Farabaugh Engineering and Testing Inc.

Project No. T147-19

Report Date: March 14, 2019

Total Pages: 26 pages (inclusive)

FM 4474
SIMULATED WIND UPLIFT RESISTANCE OF ROOF ASSEMBLIES
IN ACCORDANCE WITH FM STANDARD 4474, APPENDIX D

ON

T-PANEL - METAL ROOF PANEL
16" WIDE X 22 GA. STEEL
WITH CONTINUOUS CLIPS AND INTERMITTENT CLIPS
(5 SPANS @ 5'-0" O.C. & 12 SPANS @ 2'-0" O.C.)

FOR

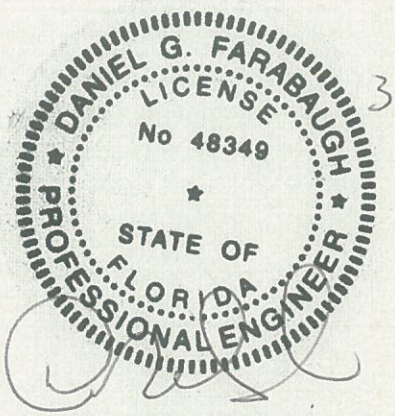
PETERSEN ALUMINUM CORP.
10551 PAC ROAD
TYLER, TX. 75707

Report Prepared By:

Paul G. Farabaugh

Reviewed and Approved By:

Daniel G. Farabaugh



3/18/19

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Project No. T147-19

FM 4474-2004
AMERICAN NATIONAL STANDARD FOR EVALUATING THE SIMULATED WIND UPLIFT RESISTANCE OF ROOF ASSEMBLIES USING STATIC POSITIVE AND /OR NEGATIVE DIFFERENTIAL PRESSURES
(APPENDIX D)

Purpose

This test method covers the evaluation of the simulated wind uplift resistance of roof assemblies by using static positive and /or negative differential pressures. The standard applies to all components as assembled in the roof system.

Test Date

2/27/19 Test #1 - 5 Spans @ 5'-0" o.c. with intermittent clips
3/4/19 Test #2 - 5 Spans @ 5'-0" o.c. with continuous clips
3/1/19 Test #3 - 12 Spans @ 2'-0" o.c. with intermittent clips
3/7/19 Test #4 - 12 Spans @ 2'-0" o.c. with continuous clips

Test Specimen

Manufacturer: Petersen Aluminum
10551 PAC Rd.
Tyler, TX. 75707

Panel: T-PANEL - Metal Roof Panel, 16" wide x 22 ga. steel with 22 ga. steel cap

Intermittent Clip: 6" wide x 16 ga. galvanized steel clip

Continuous Clip: 120" wide x 16 ga. galvanized steel clip

Testing Apparatus

The pressure test chamber measured 13' wide x 26' long x 8" deep. Air pressure was maintained from below the roof assembly. A controlled blower provided a pressure to uniformly load the specimen mock-up. Two static pressure taps located at diagonally opposite corners served as the manometer connection. Calibrated manometers were used to measure the pressure at each pressure tap. The uniform load pressure was performed in the negative direction to monitor wind uplift on the panel specimen mock-up. Calibrated deflectometers were attached to monitor panel deformation as shown.

Installation

- The panels were installed on to 16 ga supports with using (2) #14-13 X 1-1/2" long, DP1, Concealor, self-drill fasteners per intermittent/continuous clips at supports. Test #1 & Test #3 used intermittent clips and Test #2 & #4 used continuous clips. Additional screw was used at each end of a continuous clip. The panel sidejoints used a 22 ga. seam cap and were seamed with a mechanical seamer. The seam cap used 2 beads of factory sealant, one bead on each side of cap corners. The panel ends were fastened with (5) 1/4-14 x 1-1/2 long, self-drill, hex head fasteners with washer. The outer side panels were fastened with (2)1/4-14 x 1-1/2" long self- drill, hex head fasteners with washer at each support along each side of the mock-up.

- Plastic (4 mil thick) was employed loosely between the panels and subgirts and in the side joints to create a vacuum seal.

Procedure

- The specimen was checked for proper adjustment and all vents closed in the pressure measuring lines.

- The required deflection measuring apparatus were installed at their specified locations.

- A nominal initial pressure was applied equal to at least four times but not more than ten times the dead weight of the specimen. This nominal pressure was used as the reference zero and initial deflection readings were recorded.

- At each load increment, pressure was maintained for a period of not less than 60 seconds and until the deflection gages indicated no further increase in deflections.

- Successive increments were achieved as above until failure or ultimate load was reached.

The test was conducted according to the procedure in FM 4474 (Appendix D) and as noted herein. In our opinion the tape and plastic had no influence on the results of the test.

Project No. T147-19

TEST #1

Specimen: T-PANEL - Metal Roof Panel, 16" wide x 22 ga. steel with intermittent Clip

