



Force Engineering & Testing Inc.

19530 Ramblewood Drive
Humble, Texas 77338
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Project Number : 13-0459T-08A-C

Test Report Date : March 3, 2009

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

Test Procedure : AISI Uplift Load Base Test

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

Miami Dade County Lab Certification No: 05-1122.13

16 GA. REG TOPHAT UPLIFT TEST

Report Prepared by:

Brandon Jasek, P.E.

Report Reviewed by:

Terrence E. Wolfe, P.E.

Project Number : 13-0459T-08A-C

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 uplift loading.

TEST DATES:

December - January 2009

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 1/4" tall Corrugations.

Panel Fastener: #12-14 x 1" HWH @ 12"-12"-12" Fastener Pattern
1/4-14 x 7/8" Lap Tek @ 20" O.C. in panel side lap

Panel Length: 7'-0"

Purlin: 8" x 2.5" ZEE 16 Ga.

Purlin Length: 25'-7 1/2", Span = 25'-0"

Tophat Manufacturer

Manufacturer: TopHat Framing Systems
8660 Lambright
Houston, TX 77075

Tophat: 16 Ga. Regular Strength, 3 1/2" Tall Hat section w/ R Panel punch out pattern, 0.056" Material Thickness, Fy = 41.9 ksi (Per Tensile Test See Appendix)

Tophat Fastener: (2) #12-14 x 1-1/4" HWH per foot

Tophat Length: 25'-0", No Splice

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".

Project Number : 13-0459T-08A-C

INTRODUCTION:

The purpose of this test series was to obtain the moment reduction factor used in determining the nominal flexural strength of a purlin in negative bending supporting a through fastened panel system with a tophat added. The moment reduction 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.
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 positive 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 purlins.

RESULTS/CONCLUSIONS:

The 8x2.5 x 16 Ga. Zee failed at 29.73 psf, 27.51 psf and 29.02 psf. The mode of failure was buckling of the purlin bottom stiffener lip in all three tests. From the calculation page, the modification factor $R = 0.768$.

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.



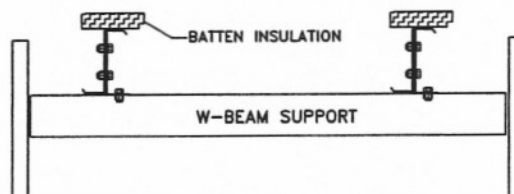
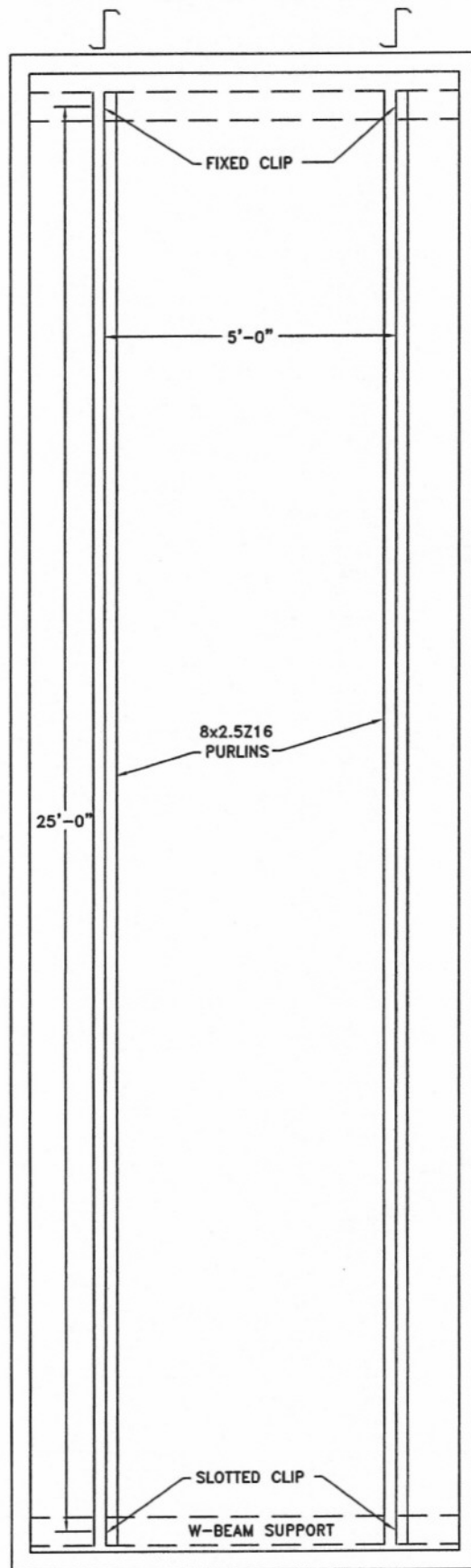
STATEMENT OF INDEPENDENCE:

