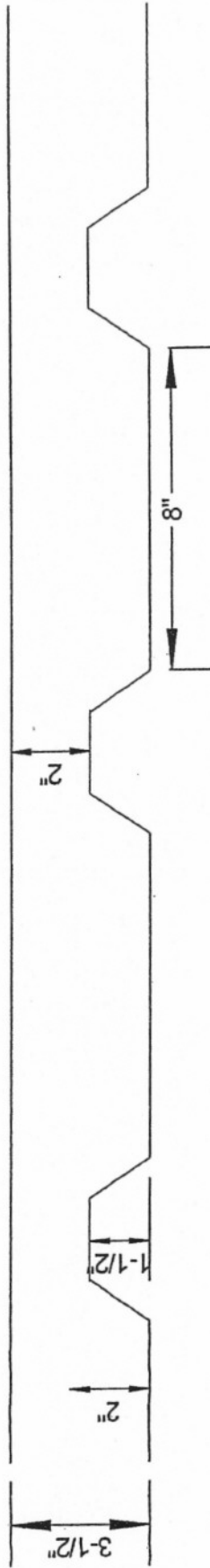
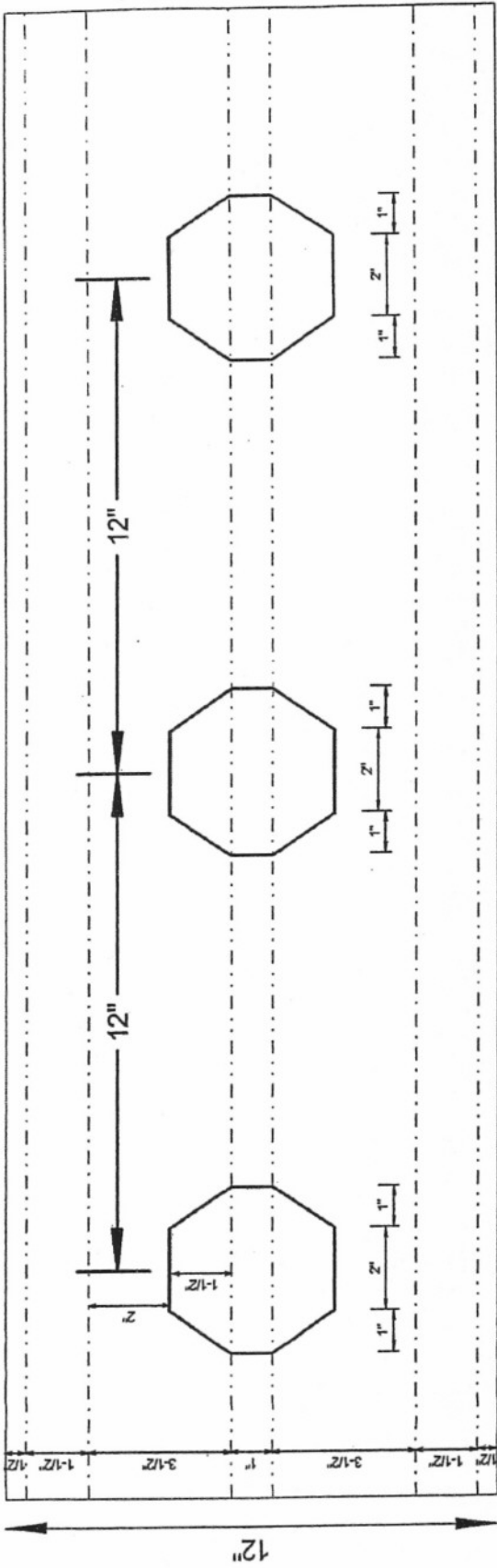
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Bodycote Testing Group, Houston North Laboratory, 9925 Regal Row, Houston, Texas, 77040  
 Tel: 281-848-0270, Fax: 281-848-0275

## Test Certificate

Force Eng. & Testing Inc.  
 19530 Ramblewood Dr.  
 Humble, TX

REF No            0801379 : Issue    1  
 Ord No            13-0022T-08  
 Date Tested      03/25/08  
 Date Reported   03/25/08

77338

Attn: Terrance E. Wolfe, P.E.

Item - Sheet Metal sample for Tensile Test  
Commercial Siding and Manufacturing, Roofrunner

Specification - Client Requirement

Tensile Test - ASTM E 8								
	Dimensions [in]	Area [in <sup>2</sup> ]	GL [in]	0.20%YS [psi]	UTS [psi]	%EL	%RA	Comments
001:Parent	0.5090x 0.0620	0.0316	2.00	38200	47800	33	N/A	Nil

### Certificate Comments

This is an electronic copy. See original certificate for photographs and figures where referenced.

Approved By      Jim Blevins

.....  
 Jim Blevins  
 For and on authority of  
 Bodycote Testing Group

This certificate should not be reproduced other than in full, without the written approval of Bodycote Testing Group, Inc. These results pertain only to the item(s) tested as sampled by the client unless otherwise indicated.

## **Data Sheets**

## Base Test Deflection Readings

**Project #:** 13-0022T-08A  
**Test:** Gravity Base Test #1  
**Panel:** 26 Ga. PBR 12"-12"-12" Fastener Pattern x 7'-0" Long  
**Purlin:** 8x2.5ZEE 16 Ga. 25' Span spaced @ 5'-0" O.C. Facing same direction  
**Tophat:** Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1" Per foot  
**Date:** 1/18/2008

LOAD (psf)	Vertical Deflection of Purlin 1 (in)	Vertical Deflection of Purlin 2 (in)	Horizontal Deflection of Panel (in)
0.00	30.2500	30.0000	7.8750
3.00	30.0938	29.8594	7.8750
6.00	29.9375	29.6875	7.8750
9.00	29.7813	29.5469	7.8750
12.00	29.5938	29.3281	7.8594
15.00	29.3750	29.1563	7.8594
18.00	29.2031	28.9219	7.8594
21.00	28.9688	28.6875	7.8594
24.00	28.7813	28.4375	7.8594
27.00	28.5469	28.1719	7.8594
30.00	28.3750	27.9375	7.8594
33.00	28.0781	27.6875	7.8594
36.00	27.8438	27.3750	7.8594
39.00	27.5938	27.0781	7.8594
42.00	27.3438	26.7969	7.8594
45.00	26.9375	26.4375	7.8594
48.00	26.7500	26.1250	7.8594
51.00	FAILED @ 51 PSF		

**Ultimate Test Pressure:** 51.00 psf  
**Mode of Failure:** Purlin #2 top flange buckled at Mid span

## ***Base Test Deflection Readings***

**Project #:** 13-0022T-08B  
**Test:** Gravity Base Test #2  
**Panel:** 26 Ga. PBR 12"-12"-12" Fastener Pattern x 7'-0" Long  
**Purlin:** 8x2.5ZEE 16 Ga. 25' Span spaced @ 5'-0" O.C. Facing same direction  
**Tophat:** Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1" Per foot  
**Date:** 2/1/2008

LOAD (psf)	Vertical Deflection of Purlin 1 (in)	Vertical Deflection of Purlin 2 (in)	Horizontal Deflection of Panel (in)
0.00	31.1250	30.2188	9.8438
4.00	30.9063	30.0000	9.8438
8.00	30.7031	29.8125	9.8438
12.00	30.4844	29.5625	9.8438
16.00	30.2813	29.3125	9.8438
20.00	30.0938	29.0000	9.8438
24.00	29.7813	28.7188	9.8438
28.00	29.4531	28.4375	9.8438
32.00	29.2813	28.1250	9.8438
36.00	29.0313	27.7813	9.8438
40.00	28.7188	27.4844	9.8438
44.00	28.4375	27.0313	9.8125
48.00	28.0625	26.6563	9.7969
52.00	27.7031	25.9844	9.7500
56.00	FAILED @ 53 PSF		

**Ultimate Test Pressure:** 53.00 psf  
**Mode of Failure:** Purlin #2 top flange buckled at Mid span

## Base Test Deflection Readings

**Project #:** 13-0022T-08C  
**Test:** Gravity Base Test #3  
**Panel:** 26 Ga. PBR 12"-12"-12" Fastener Pattern x 7'-0" Long  
**Purlin:** 8x2.5ZEE 16 Ga. 25' Span spaced @ 5'-0" O.C. Facing same direction  
**Tophat:** Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1" Per foot  
**Date:** 2/4/2008

LOAD (psf)	Vertical Deflection of Purlin 1 (in)	Vertical Deflection of Purlin 2 (in)	Horizontal Deflection of Panel (in)
0.00	30.1094	29.5000	9.1250
4.00	29.8906	29.3125	9.1250
8.00	29.7188	29.1094	9.1563
12.00	29.4531	28.8750	9.1563
16.00	29.1875	28.6250	9.1563
20.00	28.9063	28.3594	9.1719
24.00	28.6563	28.0469	9.1719
28.00	28.3750	27.7500	9.1719
32.00	28.1250	27.4063	9.1719
36.00	27.7969	27.1250	9.1719
40.00	27.5313	26.6875	9.1719
44.00	27.1406	26.3750	9.1719
48.00	26.8750	25.8125	9.1719
52.00	26.4219	25.4375	9.1719
56.00	26.1250	24.6875	9.1719
60.00	FAILED @ 57 PSF		