Clip Spacing: 5 ft o/c

NEGATIVE (UPLIFT) PRESSURE

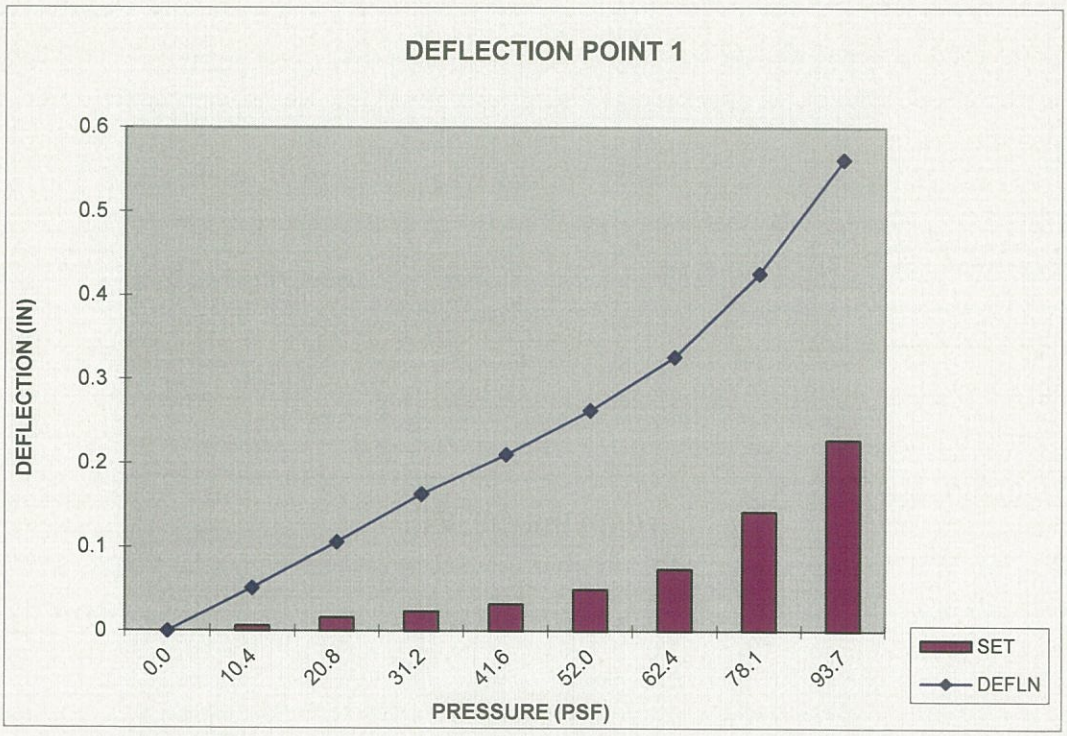
PETERSEN ALUM. T-PANEL 16" WIDE X 22 GA. STEEL (5 SPANS @ 5' O.C.) INTERMITTENT CLIP

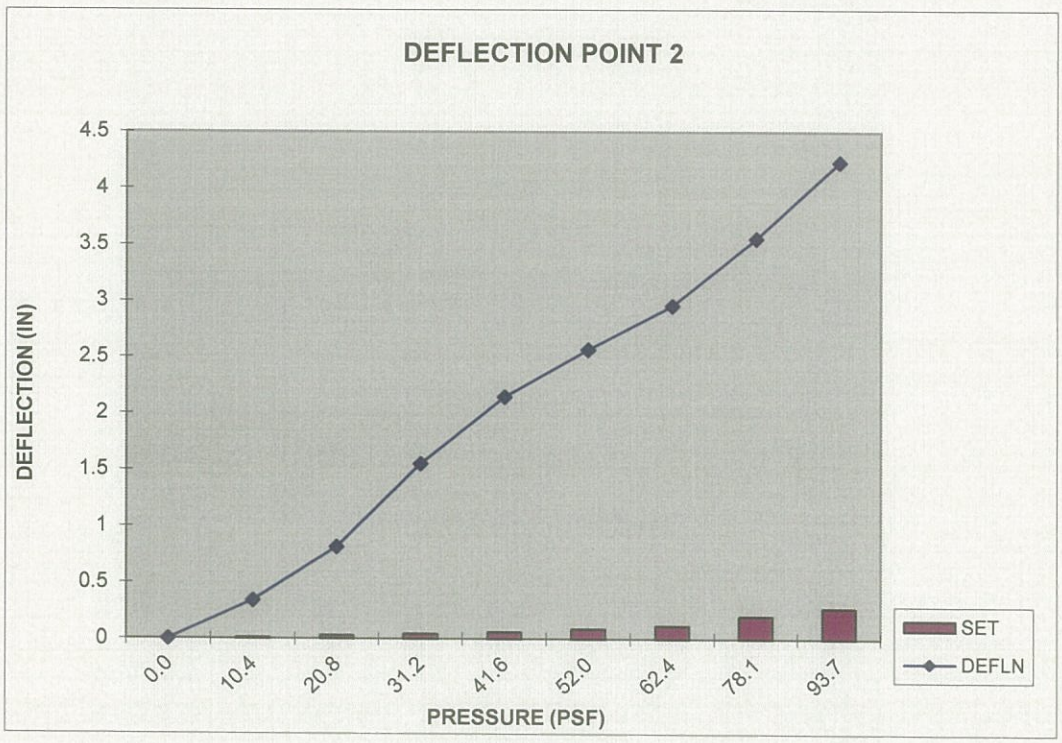
	DEFLECTION DIAL READINGS (INCHES)					
LOAD (PSF)	D-1	D-2	D-3	D-4	D-5	D-6
0.0	0.000	0.000	0.000	0.000	0.000	0.000
10.4	0.052	0.341	0.050	0.349	0.034	0.351
0.0	0.006	0.010	0.007	0.014	0.004	0.010
20.8	0.106	0.819	0.103	0.894	0.075	0.873
0.0	0.017	0.030	0.018	0.031	0.010	0.024
31.2	0.163	1.556	0.161	1.811	0.127	1.771
0.0	0.024	0.044	0.030	0.048	0.021	0.037
41.6	0.211	2.152	0.206	2.494	0.166	2.446
0.0	0.033	0.062	0.044	0.019	0.036	0.051
52.0	0.263	2.571	0.256	2.930	0.206	2.877
0.0	0.050	0.089	0.067	0.098	0.056	0.085
62.4	0.327	2.961	0.327	3.341	0.254	3.284
0.0	0.075	0.118	0.097	0.131	0.075	0.113
78.1	0.426	3.556	0.405	3.998	0.329	3.945
0.0	0.143	0.202	0.162	0.209	0.114	0.179
93.7	0.562	4.237	0.554	4.727	0.427	4.692
0.0	0.228	0.274	0.234	0.339	0.175	0.385