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

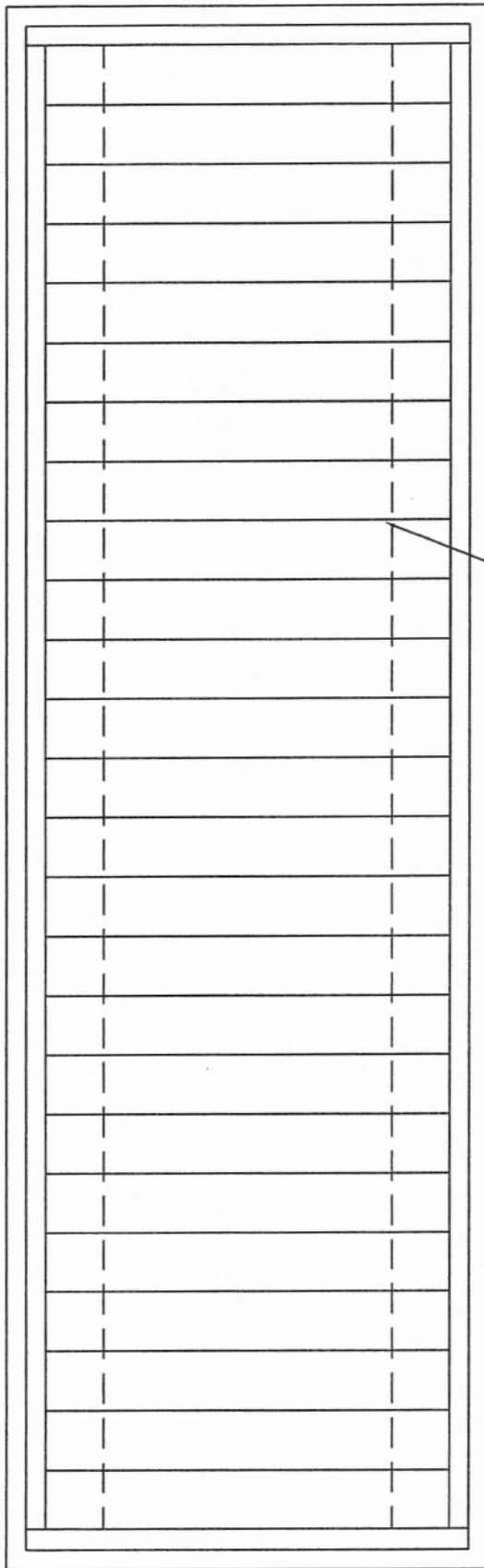
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Appendix

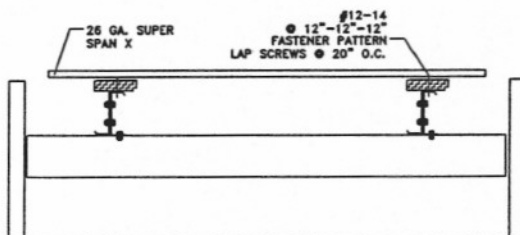
PURLIN LAYOUT



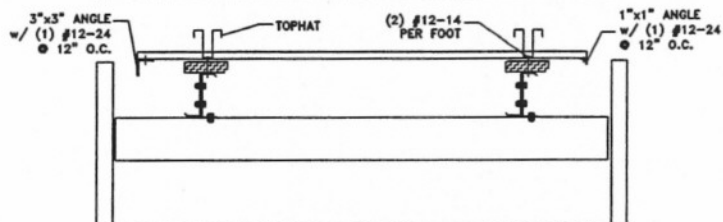
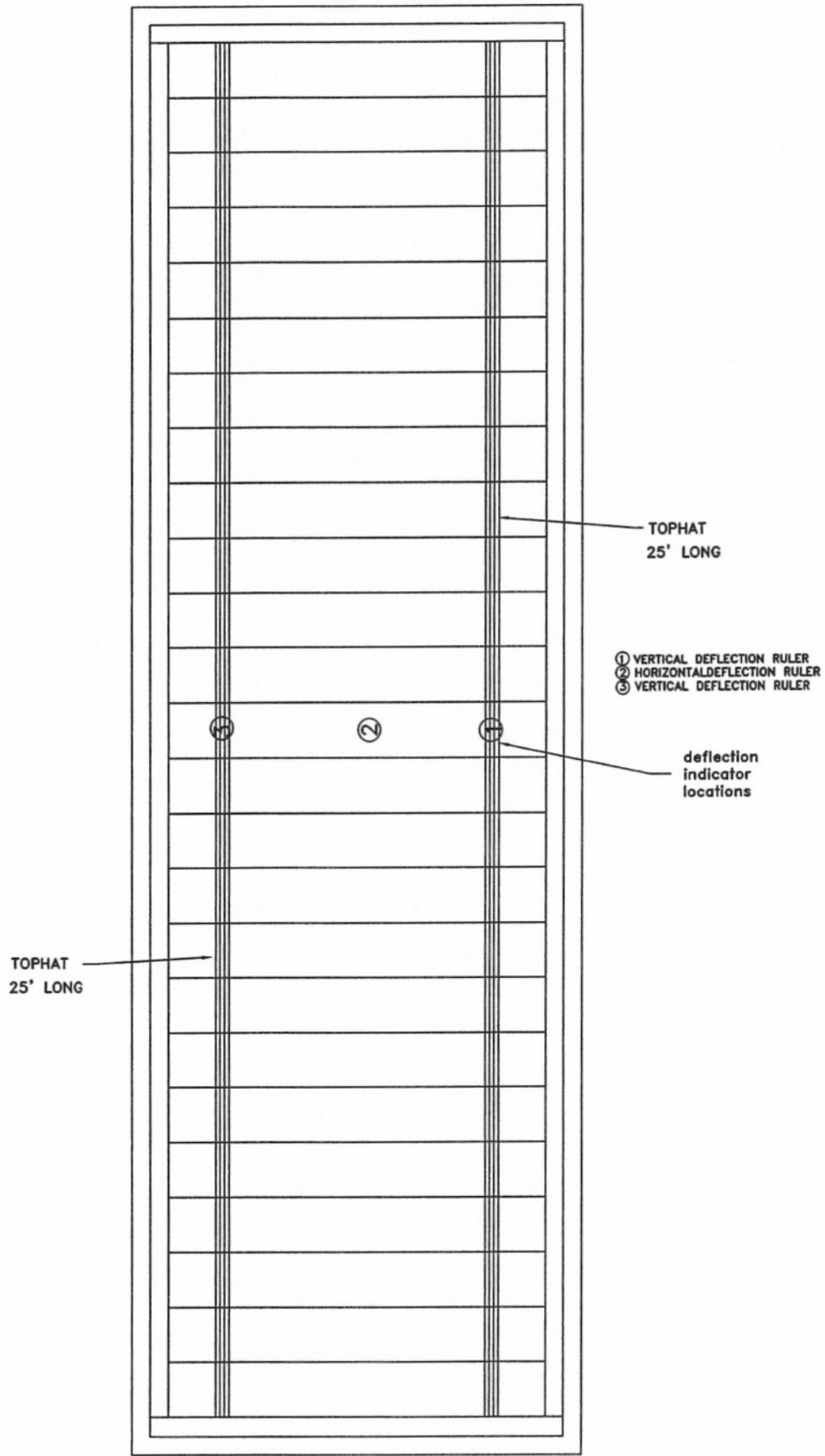
PANEL LAYOUT