**Ultimate Test Pressure:** 57.00 psf  
**Mode of Failure:** Purlin #2 top flange buckled at Mid span



## Base Test Deflection Readings

**Project #:** 13-0022T-08J  
**Test:** Gravity Base Test #1  
**Panel:** 26 Ga. PBR 12"-12"-12" Fastener Pattern x 7'-0" Long  
**Purlin:** 8x2.5ZEE 12 Ga. 25' Span spaced @ 5'-0" O.C. Facing same direction  
**Tophat:** Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1" Per foot  
**Date:** 2/11/2008

LOAD (psf)	Vertical Deflection of Purlin 1 (in)	Vertical Deflection of Purlin 2 (in)	Horizontal Deflection of Panel (in)
0.00	31.5000	31.3906	8.7969
5.00	31.3125	31.2188	8.7813
10.00	31.1250	31.0313	8.7813
15.00	30.9063	30.8125	8.7813
20.00	30.6563	30.5781	8.7656
25.00	30.4063	30.3281	8.7656
30.00	30.1406	30.1094	8.7500
35.00	29.8906	29.8750	8.7188
40.00	29.5313	29.6250	8.7031
45.00	29.3594	29.3594	8.6719
50.00	29.0781	29.1250	8.6563
55.00	28.8438	28.8438	8.5938
60.00	28.5313	28.5938	8.5469
65.00	28.2500	28.2500	8.4688
70.00	27.9375	27.9688	8.3906
75.00	FAILED @ 74 PSF		

**Ultimate Test Pressure:** 74.00 psf  
**Mode of Failure:** Tophat top flange buckled at Mid span

## ***Base Test Deflection Readings***

**Project #:** 13-0022T-08K  
**Test:** Gravity Base Test #2  
**Panel:** 26 Ga. PBR 12"-12"-12" Fastener Pattern x 7'-0" Long  
**Purlin:** 8x2.5ZEE 12 Ga. 25' Span spaced @ 5'-0" O.C. Facing same direction  
**Tophat:** Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1" Per foot  
**Date:** 2/12/2008

<b>LOAD (psf)</b>	<b>Vertical Deflection of Purlin 1 (in)</b>	<b>Vertical Deflection of Purlin 2 (in)</b>	<b>Horizontal Deflection of Panel (in)</b>
0.00	31.1563	31.5938	8.1875
5.00	30.9375	31.3750	8.1875
10.00	30.7500	31.2031	8.1719
15.00	30.5000	30.9531	8.1563
20.00	30.2344	30.7031	8.1406
25.00	30.0000	30.3906	8.1094
30.00	29.7500	30.1094	8.0938
35.00	29.5156	29.8125	8.0781
40.00	29.2500	29.5625	8.0625
45.00	29.0313	29.2813	8.0313
50.00	28.7500	29.0313	8.0156
55.00	28.5000	28.7344	7.9688
60.00	28.2031	28.4531	7.9375
65.00	27.9375	28.0625	7.9063
70.00	FAILED @ 71 PSF		

**Ultimate Test Pressure:** 71.00 psf  
**Mode of Failure:** Tophat top flange buckled at Mid span

### Base Test Deflection Readings

Project #: 13-0022T-08L  
Test: Gravity Base Test #3  
Panel: 26 Ga. PBR 12"-12"-12" Fastener Pattern x 7'-0" Long  
Purlin: 8x2.5ZEE 12 Ga. 25' Span spaced @ 5'-0" O.C. Facing same direction  
Tophat: Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1" Per foot  
Date: 2/13/2008

LOAD (psf)	Vertical Deflection of Purlin 1 (in)	Vertical Deflection of Purlin 2 (in)	Horizontal Deflection of Panel (in)
0.00	31.7813	30.8750	6.9063
5.00	31.5938	30.6875	6.9063
10.00	31.4063	30.5000	6.9063
15.00	31.1875	30.2344	6.9063
20.00	30.9688	30.0156	6.8906
25.00	30.7500	29.7813	6.8615
30.00	30.5313	29.5625	6.8438
35.00	30.2969	29.3438	6.8281
40.00	30.0938	29.0781	6.8125
45.00	29.8594	28.8750	6.7969
50.00	29.6250	28.6250	6.7656
55.00	29.3906	28.3750	6.7500
60.00	29.1875	28.0781	6.7344
65.00	FAILED @ 69 PSF		

Ultimate Test Pressure: 69.00 psf  
Mode of Failure: Tophat top flange buckled at Mid span

## Calculations

**CALCULATIONS**

PANEL : 26 Ga. PBR 7'-0" long  
 CLIP : NA  
 FASTENER : #12-14 x 1-1/4" HWH  
 PURLIN : 8x2.5Zee w/ Tophat attached w/ (2) #12-14 every foot  
 DESCRIPTION : 25'-0" Span Gravity Base Test

<b>#1 1-18-08</b>	8X2.5X16GA. ZEE		
b	purlin flange width	2.125	in.
B	purlin spacing	60.00	in.
d	purlin depth	8.00	in.
t	purlin thickness	0.057	in.
pts	failure load	51.00	psf
pd	weight of the specimen	2.350	psf
s	purlin tributary width	3.500	ft
PI	lateral anchorage force	20.36	lbs/ft
wts	failure load	192.15	lbs/ft
L	purlin span	25.00	ft
Mts	failure moment	180.14	k-in
Set	section modulus of the specimen	1.5220	in^3
Se	section modulus	1.7701	in^3
Fy	design yield strength	57.00	ksi
Fyt	measured yield strength	72.80	ksi
Mn	nominal flexural strength	100.90	k-in
Mnt	flexural strength	110.80	k-in
Rt	modification factor	1.6258	

<b>#1 2-11-08</b>	8X2.5X12GA. ZEE		
b	purlin flange width	2.125	in.
B	purlin spacing	60.00	in.
d	purlin depth	8.00	in.
t	purlin thickness	0.101	in.
pts	failure load	74.00	psf
pd	weight of the specimen	2.970	psf
s	purlin tributary width	3.500	ft
PI	lateral anchorage force	20.84	lbs/ft
wts	failure load	274.95	lbs/ft
L	purlin span	25.00	ft
Mts	failure moment	257.77	k-in
Set	section modulus of the specimen	3.2170	in^3
Se	section modulus	3.3367	in^3
Fy	design yield strength	57.00	ksi
Fyt	measured yield strength	64.40	ksi
Mn	nominal flexural strength	190.19	k-in
Mnt	flexural strength	207.17	k-in
Rt	modification factor	1.2442	

<b>#2 2-1-08</b>	8X2.5X16GA. ZEE		
b	purlin flange width	2.125	in.
B	purlin spacing	60.00	in.
d	purlin depth	8.00	in.
t	purlin thickness	0.058	in.
pts	failure load	53.00	psf
pd	weight of the specimen	2.350	psf
s	purlin tributary width	3.500	ft
PI	lateral anchorage force	20.90	lbs/ft
wts	failure load	199.30	lbs/ft
L	purlin span	25.00	ft
Mts	failure moment	186.84	k-in
Set	section modulus of the specimen	1.5651	in^3
Se	section modulus	1.7701	in^3
Fy	design yield strength	57.00	ksi
Fyt	measured yield strength	72.10	ksi
Mn	nominal flexural strength	100.90	k-in
Mnt	flexural strength	112.84	k-in
Rt	modification factor	1.6558	

<b>#2 2-12-08</b>	8X2.5X12GA. ZEE		
b	purlin flange width	2.125	in.
B	purlin spacing	60.00	in.
d	purlin depth	8.00	in.
t	purlin thickness	0.102	in.
pts	failure load	71.00	psf
pd	weight of the specimen	2.970	psf
s	purlin tributary width	3.500	ft
PI	lateral anchorage force	19.91	lbs/ft
wts	failure load	264.20	lbs/ft
L	purlin span	25.00	ft
Mts	failure moment	247.69	k-in
Set	section modulus of the specimen	3.2470	in^3
Se	section modulus	3.3367	in^3
Fy	design yield strength	57.00	ksi
Fyt	measured yield strength	63.10	ksi
Mn	nominal flexural strength	190.19	k-in
Mnt	flexural strength	204.89	k-in
Rt	modification factor	1.2089	