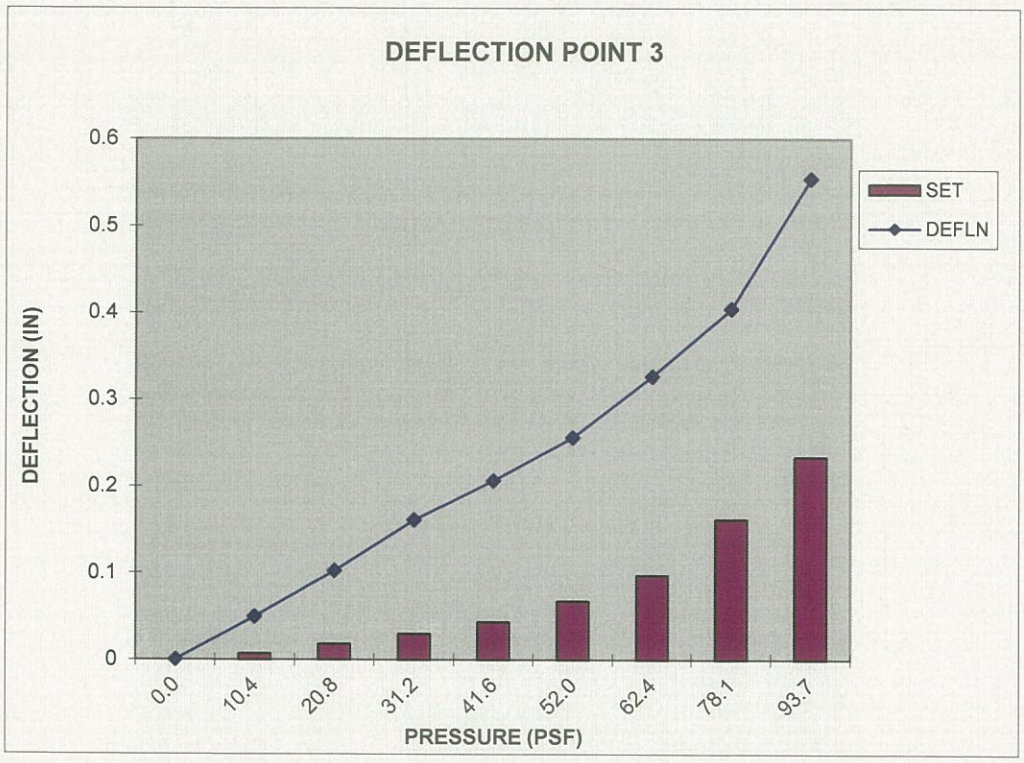
RESULTS:
Based on FM 4474Test Method Appendix D
Maximum Test Load Rating (held for 1 min.) = 90.0 psf

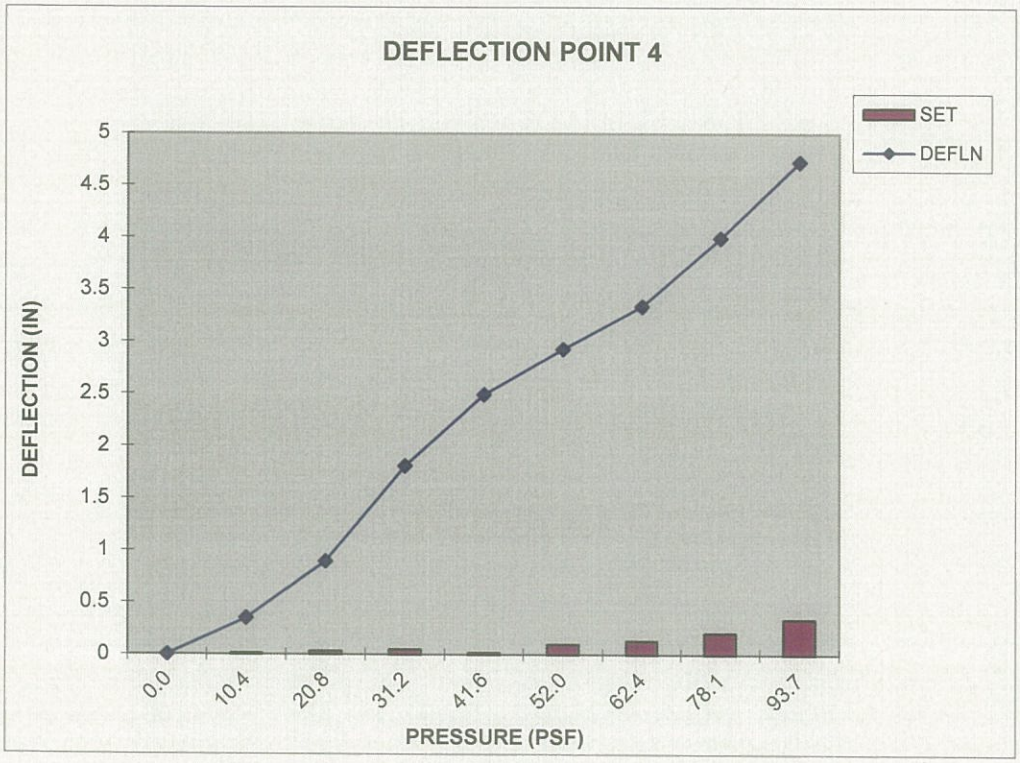
Additional Test Pressure that was held for a minute was 93.7 psf