26 GA. SUPER SPAN X PANEL



TOPHAT LAYOUT





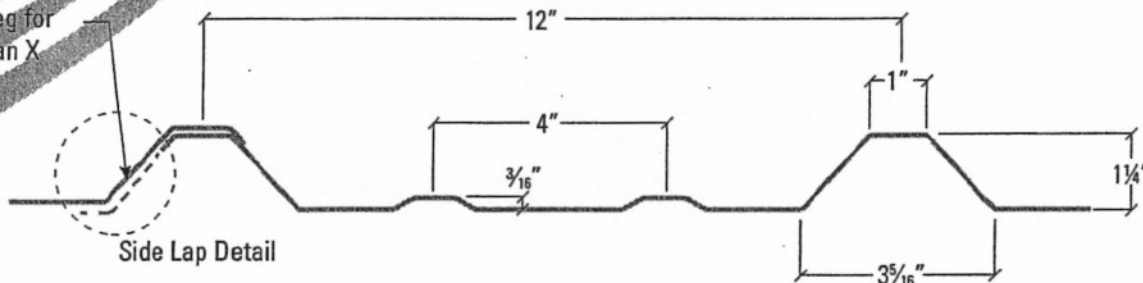
WHIRLWIND BUILDING COMPONENTS

Corporate Headquarters • 8234 Hansen Rd, Houston, TX 77075
 (Phone) 713.946.7140 | (Fax) 832.553.4700 | (US Wats) 800.324.9992

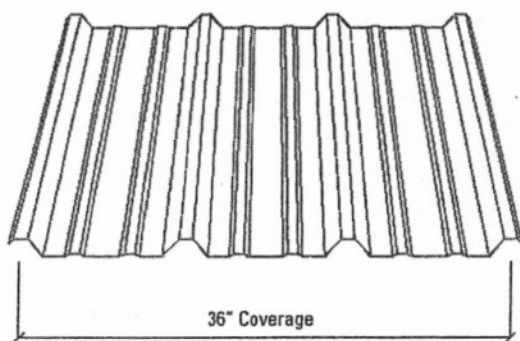


SUPER SPAN-X

Bearing leg for Super Span X



Side Lap Detail



SUPER SPAN-X DESIGN PROPERTIES

| GAUGE/ THICKNESS | F _y (KSI) | F _b (KSI) | TOP IN COMPRESSION | | BOTTOM IN COMPRESSION | |
|---------------------|-------------------------|-------------------------|---|-------------------------------|---|-------------------------------|
| | | | I _x (In ⁴ -Ft) | M _a (Kip-In/Ft) | I _x (In ⁴ -Ft) | M _a (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_y 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:

- All section properties are calculated in accordance with the 2001 edition of the North American Specification For Design Of Cold-Formed Steel Structural Members.
- I_x is for deflection determination.
- M_x 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

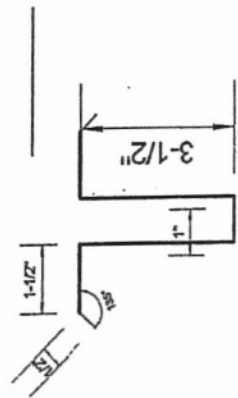
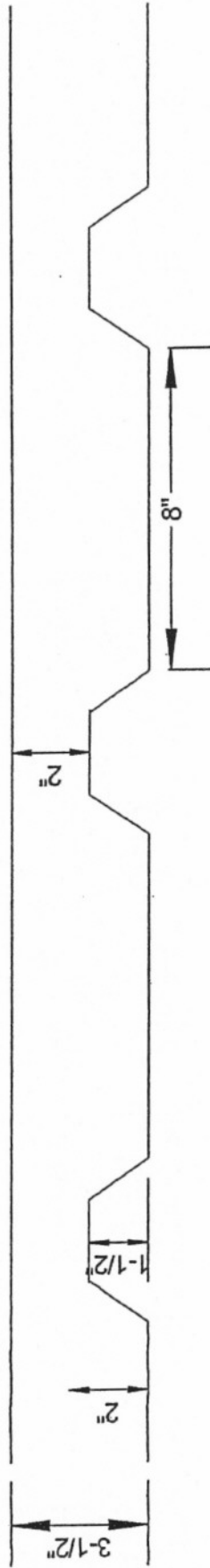
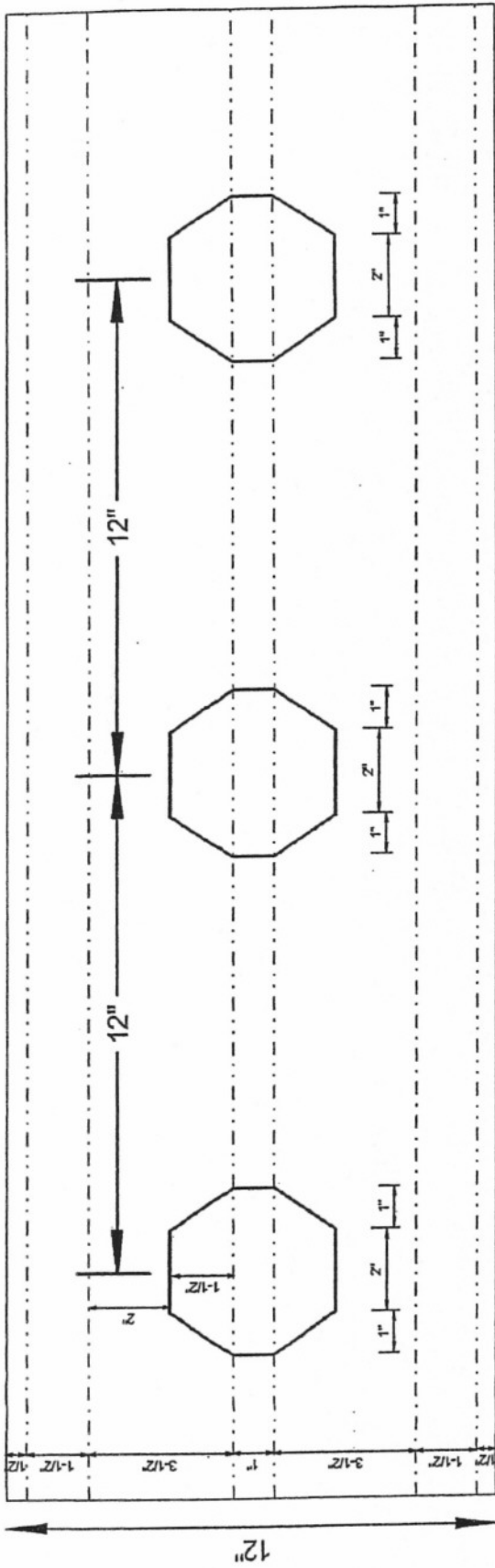
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(866) 922-2216