<b>#3 2-4-08</b>	8X2.5X16GA. ZEE		
b	purlin flange width	2.125	in.
B	purlin spacing	60.00	in.
d	purlin depth	8.00	in.
t	purlin thickness	0.059	in.
pts	failure load	57.00	psf
pd	weight of the specimen	2.350	psf
s	purlin tributary width	3.500	ft
PI	lateral anchorage force	22.18	lbs/ft
wts	failure load	213.64	lbs/ft
L	purlin span	25.00	ft
Mts	failure moment	200.29	k-in
Set	section modulus of the specimen	1.6081	in^3
Se	section modulus	1.7701	in^3
Fy	design yield strength	57.00	ksi
Fyt	measured yield strength	71.50	ksi
Mn	nominal flexural strength	100.90	k-in
Mnt	flexural strength	114.98	k-in
Rt	modification factor	1.7419	

<b>#3 2-13-08</b>	8X2.5X12GA. ZEE		
b	purlin flange width	2.125	in.
B	purlin spacing	60.00	in.
d	purlin depth	8.00	in.
t	purlin thickness	0.101	in.
pts	failure load	69.00	psf
pd	weight of the specimen	2.970	psf
s	purlin tributary width	3.500	ft
PI	lateral anchorage force	19.48	lbs/ft
wts	failure load	257.09	lbs/ft
L	purlin span	25.00	ft
Mts	failure moment	241.02	k-in
Set	section modulus of the specimen	3.2170	in^3
Se	section modulus	3.3367	in^3
Fy	design yield strength	57.00	ksi
Fyt	measured yield strength	64.80	ksi
Mn	nominal flexural strength	190.19	k-in
Mnt	flexural strength	208.46	k-in
Rt	modification factor	1.1562	

<b>AVERAGE Rt</b>	1.675
<b>STANDARD DEVIATION</b>	0.060
<b>Rt min.</b>	1.614
<b>Mnt min.</b>	112.875

<b>AVERAGE Rt</b>	1.203
<b>STANDARD DEVIATION</b>	0.044
<b>Rt max.</b>	1.159
<b>Mnt max.</b>	206.841

8x2.5 Zee 16 Ga.	R =	1.6723
8x2.5 Zee 14 Ga.	R =	1.548
8x2.5 Zee 12 Ga.	R =	1.2395

Average Tested Failure Moment		
8x2.5 Zee 16 Ga.	Mts =	189.09
8x2.5 Zee 14 Ga.	Mts =	218.96
8x2.5 Zee 12 Ga.	Mts =	248.83



Bodycote Testing Group, Houston North Laboratory, 9925 Regal Row, Houston, Texas, 77040  
 Tel: 281-848-0270, Fax: 281-848-0275

## Test Certificate

Force Eng. & Testing Inc.  
 19530 Ramblewood Dr.  
 Humble, TX

REF No            0801380 : Issue    1  
 Ord No            13-0022T-08  
 Date Tested      03/25/08  
 Date Reported   03/25/08

77338

Attn: Terrance E. Wolfe, P.E.

Item \_\_\_\_\_ - Sheet Metal samples for Tensile Test, Samples 1 thru 3  
Commercial Siding and Manufacturing, 8x2.5ZEE16 Gravity 1-3

Specification - Client Requirement

Tensile Test - ASTM E 8								
	Dimensions [in]	Area [in <sup>2</sup> ]	GL [in]	0.20%YS [psi]	UTS [psi]	%El	%RA	Comments
001:Parent	0.5150x 0.0570	0.0294	2.00	72800	85400	22	N/A	Sample 1
002:Parent	0.5070x 0.0580	0.0294	2.00	72100	84700	20	N/A	Sample 2
003:Parent	0.5120x 0.0590	0.0302	2.00	71500	84800	24	N/A	Sample 3

### Certificate Comments

This is an electronic copy. See original certificate for photographs and figures where referenced.

Approved By      Jim Blevins

.....  
 Jim Blevins  
 For and on authority of  
 Bodycote Testing Group

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Bodycote Testing Group, Houston North Laboratory, 9925 Regal Row, Houston, Texas, 77040  
 Tel: 281-848-0270, Fax: 281-848-0275

## Test Certificate

Force Eng. & Testing Inc.  
 19530 Ramblewood Dr.  
 Humble, TX

REF No            0801382 : Issue    1  
 Ord No            13-0022T-08  
 Date Tested      03/25/08  
 Date Reported    03/25/08

77338

Attn: Terrance E. Wolfe, P.E.

Item \_\_\_\_\_ - Sheet Metal samples for Tensile Test, Samples 1 thru 3  
Commercial Siding and Manufacturing, 8x2.5ZEE12 Gravity 1-3

Specification - Client Requirement

Tensile Test - ASTM E 8								
	Dimensions [in]	Area [in <sup>2</sup> ]	GL [in]	0.20%YS [psi]	UTS [psi]	%EL	%RA	Comments
001:Parent	0.5040x 0.1010	0.0509	2.00	64400	74100	22	N/A	Sample 1
002:Parent	0.5050x 0.1020	0.0515	2.00	63100	74200	25	N/A	Sample 2
003:Parent	0.5060x 0.1010	0.0511	2.00	64800	74600	22	N/A	Sample 3

### Certificate Comments

This is an electronic copy. See original certificate for photographs and figures where referenced.

Approved By      Jim Blevins

.....  
 Jim Blevins  
 For and on authority of  
 Bodycote Testing Group

This certificate should not be reproduced other than in full, without the written approval of Bodycote Testing Group, Inc.  
 These results pertain only to the item(s) tested as sampled by the client unless otherwise indicated.

Section: 8x2.5Z16 Gravity Calculated.sct  
 8 x 2.5 Z 16 Gage  
 LGSi Library  
 Rev. Date: 4/1/2008 12:45:33 PM  
 By: Brandon Jasek

Brandon Jasek  
 Force Engineering & Testing  
 8x2.5Z16 Gravity Calculated



**Section Inputs**

---

Material: A1011 HSLAS Grade 55/2  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E            29500 ksi  
 Yield Strength, Fy                    57 ksi  
 Tensile Strength, Fu                 65 ksi  
 Warping Constant Override, Cw       0 in<sup>6</sup>  
 Torsion Constant Override, J         0 in<sup>4</sup>

Z-Section, Thickness 0.0589 in  
 Placement of Part from Origin:  
 X to center of gravity                0 in  
 Y to center of gravity                0 in

Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705



Full Section Properties

Area	0.82082 in <sup>2</sup>	Wt.	2.7908 lb/ft	Width	13.936 in
Ix	7.7244 in <sup>4</sup>	rx	3.0677 in	Ixy	2.1089 in <sup>4</sup>
Sx(t)	1.8973 in <sup>3</sup>	y(t)	4.0712 in	α	-16.250 deg
Sx(b)	1.9661 in <sup>3</sup>	y(b)	3.9288 in		
		Height	8.0000 in		
Iy	1.1040 in <sup>4</sup>	ry	1.1597 in	Xo	-0.0242 in
Sy(l)	0.3814 in <sup>3</sup>	x(l)	2.8945 in	Yo	-0.4860 in
Sy(r)	0.4005 in <sup>3</sup>	x(r)	2.7563 in	jx	-0.0586 in
		Width	5.6508 in	jy	0.5195 in
I1	8.3391 in <sup>4</sup>	r1	3.1874 in		
I2	0.4893 in <sup>4</sup>	r2	0.7721 in		
Ic	8.8284 in <sup>4</sup>	rc	3.2796 in	Cw	12.572 in <sup>6</sup>
Io	9.0228 in <sup>4</sup>	ro	3.3155 in	J	0.000949 in <sup>4</sup>

Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	14942 lb	Maxo	60.415 k-in	Mayo	12.367 k-in
Ae	0.47186 in <sup>2</sup>	Ixe	7.3990 in <sup>4</sup>	Iye	1.0370 in <sup>4</sup>
		Sxe(t)	1.7701 in <sup>3</sup>	Sye(l)	0.3623 in <sup>3</sup>
		Sxe(b)	1.9370 in <sup>3</sup>	Sye(r)	0.3718 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	26677 lb	Maxo	61.130 k-in	Mayo	11.825 k-in
		Ixe	7.2926 in <sup>4</sup>	Iye	1.0183 in <sup>4</sup>
		Sxe(t)	1.8565 in <sup>3</sup>	Sye(l)	0.3465 in <sup>3</sup>
		Sxe(b)	1.7910 in <sup>3</sup>	Sye(r)	0.3755 in <sup>3</sup>
Shear					
Vay	2463 lb				
Vax	4525 lb				



### Section Inputs

---

Material: [Tested Purlins]  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E 29500 ksi  
 Yield Strength, Fy 72.8 ksi  
 Tensile Strength, Fu 85.4 ksi  
 Warping Constant Override, Cw 0 in<sup>6</sup>  
 Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.057 in  
 Placement of Part from Origin:  
 X to center of gravity 0 in  
 Y to center of gravity 0 in

Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705

Full Section Properties

Area	0.79472 in <sup>2</sup>	Wt.	2.7020 lb/ft	Width	13.942 in
Ix	7.4834 in <sup>4</sup>	rx	3.0686 in	Ixy	2.0438 in <sup>4</sup>
Sx(t)	1.8381 in <sup>3</sup>	y(t)	4.0712 in	α	-16.256 deg
Sx(b)	1.9048 in <sup>3</sup>	y(b)	3.9288 in		
		Height	8.0000 in		
Iy	1.0703 in <sup>4</sup>	ry	1.1605 in	Xo	-0.0242 in
Sy(l)	0.3696 in <sup>3</sup>	x(l)	2.8954 in	Yo	-0.4858 in
Sy(r)	0.3882 in <sup>3</sup>	x(r)	2.7573 in	jx	-0.0586 in
		Width	5.6527 in	jy	0.5193 in
I1	8.0793 in <sup>4</sup>	r1	3.1885 in		
I2	0.4743 in <sup>4</sup>	r2	0.7725 in		
Ic	8.5536 in <sup>4</sup>	rc	3.2807 in	Cw	12.195 in <sup>6</sup>
Io	8.7417 in <sup>4</sup>	ro	3.3166 in	J	0.000861 in <sup>4</sup>

Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	16620 lb	Maxo	66.346 k-in	Mayo	14.800 k-in
Ae	0.41093 in <sup>2</sup>	Ixe	6.6909 in <sup>4</sup>	Iye	0.9620 in <sup>4</sup>
		Sxe(t)	1.5220 in <sup>3</sup>	Sye(l)	0.3395 in <sup>3</sup>
		Sxe(b)	1.8566 in <sup>3</sup>	Sye(r)	0.3412 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	33934 lb	Maxo	67.308 k-in	Mayo	13.773 k-in
		Ixe	6.6041 in <sup>4</sup>	Iye	0.9388 in <sup>4</sup>
		Sxe(t)	1.7740 in <sup>3</sup>	Sye(l)	0.3159 in <sup>3</sup>
		Sxe(b)	1.5440 in <sup>3</sup>	Sye(r)	0.3501 in <sup>3</sup>
Shear					
Vay	2231 lb				
Vax	5601 lb				

Section: 8x2.5Z16 Gravity Test #2.sct

Brandon Jasek

8 x 2.5 Z 16 Gage

Force Engineering &amp; Testing

LGSI Library

8x2.5Z16 Gravity Test #2

Rev. Date: 4/1/2008 12:53:08 PM

By: Brandon Jasek



### Section Inputs

---

Material: [Tested Purlins]

No strength increase from cold work of forming.

Modulus of Elasticity, E 29500 ksi

Yield Strength, Fy 72.1 ksi

Tensile Strength, Fu 84.7 ksi

Warping Constant Override, Cw 0 in<sup>6</sup>Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.058 in

Placement of Part from Origin:

X to center of gravity 0 in

Y to center of gravity 0 in

Outside dimensions, Open shape

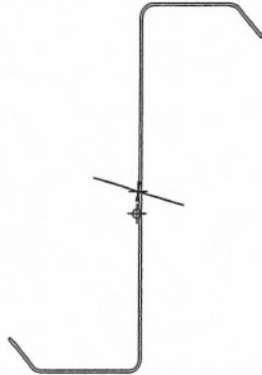
	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705

Full Section Properties

Area	0.80846 in <sup>2</sup>	Wt.	2.7488 lb/ft	Width	13.939 in
Ix	7.6103 in <sup>4</sup>	rx	3.0681 in	Ixy	2.0781 in <sup>4</sup>
Sx(t)	1.8693 in <sup>3</sup>	y(t)	4.0712 in	α	-16.253 deg
Sx(b)	1.9371 in <sup>3</sup>	y(b)	3.9288 in		
		Height	8.0000 in		
Iy	1.0880 in <sup>4</sup>	ry	1.1601 in	Xo	-0.0242 in
Sy(l)	0.3758 in <sup>3</sup>	x(l)	2.8949 in	Yo	-0.4859 in
Sy(r)	0.3947 in <sup>3</sup>	x(r)	2.7568 in	jx	-0.0586 in
		Width	5.6517 in	jy	0.5194 in
I1	8.2162 in <sup>4</sup>	r1	3.1879 in		
I2	0.4822 in <sup>4</sup>	r2	0.7723 in		
Ic	8.6983 in <sup>4</sup>	rc	3.2801 in	Cw	12.394 in <sup>6</sup>
Io	8.8897 in <sup>4</sup>	ro	3.3160 in	J	0.000907 in <sup>4</sup>

Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	16896 lb	Maxo	67.570 k-in	Mayo	14.976 k-in
Ae	0.42182 in <sup>2</sup>	Ixe	6.8473 in <sup>4</sup>	Iye	0.9845 in <sup>4</sup>
		Sxe(t)	1.5651 in <sup>3</sup>	Sye(l)	0.3469 in <sup>3</sup>
		Sxe(b)	1.8890 in <sup>3</sup>	Sye(r)	0.3499 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	34238 lb	Maxo	68.632 k-in	Mayo	13.825 k-in
		Ixe	6.7628 in <sup>4</sup>	Iye	0.9514 in <sup>4</sup>
		Sxe(t)	1.8054 in <sup>3</sup>	Sye(l)	0.3202 in <sup>3</sup>
		Sxe(b)	1.5897 in <sup>3</sup>	Sye(r)	0.3549 in <sup>3</sup>
Shear					
Vay	2351 lb				
Vax	5640 lb				



**Section Inputs**

---

Material: [Tested Purlins]  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E           29500 ksi  
 Yield Strength, Fy                 71.5 ksi  
 Tensile Strength, Fu               84.8 ksi  
 Warping Constant Override, Cw       0 in<sup>6</sup>  
 Torsion Constant Override, J        0 in<sup>4</sup>

Z-Section, Thickness 0.059 in  
 Placement of Part from Origin:  
 X to center of gravity               0 in  
 Y to center of gravity               0 in

Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	0.9410	-50.000	0.25000	None	0.000	0.0000	0.4705

**Full Section Properties**

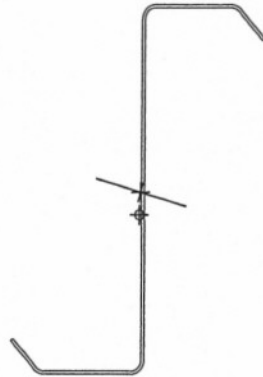
Area	0.82220 in <sup>2</sup>	Wt.	2.7955 lb/ft	Width	13.936 in
Ix	7.7371 in <sup>4</sup>	rx	3.0676 in	Ixy	2.1123 in <sup>4</sup>
Sx(t)	1.9004 in <sup>3</sup>	y(t)	4.0712 in	α	-16.250 deg
Sx(b)	1.9693 in <sup>3</sup>	y(b)	3.9288 in		
		Height	8.0000 in		
Iy	1.1057 in <sup>4</sup>	ry	1.1597 in	Xo	-0.0242 in
Sy(l)	0.3820 in <sup>3</sup>	x(l)	2.8944 in	Yo	-0.4861 in
Sy(r)	0.4012 in <sup>3</sup>	x(r)	2.7563 in	jx	-0.0586 in
		Width	5.6507 in	jy	0.5195 in
I1	8.3528 in <sup>4</sup>	r1	3.1873 in		
I2	0.4900 in <sup>4</sup>	r2	0.7720 in		
Ic	8.8429 in <sup>4</sup>	rc	3.2795 in	Cw	12.592 in <sup>6</sup>
Io	9.0376 in <sup>4</sup>	ro	3.3154 in	J	0.000954 in <sup>4</sup>

**Fully Braced Strength - 2001 AISI Specification - US (ASD)**

Compression		Positive Moment		Positive Moment	
Pao	17185 lb	Maxo	68.850 k-in	Mayo	15.169 k-in
Ae	0.43262 in <sup>2</sup>	Ixe	7.0032 in <sup>4</sup>	Iye	1.0068 in <sup>4</sup>
		Sxe(t)	1.6081 in <sup>3</sup>	Sye(l)	0.3543 in <sup>3</sup>
		Sxe(b)	1.9213 in <sup>3</sup>	Sye(r)	0.3584 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	34861 lb	Maxo	70.035 k-in	Mayo	13.888 k-in
		Ixe	6.9220 in <sup>4</sup>	Iye	0.9638 in <sup>4</sup>
		Sxe(t)	1.8369 in <sup>3</sup>	Sye(l)	0.3244 in <sup>3</sup>
		Sxe(b)	1.6358 in <sup>3</sup>	Sye(r)	0.3597 in <sup>3</sup>
Shear					
Vay	2476 lb				
Vax	5685 lb				

Section: 8x2.5Z14 Gravity Calculated.sct  
 8 x 2.5 Z 14 Gage  
 LGSI Library  
 Rev. Date: 4/2/2008 3:34:22 PM  
 By: Brandon Jasek