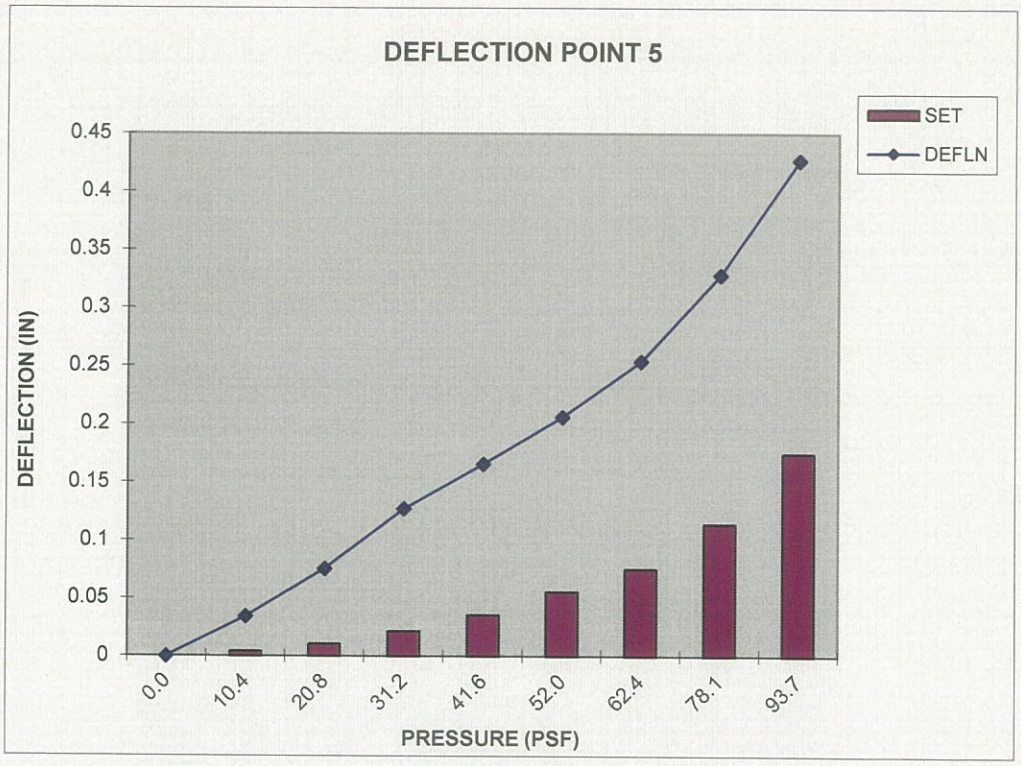
Maximum Test Load = 104.5 psf (Panel disengaged from clip – Clip straightened out)

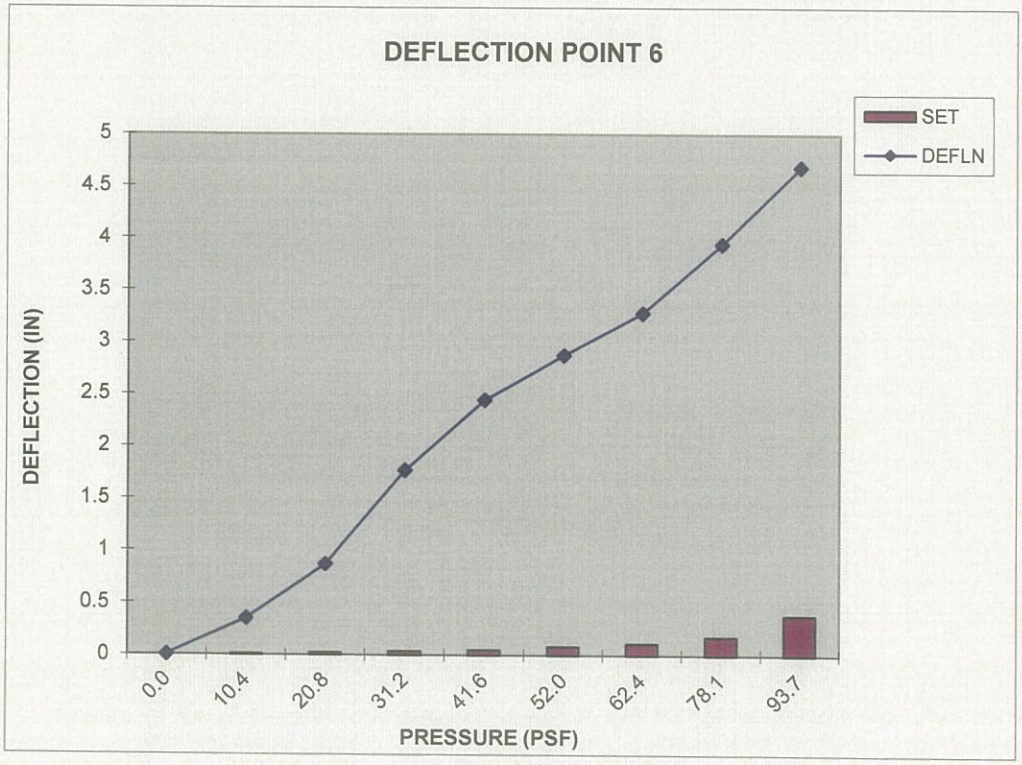

DEFLECTION POINT 1
DEFLECTION (IN)
0.6
0.5
0.4
0.3
0.2
0.1
0
0.0
10.4
20.8
31.2
41.6
52.0
62.4
78.1
93.7
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 2
DEFLECTION (IN)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
10.4
20.8
31.2
41.6
52.0
62.4
78.1
93.7
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 3
DEFLECTION (IN)
0.6
0.5
0.4
0.3
0.2
0.1
0
SET
DEFLN
0.0
10.4
20.8
31.2
41.6
52.0
62.4
78.1
93.7
PRESSURE (PSF)