Freeport, MN
(888) 836-7203



MTEC
MECHANICAL
TESTING
SERVICES

ISO 9001-2000

CERTIFICATE OF TEST

ATTENTION : BRANDON JASEK
CUSTOMER : FORCE ENGINEERING & TESTING INC.
19530 RAMBLEWOOD DR
HUMBLE, TX 77338

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0901582

DATE : 02/12/09 12:14:16
PO NO :13-0459T-08
SPECIMEN :16RTP

TEST DATA

REDUCED SECTION TENSILE

| UTS PSI | YS.2%PSI | %EL | %RA | WIDTH | THICK | AREA IN. |
|---------|----------|-------|-------|-------|-------|----------|
| 54,500 | 41,900 | 37.80 | 59.10 | 0.502 | 0.056 | 0.028 |


MTEC Representative

Data Sheets

Base Test Deflection Readings

Project #: 13-0459T-08A
Test: Uplift 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: 16 ga. Reg Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1-1/4" Per foot
Date: 12/4/2008

| LOAD (psf) | Vertical Deflection of Purlin 1 (in) | Vertical Deflection of Purlin 2 (in) | Horizontal Deflection of Panel (in) |
|------------|--------------------------------------|--------------------------------------|-------------------------------------|
| 0.00 | 26.6875 | 26.5000 | 19.2500 |
| 3.00 | 26.7500 | 26.6875 | 19.2500 |
| 6.00 | 27.0000 | 26.8750 | 19.2500 |
| 9.00 | 27.2500 | 27.0000 | 19.2500 |
| 12.00 | 27.3750 | 27.1875 | 19.2500 |
| 15.00 | 27.6250 | 27.4375 | 19.2500 |
| 18.00 | 27.7500 | 27.5000 | 19.2500 |
| 21.00 | 28.0000 | 27.7500 | 19.3125 |
| 24.00 | 28.1875 | 27.8750 | 19.3125 |
| 27.00 | 28.5000 | 28.0625 | 19.3125 |
| 30.00 | FAILED @ 29.73 PSF | | |
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Ultimate Test Pressure: 29.73 psf
Mode of Failure: Purlin Bottom Lip Buckled

Base Test Deflection Readings

Project #: 13-0459T-08B
Test: Uplift 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: 16 ga. Reg Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1-1/4" Per foot
Date: 1/22/2009

| LOAD (psf) | Vertical Deflection of Purlin 1 (in) | Vertical Deflection of Purlin 2 (in) | Horizontal Deflection of Panel (in) |
|---------------|---|---|---|
| 0.00 | 25.1250 | 24.5000 | 19.3125 |
| 3.00 | 25.4375 | 24.6875 | 19.3125 |
| 6.00 | 25.5000 | 24.8125 | 19.3125 |
| 9.00 | 25.7500 | 24.9375 | 19.3125 |
| 12.00 | 26.0000 | 25.1250 | 19.3125 |
| 15.00 | 26.1875 | 25.3125 | 19.3125 |
| 18.00 | 26.3750 | 25.5000 | 19.3125 |
| 21.00 | 26.6250 | 25.6875 | 19.3125 |
| 24.00 | 26.8125 | 26.0000 | 19.3125 |
| 27.00 | FAILED @ 27.51 PSF | | |
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Ultimate Test Pressure: 27.51 psf
Mode of Failure: Purlin Bottom Lip Buckled