Brandon Jasek  
 Force Engineering & Testing  
 8x2.5Z14 Gravity Calculated



**Section Inputs**

---

Material: A1011 HSLAS Grade 55/2  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E 29500 ksi  
 Yield Strength, Fy 57 ksi  
 Tensile Strength, Fu 65 ksi  
 Warping Constant Override, Cw 0 in<sup>6</sup>  
 Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.0705 in

Placement of Part from Origin:

X to center of gravity 0 in

Y to center of gravity 0 in

Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	0.9605	-50.000	0.25000	None	0.000	0.0000	0.4803
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	0.9605	-50.000	0.25000	None	0.000	0.0000	0.4803



Full Section Properties

Area	0.98243 in <sup>2</sup>	Wt.	3.3403 lb/ft	Width	13.935 in
Ix	9.214 in <sup>4</sup>	rx	3.0624 in	Ixy	2.527 in <sup>4</sup>
Sx(t)	2.2632 in <sup>3</sup>	y(t)	4.0711 in	α	-16.329 deg
Sx(b)	2.3451 in <sup>3</sup>	y(b)	3.9289 in		
		Height	8.0000 in		
Iy	1.329 in <sup>4</sup>	ry	1.1629 in	Xo	-0.0244 in
Sy(l)	0.4579 in <sup>3</sup>	x(l)	2.9011 in	Yo	-0.4853 in
Sy(r)	0.4808 in <sup>3</sup>	x(r)	2.7632 in	jx	-0.0578 in
		Width	5.6643 in	jy	0.5187 in
I1	9.954 in <sup>4</sup>	r1	3.1831 in		
I2	0.588 in <sup>4</sup>	r2	0.7737 in		
Ic	10.542 in <sup>4</sup>	rc	3.2758 in	Cw	15.103 in <sup>6</sup>
Io	10.774 in <sup>4</sup>	ro	3.3116 in	J	0.001628 in <sup>4</sup>

Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	19873 lb	Maxo	75.801 k-in	Mayo	15.266 k-in
Ae	0.62756 in <sup>2</sup>	Ixe	9.1076 in <sup>4</sup>	Iye	1.2913 in <sup>4</sup>
		Sxe(t)	2.2208 in <sup>3</sup>	Sye(l)	0.4473 in <sup>3</sup>
		Sxe(b)	2.3359 in <sup>3</sup>	Sye(r)	0.4650 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	31929 lb	Maxo	76.287 k-in	Mayo	15.001 k-in
		Ixe	8.9498 in <sup>4</sup>	Iye	1.2823 in <sup>4</sup>
		Sxe(t)	2.2398 in <sup>3</sup>	Sye(l)	0.4395 in <sup>3</sup>
		Sxe(b)	2.2351 in <sup>3</sup>	Sye(r)	0.4669 in <sup>3</sup>
Shear					
Vay	4237 lb				
Vax	5365 lb				

Section: 8x2.5Z12 Gravity Calculated.sct

Brandon Jasek

8 x 2.5 Z 12 Gage

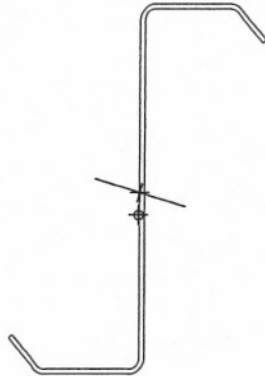
Force Engineering &amp; Testing

LGSI Library

8x2.5Z12 Gravity Calculated

Rev. Date: 4/2/2008 3:37:40 PM

By: Brandon Jasek



### Section Inputs

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Material: A1011 HSLAS Grade 55/2

No strength increase from cold work of forming.

Modulus of Elasticity, E 29500 ksi

Yield Strength, Fy 57 ksi

Tensile Strength, Fu 65 ksi

Warping Constant Override, Cw 0 in<sup>6</sup>Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.105 in

Placement of Part from Origin:

X to center of gravity 0 in

Y to center of gravity 0 in

Outside dimensions, Open shape

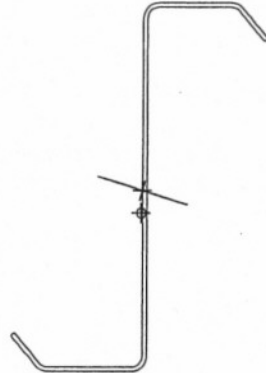
	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100

**Full Section Properties**

Area	1.4633 in <sup>2</sup>	Wt.	4.9752 lb/ft	Width	13.936 in
Ix	13.583 in <sup>4</sup>	rx	3.0467 in	Ixy	3.778 in <sup>4</sup>
Sx(t)	3.3367 in <sup>3</sup>	y(t)	4.0708 in	α	-16.575 deg
Sx(b)	3.4570 in <sup>3</sup>	y(b)	3.9292 in		
		Height	8.0000 in		
Iy	2.013 in <sup>4</sup>	ry	1.1728 in	Xo	-0.0249 in
Sy(l)	0.6889 in <sup>3</sup>	x(l)	2.9216 in	Yo	-0.4830 in
Sy(r)	0.7228 in <sup>3</sup>	x(r)	2.7847 in	jx	-0.0555 in
		Width	5.7063 in	jy	0.5161 in
I1	14.708 in <sup>4</sup>	r1	3.1704 in		
I2	0.888 in <sup>4</sup>	r2	0.7791 in		
Ic	15.596 in <sup>4</sup>	rc	3.2647 in	Cw	22.761 in <sup>6</sup>
Io	15.938 in <sup>4</sup>	ro	3.3003 in	J	0.005378 in <sup>4</sup>

**Fully Braced Strength - 2001 AISI Specification - US (ASD)**

Compression		Positive Moment		Positive Moment	
Pao	35129 lb	Maxo	113.89 k-in	Mayo	23.51 k-in
Ae	1.1093 in <sup>2</sup>	Ixe	13.583 in <sup>4</sup>	Iye	2.013 in <sup>4</sup>
		Sxe(t)	3.3367 in <sup>3</sup>	Sye(l)	0.6889 in <sup>3</sup>
		Sxe(b)	3.4570 in <sup>3</sup>	Sye(r)	0.7228 in <sup>3</sup>
		Negative Moment		Negative Moment	
		Maxo	113.89 k-in	Mayo	23.51 k-in
		Ixe	13.583 in <sup>4</sup>	Iye	2.013 in <sup>4</sup>
		Sxe(t)	3.3367 in <sup>3</sup>	Sye(l)	0.6889 in <sup>3</sup>
		Sxe(b)	3.4570 in <sup>3</sup>	Sye(r)	0.7228 in <sup>3</sup>
Tension					
Ta	47557 lb				
Shear					
Vay	12389 lb				
Vax	7763 lb				



### Section Inputs

---

Material: [Tested]  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E 29500 ksi  
 Yield Strength, Fy 64.4 ksi  
 Tensile Strength, Fu 74.1 ksi  
 Warping Constant Override, Cw 0 in<sup>6</sup>  
 Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.101 in  
 Placement of Part from Origin:  
 X to center of gravity 0 in  
 Y to center of gravity 0 in  
 Outside dimensions, Open shape

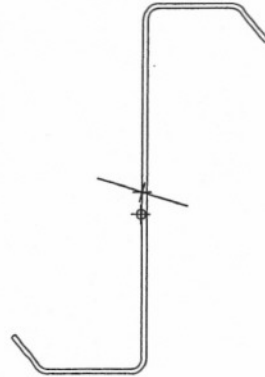
	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100

Full Section Properties

Area	1.4089 in <sup>2</sup>	Wt.	4.7904 lb/ft	Width	13.950 in
Ix	13.096 in <sup>4</sup>	rx	3.0487 in	Ixy	3.645 in <sup>4</sup>
Sx(t)	3.2170 in <sup>3</sup>	y(t)	4.0708 in	$\alpha$	-16.587 deg
Sx(b)	3.3329 in <sup>3</sup>	y(b)	3.9292 in		
		Height	8.0000 in		
Iy	1.943 in <sup>4</sup>	ry	1.1744 in	Xo	-0.0249 in
Sy(l)	0.6647 in <sup>3</sup>	x(l)	2.9236 in	Yo	-0.4826 in
Sy(r)	0.6973 in <sup>3</sup>	x(r)	2.7867 in	jx	-0.0554 in
		Width	5.7103 in	jy	0.5156 in
I1	14.181 in <sup>4</sup>	r1	3.1726 in		
I2	0.857 in <sup>4</sup>	r2	0.7801 in		
Ic	15.039 in <sup>4</sup>	rc	3.2671 in	Cw	22.000 in <sup>6</sup>
Io	15.368 in <sup>4</sup>	ro	3.3026 in	J	0.004791 in <sup>4</sup>

Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	37047 lb	Maxo	124.06 k-in	Mayo	25.63 k-in
Ae	1.0355 in <sup>2</sup>	Ixe	13.096 in <sup>4</sup>	Iye	1.943 in <sup>4</sup>
		Sxe(t)	3.2170 in <sup>3</sup>	Sye(l)	0.6647 in <sup>3</sup>
		Sxe(b)	3.3329 in <sup>3</sup>	Sye(r)	0.6973 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	52201 lb	Maxo	124.06 k-in	Mayo	25.63 k-in
		Ixe	13.096 in <sup>4</sup>	Iye	1.943 in <sup>4</sup>
		Sxe(t)	3.2170 in <sup>3</sup>	Sye(l)	0.6647 in <sup>3</sup>
		Sxe(b)	3.3329 in <sup>3</sup>	Sye(r)	0.6973 in <sup>3</sup>
Shear					
Vay	12184 lb				
Vax	8465 lb				



### Section Inputs

---

Material: [Tested]  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E 29500 ksi  
 Yield Strength, Fy 63.1 ksi  
 Tensile Strength, Fu 74.2 ksi  
 Warping Constant Override, Cw 0 in<sup>6</sup>  
 Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.102 in

Placement of Part from Origin:

X to center of gravity 0 in

Y to center of gravity 0 in

Outside dimensions, Open shape

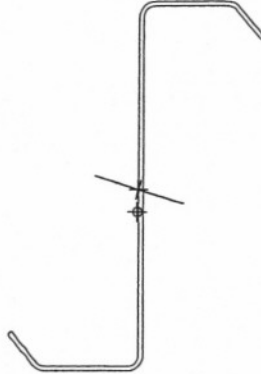
	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100

### Full Section Properties

Area	1.4225 in <sup>2</sup>	Wt.	4.8366 lb/ft	Width	13.946 in
Ix	13.218 in <sup>4</sup>	rx	3.0482 in	Ixy	3.679 in <sup>4</sup>
Sx(t)	3.2470 in <sup>3</sup>	y(t)	4.0708 in	$\alpha$	-16.584 deg
Sx(b)	3.3640 in <sup>3</sup>	y(b)	3.9292 in		
		Height	8.0000 in		
Iy	1.961 in <sup>4</sup>	ry	1.1740 in	Xo	-0.0249 in
Sy(l)	0.6708 in <sup>3</sup>	x(l)	2.9231 in	Yo	-0.4827 in
Sy(r)	0.7037 in <sup>3</sup>	x(r)	2.7862 in	jx	-0.0554 in
		Width	5.7093 in	jy	0.5157 in
I1	14.313 in <sup>4</sup>	r1	3.1720 in		
I2	0.865 in <sup>4</sup>	r2	0.7798 in		
Ic	15.178 in <sup>4</sup>	rc	3.2665 in	Cw	22.191 in <sup>6</sup>
Io	15.511 in <sup>4</sup>	ro	3.3021 in	J	0.004933 in <sup>4</sup>

### Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	36876 lb	Maxo	122.68 k-in	Mayo	25.34 k-in
Ae	1.0519 in <sup>2</sup>	Ixe	13.218 in <sup>4</sup>	Iye	1.961 in <sup>4</sup>
		Sxe(t)	3.2470 in <sup>3</sup>	Sye(l)	0.6708 in <sup>3</sup>
		Sxe(b)	3.3640 in <sup>3</sup>	Sye(r)	0.7037 in <sup>3</sup>
Tension		Negative Moment		Negative Moment	
Ta	52776 lb	Maxo	122.68 k-in	Mayo	25.34 k-in
		Ixe	13.218 in <sup>4</sup>	Iye	1.961 in <sup>4</sup>
		Sxe(t)	3.2470 in <sup>3</sup>	Sye(l)	0.6708 in <sup>3</sup>
		Sxe(b)	3.3640 in <sup>3</sup>	Sye(r)	0.7037 in <sup>3</sup>
Shear					
Vay	12301 lb				
Vax	8370 lb				



### Section Inputs

---

Material: [Tested]  
 No strength increase from cold work of forming.  
 Modulus of Elasticity, E 29500 ksi  
 Yield Strength, Fy 64.8 ksi  
 Tensile Strength, Fu 74.6 ksi  
 Warping Constant Override, Cw 0 in<sup>6</sup>  
 Torsion Constant Override, J 0 in<sup>4</sup>

Z-Section, Thickness 0.101 in  
 Placement of Part from Origin:  
 X to center of gravity 0 in  
 Y to center of gravity 0 in  
 Outside dimensions, Open shape

	Length (in)	Angle (deg)	Radius (in)	Web	k Coef.	Hole Size (in)	Distance (in)
1	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100
2	2.3750	0.000	0.25000	Single	0.000	0.0000	1.1875
3	8.0000	90.000	0.25000	Zee	0.000	0.0000	4.0000
4	2.1250	0.000	0.25000	Single	0.000	0.0000	1.0625
5	1.0200	-50.000	0.25000	None	0.000	0.0000	0.5100



Full Section Properties

Area	1.4089 in <sup>2</sup>	Wt.	4.7904 lb/ft	Width	13.950 in
Ix	13.096 in <sup>4</sup>	rx	3.0487 in	Ixy	3.645 in <sup>4</sup>
Sx(t)	3.2170 in <sup>3</sup>	y(t)	4.0708 in	α	-16.587 deg
Sx(b)	3.3329 in <sup>3</sup>	y(b)	3.9292 in		
		Height	8.0000 in		
Iy	1.943 in <sup>4</sup>	ry	1.1744 in	Xo	-0.0249 in
Sy(l)	0.6647 in <sup>3</sup>	x(l)	2.9236 in	Yo	-0.4826 in
Sy(r)	0.6973 in <sup>3</sup>	x(r)	2.7867 in	jx	-0.0554 in
		Width	5.7103 in	jy	0.5156 in
I1	14.181 in <sup>4</sup>	r1	3.1726 in		
I2	0.857 in <sup>4</sup>	r2	0.7801 in		
Ic	15.039 in <sup>4</sup>	rc	3.2671 in	Cw	22.000 in <sup>6</sup>
Io	15.368 in <sup>4</sup>	ro	3.3026 in	J	0.004791 in <sup>4</sup>

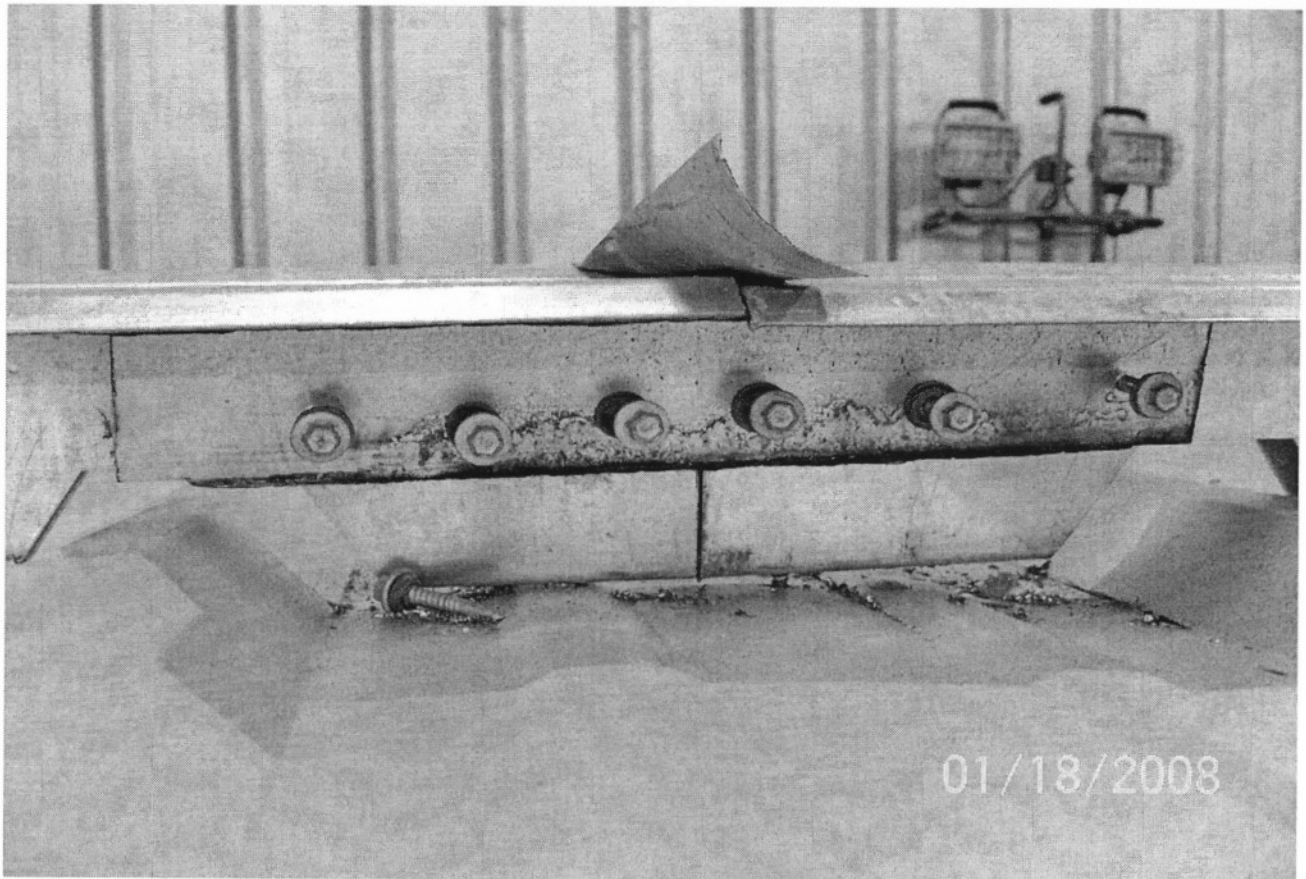
Fully Braced Strength - 2001 AISI Specification - US (ASD)