DEFLECTION POINT 4
DEFLECTION (IN)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
SET
DEFLN
0.0
10.4
20.8
31.2
41.6
52.0
62.4
78.1
93.7
PRESSURE (PSF)


DEFLECTION POINT 5
SET
DEFLN
DEFLECTION (IN)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0
10.4
20.8
31.2
41.6
52.0
62.4
78.1
93.7
PRESSURE (PSF)


DEFLECTION POINT 6
SET
DEFLN
DEFLECTION (IN)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
10.4
20.8
31.2
41.6
52.0
62.4
78.1
93.7
PRESSURE (PSF)

Project No. T147-19

TEST #2

Specimen: T-PANEL - Metal Roof Panel, 16" wide x 22 ga. steel with continuous Clip

Clip Spacing: 5 ft o/c

NEGATIVE (UPLIFT) PRESSURE

PETERSEN ALUM. T-PANEL 16" WIDE X 22 GA. STEEL (5 SPANS @ 5' O.C.) CONT. CLIP

	DEFLECTION DIAL READINGS (INCHES)					
LOAD (PSF)	D-1	D-2	D-3	D-4	D-5	D-6
0.0	0.000	0.000	0.000	0.000	0.000	0.000
15.6	0.022	0.576	0.021	0.533	0.021	0.546
0.0	0.005	0.015	0.004	0.008	0.005	0.013
31.2	0.059	1.303	0.051	1.231	0.058	1.268
0.0	0.013	0.034	0.010	0.022	0.013	0.036
46.8	0.095	1.875	0.084	1.789	0.097	1.843
0.0	0.022	0.047	0.019	0.037	0.025	0.055
62.4	0.137	2.271	0.123	2.187	0.145	2.246
0.0	0.032	0.064	0.030	0.061	0.039	0.089
78.1	0.180	2.583	0.166	2.504	0.198	2.567
0.0	0.044	0.081	0.042	0.098	0.054	0.117
93.7	0.231	2.862	0.213	2.788	0.256	2.866
0.0	0.056	0.103	0.060	0.137	0.075	0.145
109.3	0.285	3.166	0.269	3.105	0.329	3.190
0.0	0.143	0.815	0.123	0.145	0.179	0.797
124.9	0.326	3.366	0.312	3.325	0.392	3.400
0.0	0.132	0.417	0.091	0.162	0.199	0.602
140.5	0.358	3.579	0.353	3.562	0.443	3.638
0.0	0.155	0.322	0.160	0.540	0.229	0.498

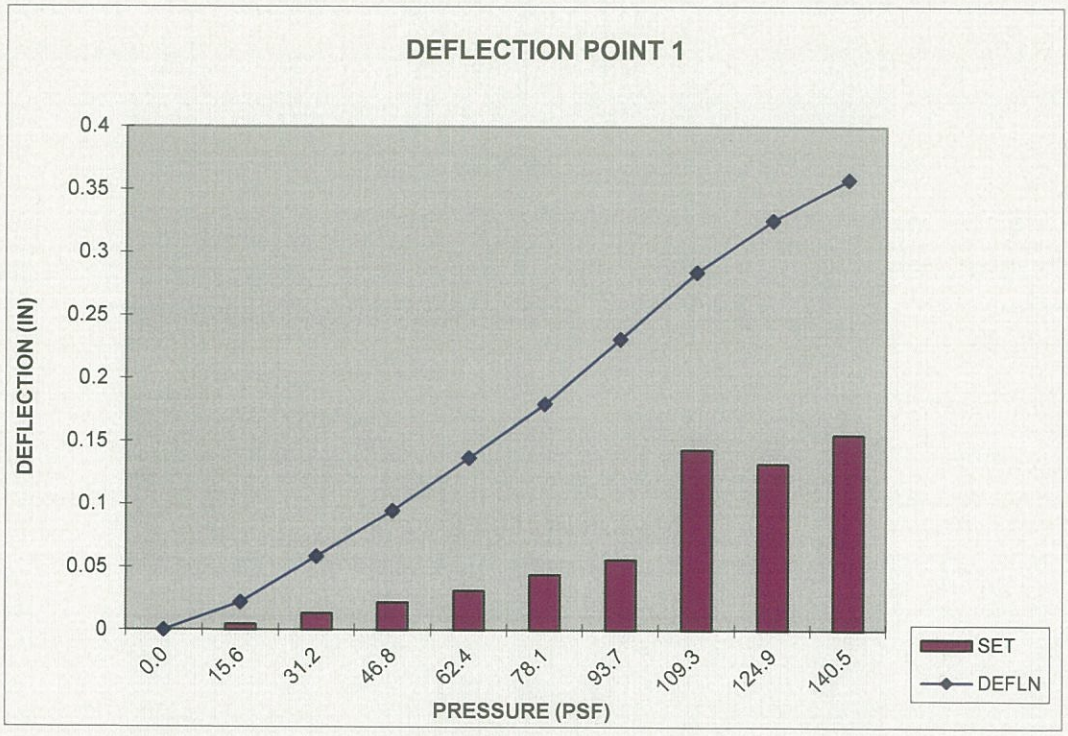
RESULTS:

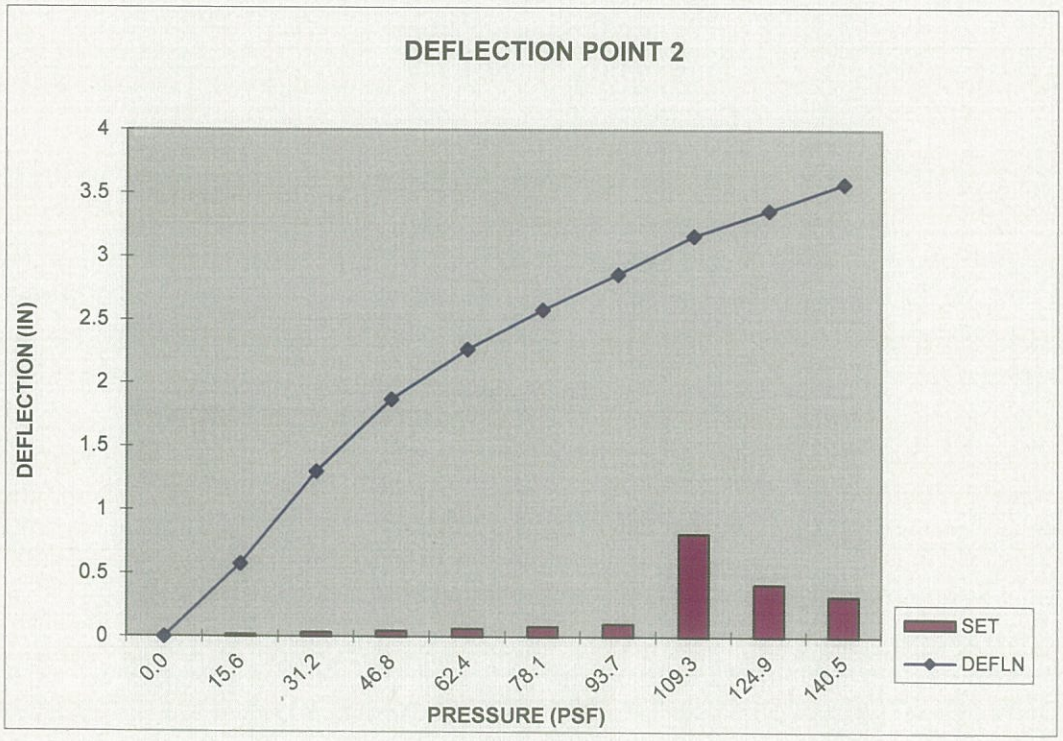
Based on FM 4474Test Method Appendix D

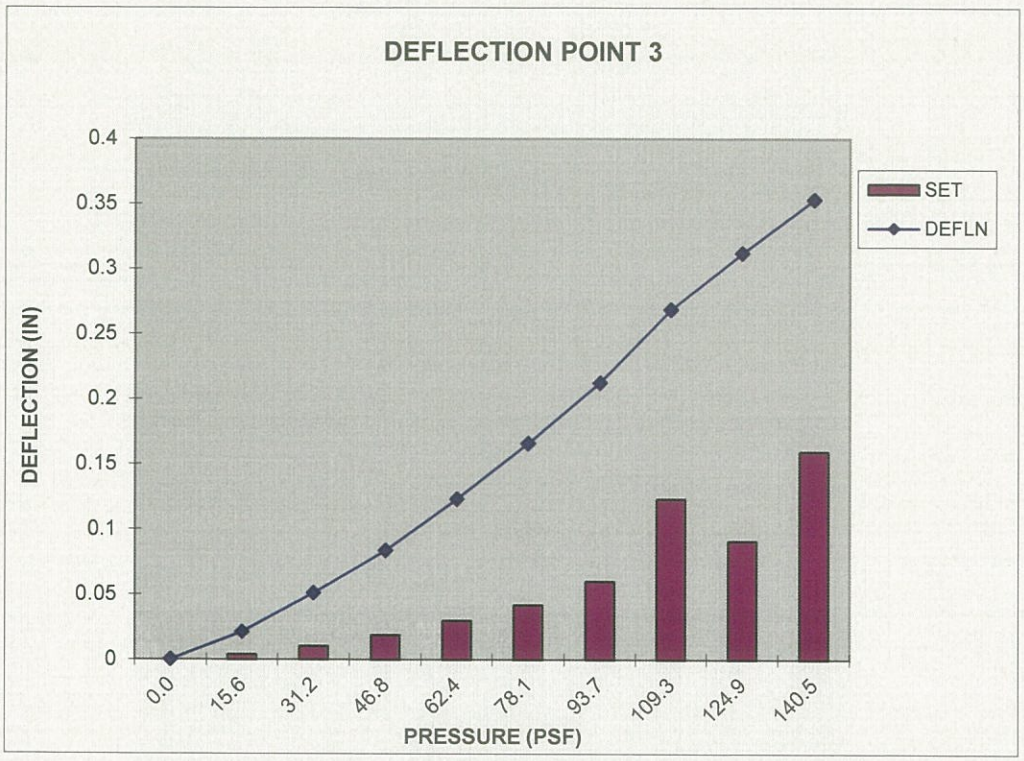
Maximum Test Load Rating (held for 1 min.) = 180.0 psf