Base Test Deflection Readings

Project #: 13-0459T-08C
Test: Uplift 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: 16 ga. Reg Tophat over PBR panel, attached to Purlin w/ (2) #12-14 x 1-1/4" Per foot
Date: 1/22/2009

| LOAD (psf) | Vertical Deflection of Purlin 1 (in) | Vertical Deflection of Purlin 2 (in) | Horizontal Deflection of Panel (in) |
|------------|--------------------------------------|--------------------------------------|-------------------------------------|
| 0.00 | 24.1875 | 23.9375 | 19.1250 |
| 3.00 | 24.3750 | 24.0625 | 19.1250 |
| 6.00 | 24.5000 | 24.1875 | 19.1250 |
| 9.00 | 24.7500 | 24.3750 | 19.1250 |
| 12.00 | 24.8750 | 24.5625 | 19.1250 |
| 15.00 | 25.1250 | 24.7500 | 19.1250 |
| 18.00 | 25.3125 | 24.9375 | 19.1250 |
| 21.00 | 25.5000 | 25.1250 | 19.1875 |
| 24.00 | 25.7500 | 25.3125 | 19.1875 |
| 27.00 | 26.0000 | 25.5000 | 19.1875 |
| 30.00 | FAILED @ 29.02 PSF | | |
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Ultimate Test Pressure: 29.02 psf
Mode of Failure: Purlin Bottom Lip Buckled

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
 TOPHAT : 16 Ga. Reg Strength Tophat
 DESCRIPTION : 25'-0" Span Uplift Base Test

| | | | |
|-------------------|---------------------------------|--------|-----------------|
| #1 12-4-08 | 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 | 29.73 | psf |
| pd | weight of the specimen | 2.370 | psf |
| s | purlin tributary width | 3.500 | ft |
| Pl | lateral anchorage force | 12.00 | lbs/ft |
| wts | failure load | 95.76 | lbs/ft |
| L | purlin span | 25.00 | ft |
| Mts | failure moment | 89.78 | k-in |
| Set | section modulus of the specimen | 1.6839 | in ³ |
| Se | section modulus | 1.7701 | in ³ |
| Fy | design yield strength | 57.00 | ksi |
| Fyt | measured yield strength | 64.70 | ksi |
| Mn | nominal flexural strength | 100.90 | k-in |
| Mnt | flexural strength | 108.95 | k-in |
| Rt | modification factor | 0.8240 | |

| | | | |
|-------------------|---------------------------------|--------|-----------------|
| #2 1-22-09 | 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 | 27.51 | psf |
| pd | weight of the specimen | 2.370 | psf |
| s | purlin tributary width | 3.500 | ft |
| Pl | lateral anchorage force | 11.17 | lbs/ft |
| wts | failure load | 87.99 | lbs/ft |
| L | purlin span | 25.00 | ft |
| Mts | failure moment | 82.49 | k-in |
| Set | section modulus of the specimen | 1.6987 | in ³ |
| Se | section modulus | 1.7701 | in ³ |
| Fy | design yield strength | 57.00 | ksi |
| Fyt | measured yield strength | 63.50 | ksi |
| Mn | nominal flexural strength | 100.90 | k-in |
| Mnt | flexural strength | 107.87 | k-in |
| Rt | modification factor | 0.7647 | |

| | | | |
|-------------------|---------------------------------|--------|-----------------|
| #3 1-22-09 | 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 | 29.02 | psf |
| pd | weight of the specimen | 2.370 | psf |
| s | purlin tributary width | 3.500 | ft |
| Pl | lateral anchorage force | 11.73 | lbs/ft |
| wts | failure load | 93.28 | lbs/ft |
| L | purlin span | 25.00 | ft |
| Mts | failure moment | 87.45 | k-in |
| Set | section modulus of the specimen | 1.6876 | in ³ |
| Se | section modulus | 1.7701 | in ³ |
| Fy | design yield strength | 57.00 | ksi |
| Fyt | measured yield strength | 64.40 | ksi |
| Mn | nominal flexural strength | 100.90 | k-in |
| Mnt | flexural strength | 108.68 | k-in |
| Rt | modification factor | 0.8046 | |

| | |
|---------------------------|---------|
| AVERAGE Rt | 0.798 |
| STANDARD DEVIATION | 0.030 |
| Rt min. | 0.768 |
| Mnt min. | 108.499 |



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 in⁶
 Torsion Constant Override, J 0 in⁴

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 | 2.1250 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.0625 |
| 3 | 8.0000 | 90.000 | 0.25000 | Zee | 0.000 | 0.0000 | 4.0000 |
| 4 | 2.3750 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.1875 |
| 5 | 0.9410 | -50.000 | 0.25000 | None | 0.000 | 0.0000 | 0.4705 |

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

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

Section: 16 Ga. Reg Test 1.sct

Brandon Jasek

8 x 2.5 Z 16 Gage

Force Engineering & Testing

LGS Library

16 Ga. Reg Test 1

Rev. Date: 2/26/2009 10:00:28 AM

By: Brandon Jasek



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 64.7 ksi
 Tensile Strength, Fu 75.9 ksi
 Warping Constant Override, Cw 0 in⁶
 Torsion Constant Override, J 0 in⁴

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 | 2.1250 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.0625 |
| 3 | 8.0000 | 90.000 | 0.25000 | Zee | 0.000 | 0.0000 | 4.0000 |
| 4 | 2.3750 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.1875 |
| 5 | 0.9410 | -50.000 | 0.25000 | None | 0.000 | 0.0000 | 0.4705 |

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

| Compression | | Positive Moment | | Positive Moment | |
|-------------|-------------------------|-----------------|------------------------|-----------------|------------------------|
| Pao | 16200 lb | Maxo | 66.459 k-in | Mayo | 13.041 k-in |
| Ae | 0.45068 in ² | Ixe | 7.1147 in ⁴ | Iye | 0.9944 in ⁴ |
| | | Sxe(t) | 1.7154 in ³ | Sye(l) | 0.3687 in ³ |
| | | Sxe(b) | 1.8468 in ³ | Sye(r) | 0.3366 in ³ |
| Tension | | Negative Moment | | Negative Moment | |
| Ta | 31202 lb | Maxo | 65.239 k-in | Mayo | 13.877 k-in |
| | | Ixe | 7.1945 in ⁴ | Iye | 1.0211 in ⁴ |
| Shear | | Sxe(t) | 1.9301 in ³ | Sye(l) | 0.3647 in ³ |
| Vay | 2476 lb | Sxe(b) | 1.6839 in ³ | Sye(r) | 0.3582 in ³ |
| Vax | 5145 lb | | | | |