Compression		Positive Moment		Positive Moment	
Pao	37243 lb	Maxo	124.83 k-in	Mayo	25.79 k-in
Ae	1.0345 in <sup>2</sup>	Ixe	13.096 in <sup>4</sup>	Iye	1.943 in <sup>4</sup>
		Sxe(t)	3.2170 in <sup>3</sup>	Sye(l)	0.6647 in <sup>3</sup>
		Sxe(b)	3.3329 in <sup>3</sup>	Sye(r)	0.6973 in <sup>3</sup>
		Negative Moment		Negative Moment	
		Maxo	124.83 k-in	Mayo	25.79 k-in
		Ixe	13.096 in <sup>4</sup>	Iye	1.943 in <sup>4</sup>
		Sxe(t)	3.2170 in <sup>3</sup>	Sye(l)	0.6647 in <sup>3</sup>
		Sxe(b)	3.3329 in <sup>3</sup>	Sye(r)	0.6973 in <sup>3</sup>
Tension					
Ta	52553 lb				
Shear					
Vay	12222 lb				
Vax	8518 lb				

## Photos



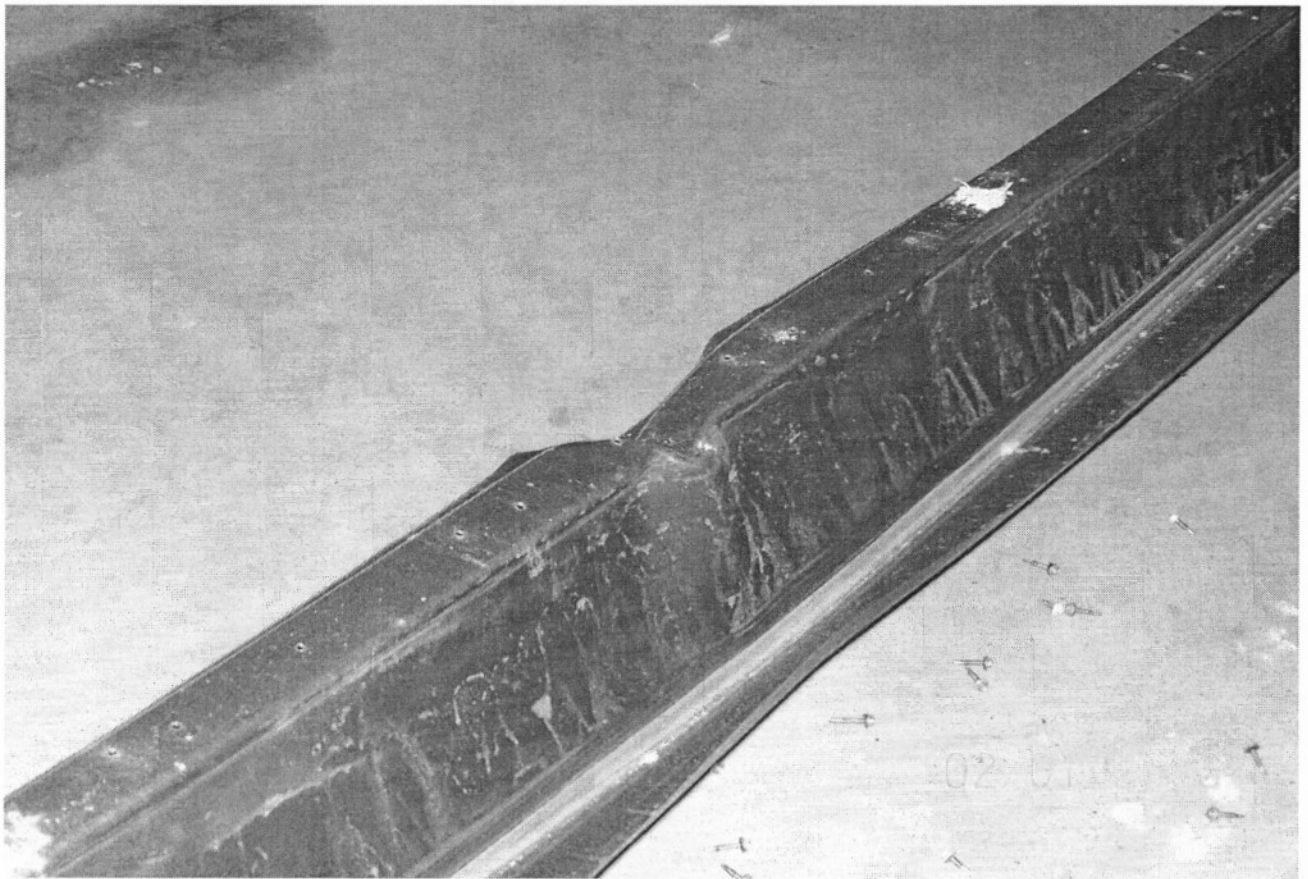
**TYPICAL TEST SET UP**



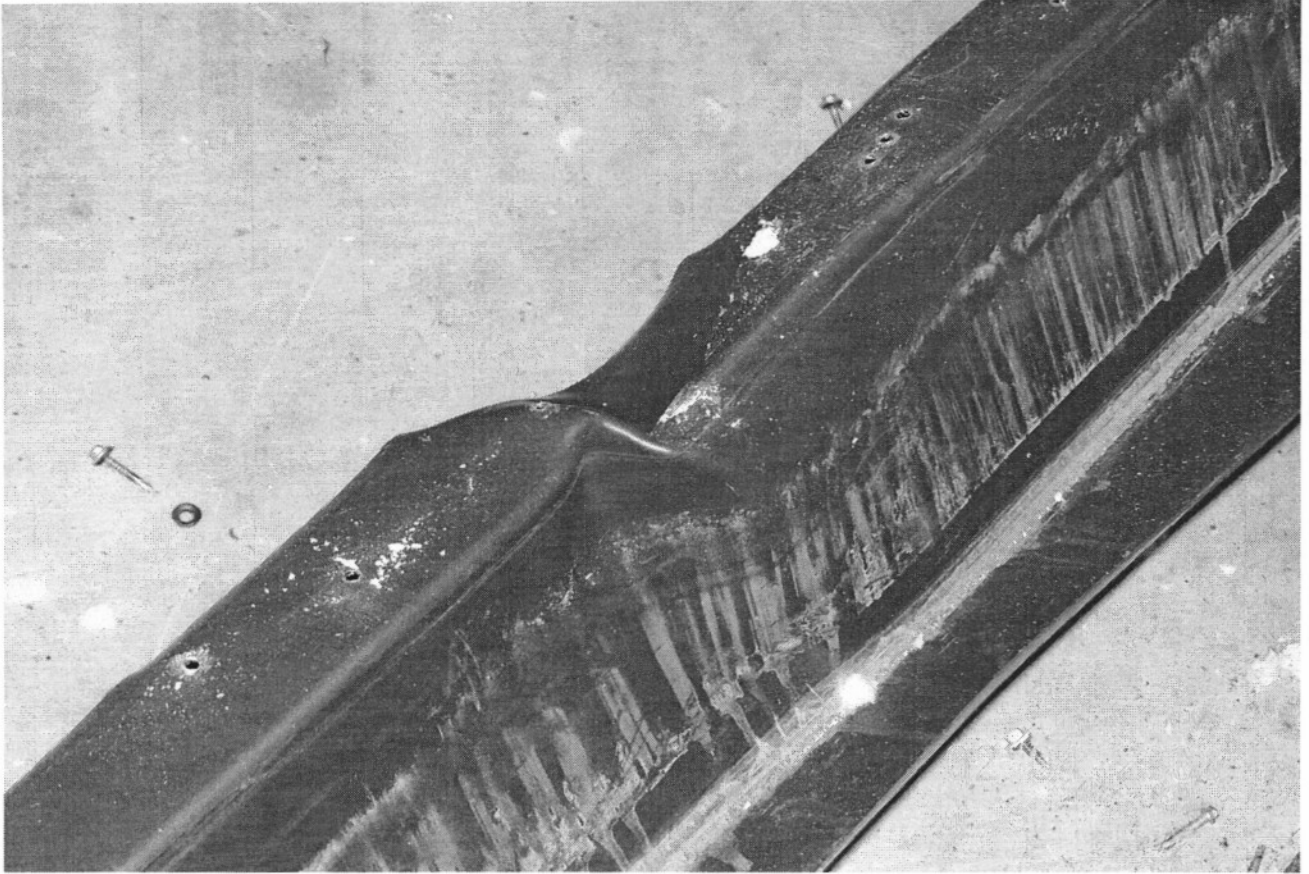
**TYPICAL TOPHAT SPLICE**



**8X2.5ZEE 16 GA. TEST #1 FAILURE**



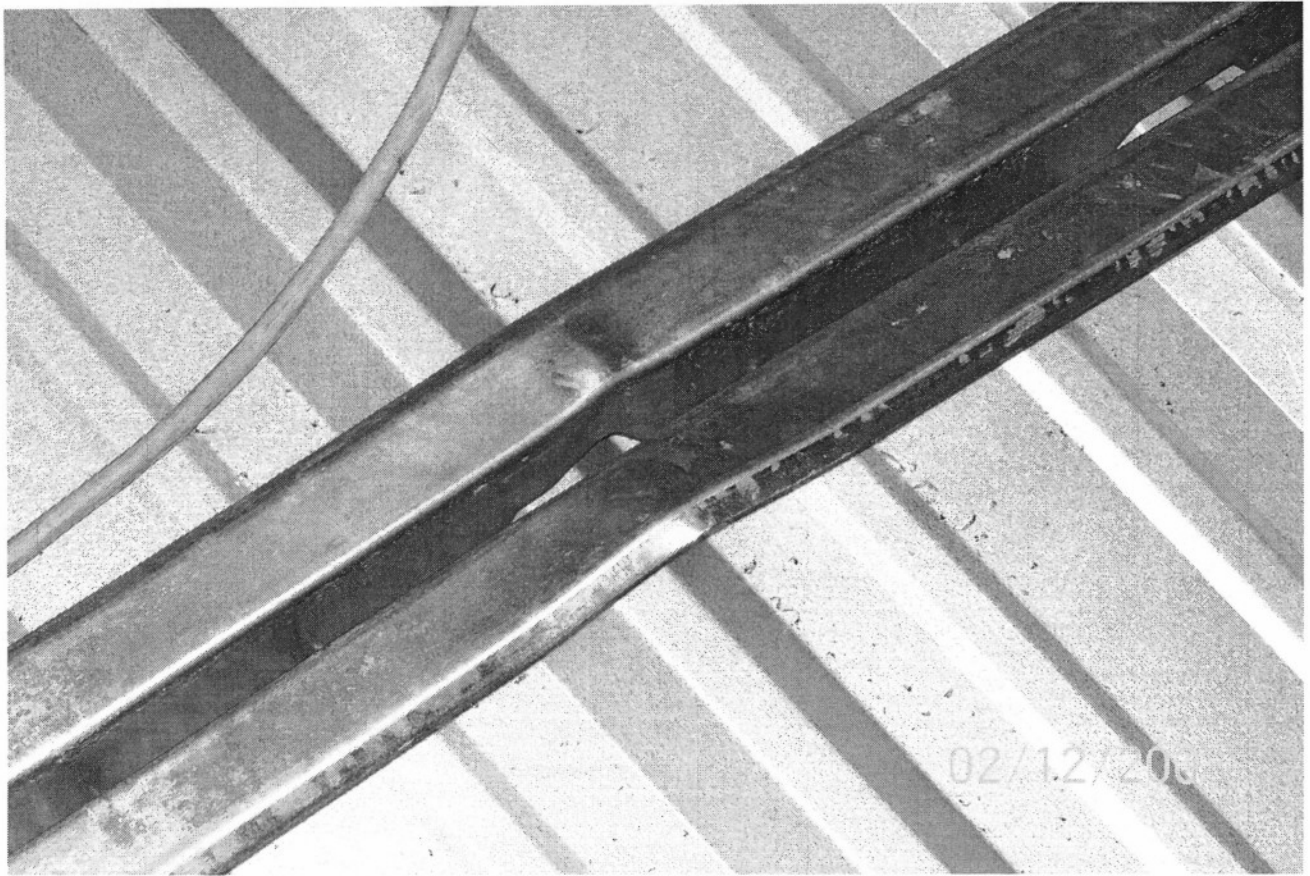
**8X2.5ZEE 16 GA. TEST #2 FAILURE**



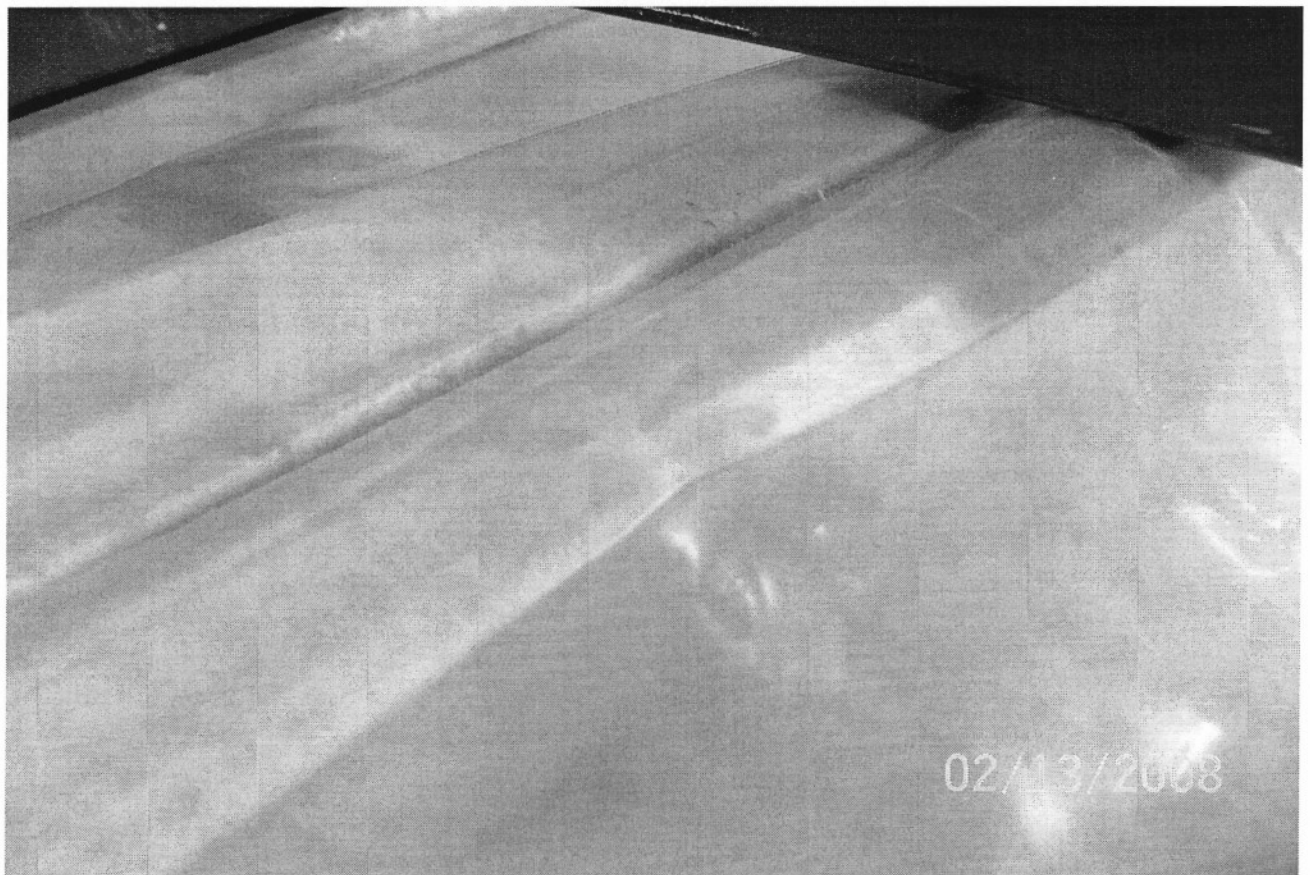
**8X2.5ZEE 16 GA. TEST #3 FAILURE**



**8X2.5ZEE 12 GA. TEST #1 FAILURE**



**8X2.5ZEE 12 GA. TEST #2 FAILURE**



**8X2.5ZEE 12 GA. TEST #3 FAILURE**