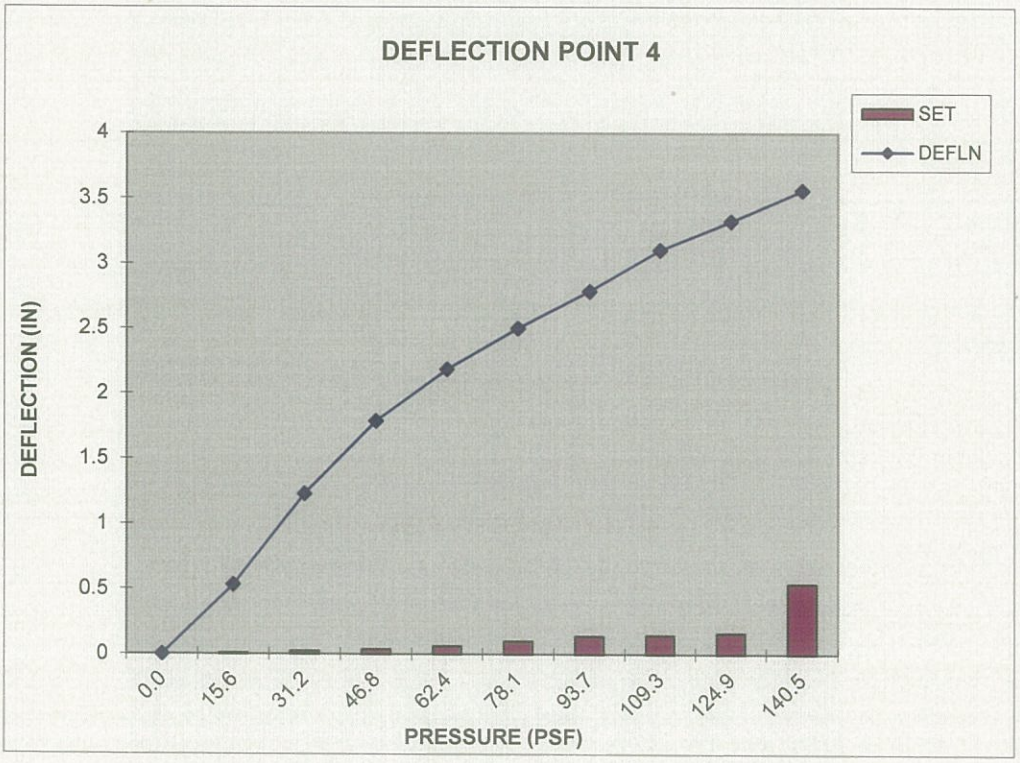
Additional Test Pressure that was held for a minute was 182 psf

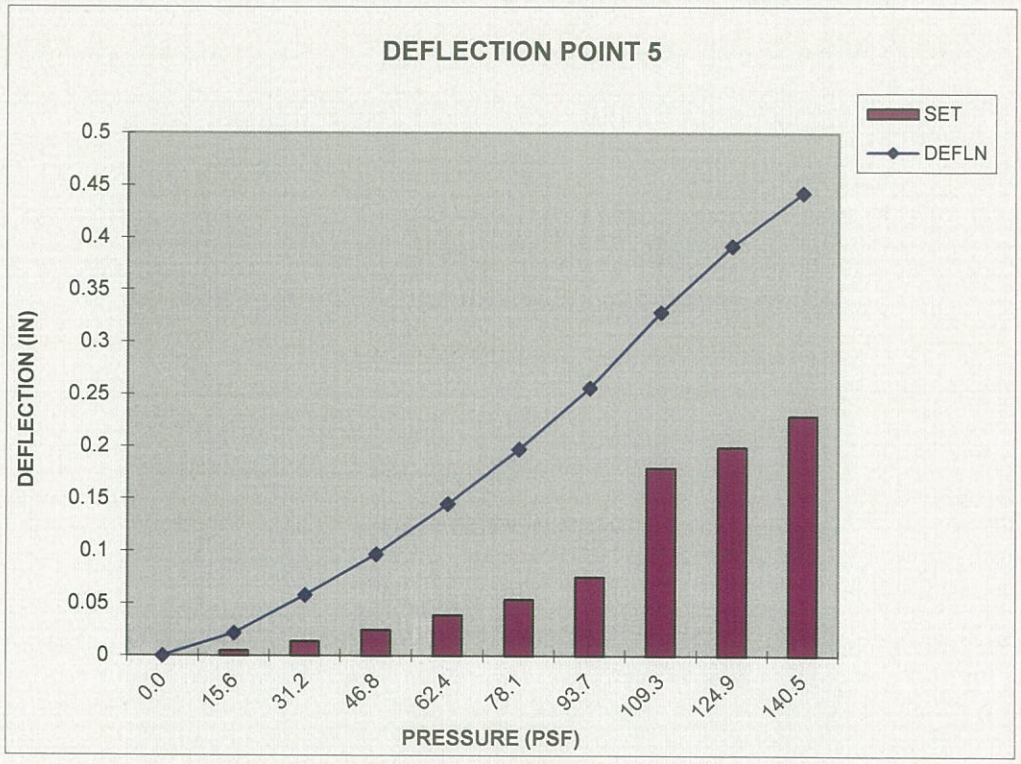
Maximum Test Load = 185.6 psf (clip fastener pulled thru clip)