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 63.5 ksi
 Tensile Strength, Fu 78 ksi
 Warping Constant Override, Cw 0 in⁶
 Torsion Constant Override, J 0 in⁴

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 | 2.1250 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.0625 |
| 3 | 8.0000 | 90.000 | 0.25000 | Zee | 0.000 | 0.0000 | 4.0000 |
| 4 | 2.3750 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.1875 |
| 5 | 0.9410 | -50.000 | 0.25000 | None | 0.000 | 0.0000 | 0.4705 |

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

| Compression | | Positive Moment | | Positive Moment | |
|-------------|-------------------------|-----------------|------------------------|-----------------|------------------------|
| Pao | 16021 lb | Maxo | 65.818 k-in | Mayo | 12.889 k-in |
| Ae | 0.45415 in ² | Ixe | 7.1517 in ⁴ | Iye | 1.0002 in ⁴ |
| | | Sxe(t) | 1.7310 in ³ | Sye(l) | 0.3705 in ³ |
| | | Sxe(b) | 1.8488 in ³ | Sye(r) | 0.3390 in ³ |
| Tension | | Negative Moment | | Negative Moment | |
| Ta | 31263 lb | Maxo | 64.590 k-in | Mayo | 13.647 k-in |
| | | Ixe | 7.2311 in ⁴ | Iye | 1.0237 in ⁴ |
| Shear | | Sxe(t) | 1.9319 in ³ | Sye(l) | 0.3658 in ³ |
| Vay | 2476 lb | Sxe(b) | 1.6987 in ³ | Sye(r) | 0.3589 in ³ |
| Vax | 5049 lb | | | | |



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 64.4 ksi
 Tensile Strength, Fu 75.5 ksi
 Warping Constant Override, Cw 0 in⁶
 Torsion Constant Override, J 0 in⁴

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 | 2.1250 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.0625 |
| 3 | 8.0000 | 90.000 | 0.25000 | Zee | 0.000 | 0.0000 | 4.0000 |
| 4 | 2.3750 | 0.000 | 0.25000 | Single | 0.000 | 0.0000 | 1.1875 |
| 5 | 0.9410 | -50.000 | 0.25000 | None | 0.000 | 0.0000 | 0.4705 |

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

| Compression | | Positive Moment | | Positive Moment | |
|-------------|-------------------------|-----------------|------------------------|-----------------|------------------------|
| Pao | 16155 lb | Maxo | 66.299 k-in | Mayo | 13.003 k-in |
| Ae | 0.45154 in ² | Ixe | 7.1238 in ⁴ | Iye | 0.9958 in ⁴ |
| | | Sxe (t) | 1.7192 in ³ | Sye (l) | 0.3692 in ³ |
| Tension | | Sxe (b) | 1.8473 in ³ | Sye (r) | 0.3372 in ³ |
| Ta | 31038 lb | Negative Moment | | Negative Moment | |
| | | Maxo | 65.077 k-in | Mayo | 13.819 k-in |
| Shear | | Ixe | 7.2036 in ⁴ | Iye | 1.0217 in ⁴ |
| Vay | 2476 lb | Sxe (t) | 1.9305 in ³ | Sye (l) | 0.3650 in ³ |
| Vax | 5121 lb | Sxe (b) | 1.6876 in ³ | Sye (r) | 0.3584 in ³ |

MTEC
MECHANICAL
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SERVICES

ISO 9001-2000

CERTIFICATE OF TEST

ATTENTION : BRANDON JASEK
CUSTOMER : FORCE ENGINEERING & TESTING INC.
19530 RAMBLEWOOD DR
HUMBLE, TX 77338

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0901576

DATE : 02/12/09 12:03:33
PO NO :13-0459T-08
SPECIMEN :16REGU1

TEST DATA

REDUCED SECTION TENSILE

| UTS PSI | YS.2%PSI | %EL | %RA | WIDTH | THICK | AREA IN. |
|---------|----------|-------|-------|-------|-------|----------|
| 75,900 | 64,700 | 16.20 | 51.90 | 0.501 | 0.059 | 0.030 |


MTEC Representative

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CERTIFICATE OF TEST

ATTENTION : BRANDON JASEK
CUSTOMER : FORCE ENGINEERING & TESTING INC.
19530 RAMBLEWOOD DR
HUMBLE, TX 77338

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0901577

DATE : 02/12/09 12:05:39
PO NO : 13-0459T-08
SPECIMEN : 16REGU2

TEST DATA

REDUCED SECTION TENSILE

| UTS PSI | YS.2%PSI | %EL | %RA | WIDTH | THICK | AREA IN. |
|---------|----------|-------|-------|-------|-------|----------|
| 78,000 | 63,500 | 15.60 | 62.40 | 0.502 | 0.059 | 0.030 |


MTEC Representative

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CERTIFICATE OF TEST

ATTENTION : BRANDON JASEK
CUSTOMER : FORCE ENGINEERING & TESTING INC.
19530 RAMBLEWOOD DR
HUMBLE, TX 77338

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0901578

DATE : 02/12/09 12:06:34
PO NO :13-0459T-08
SPECIMEN :16REGU3

TEST DATA

REDUCED SECTION TENSILE

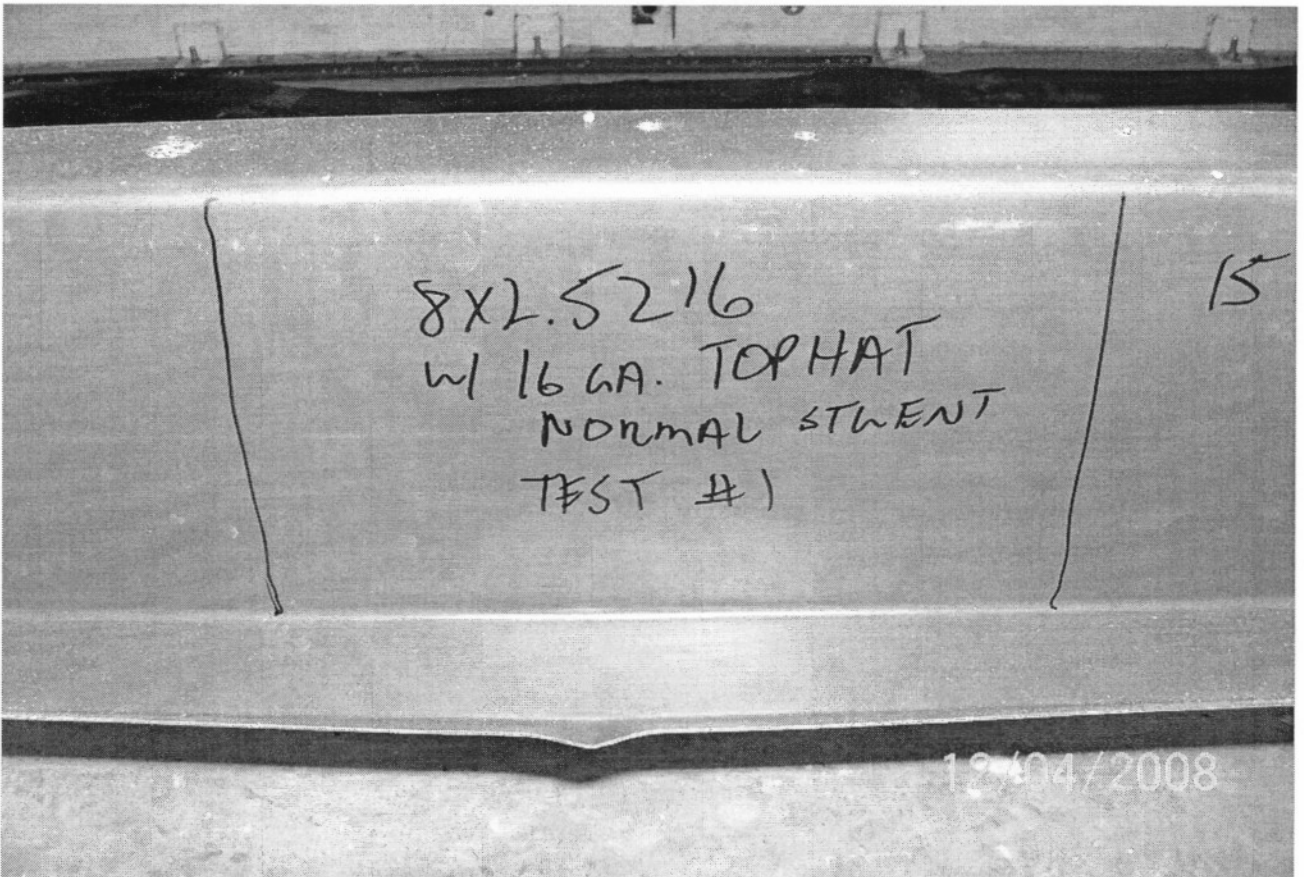
| UTS PSI | YS.2%PSI | %EL | %RA | WIDTH | THICK | AREA IN. |
|---------|----------|-------|-------|-------|-------|----------|
| 75,500 | 64,400 | 18.60 | 61.10 | 0.503 | 0.059 | 0.030 |


MTEC Representative

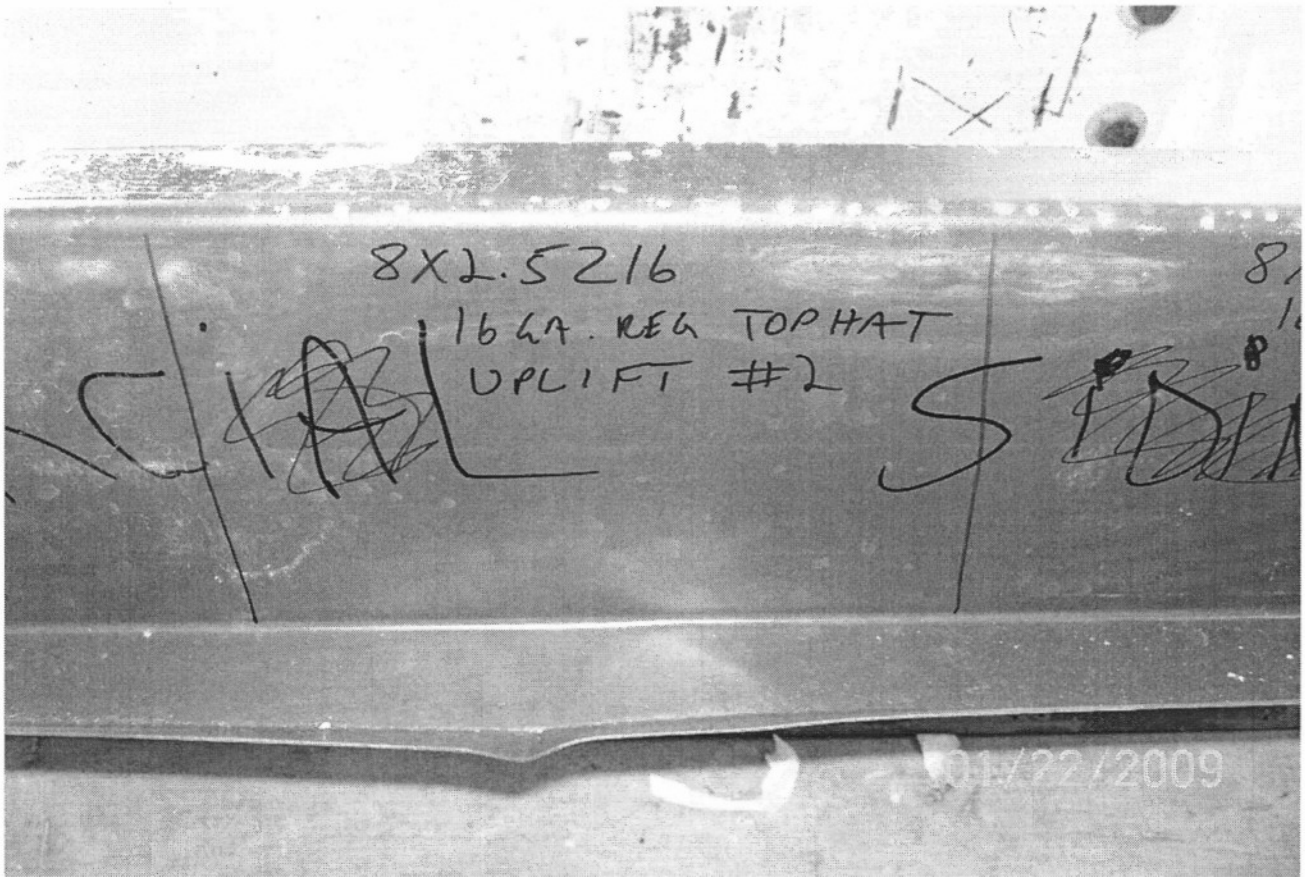
Photos



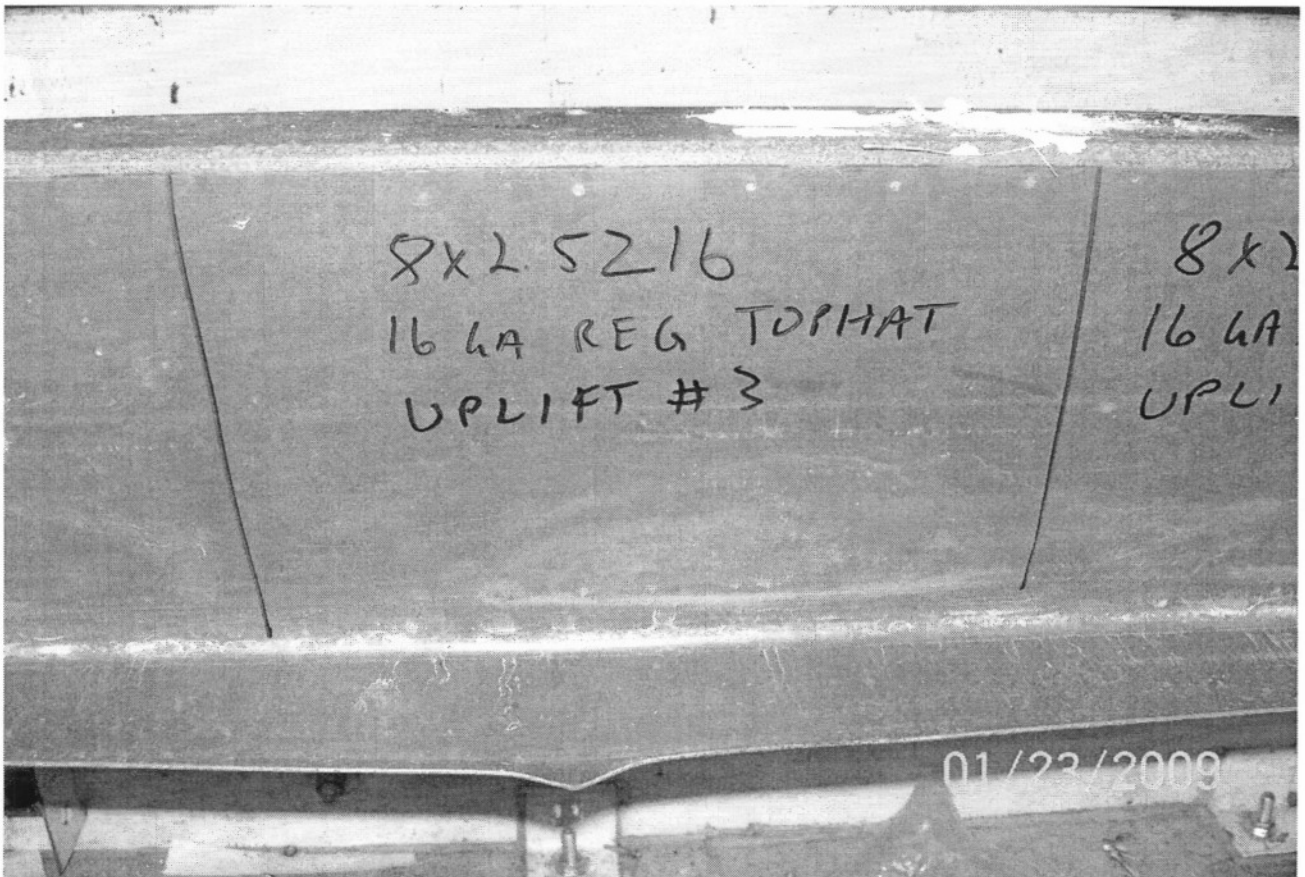
TYPICAL TEST SET UP



TEST A FAILURE



TEST B FAILURE



TEST C FAILURE