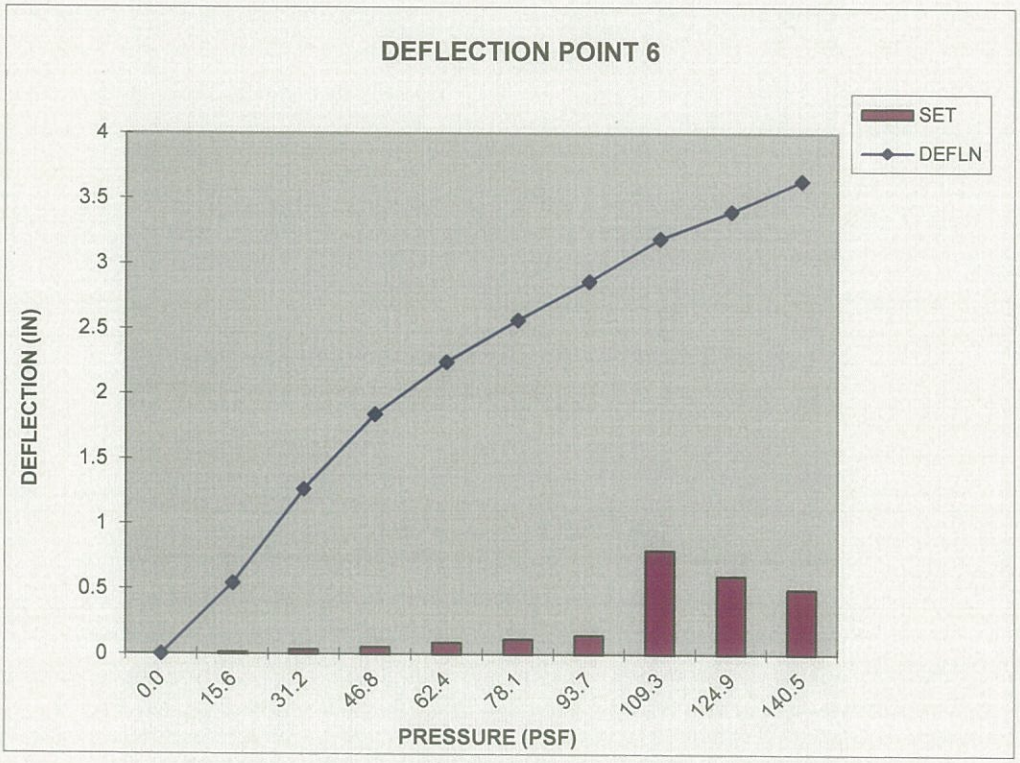

DEFLECTION POINT 1
DEFLECTION (IN)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 2
DEFLECTION (IN)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 3
DEFLECTION (IN)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
SET
DEFLN
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
PRESSURE (PSF)


DEFLECTION POINT 4
DEFLECTION (IN)
4
3.5
3
2.5
2
1.5
1
0.5
0
SET
DEFLN
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
PRESSURE (PSF)


DEFLECTION POINT 5
SET
DEFLN
DEFLECTION (IN)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
PRESSURE (PSF)


DEFLECTION POINT 6
SET
DEFLN
DEFLECTION (IN)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
PRESSURE (PSF)

Project No. T147-19

TEST #3

Specimen: T-PANEL - Metal Roof Panel, 16" wide x 22 ga. steel with intermittent Clip

Clip Spacing: 2 ft o/c

NEGATIVE (UPLIFT) PRESSURE

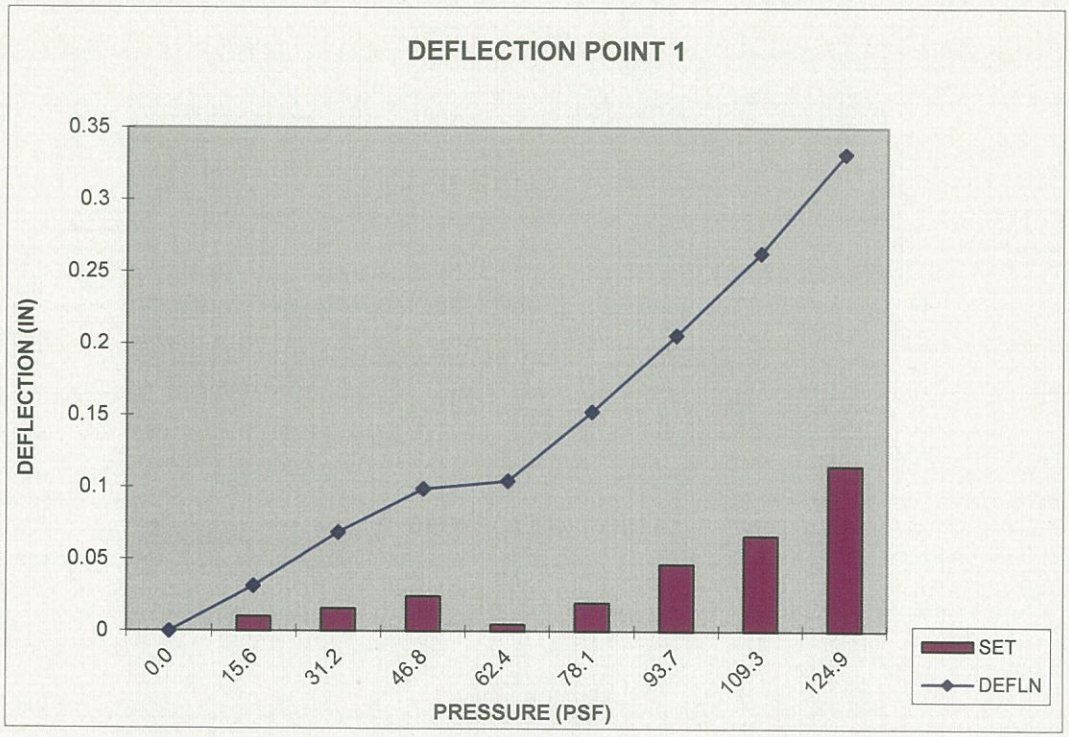
PETERSEN ALUM. T-PANEL 16" WIDE X 22 GA. STEEL (12 SPANS @ 2' O.C.) INTERMITTENT CLIP

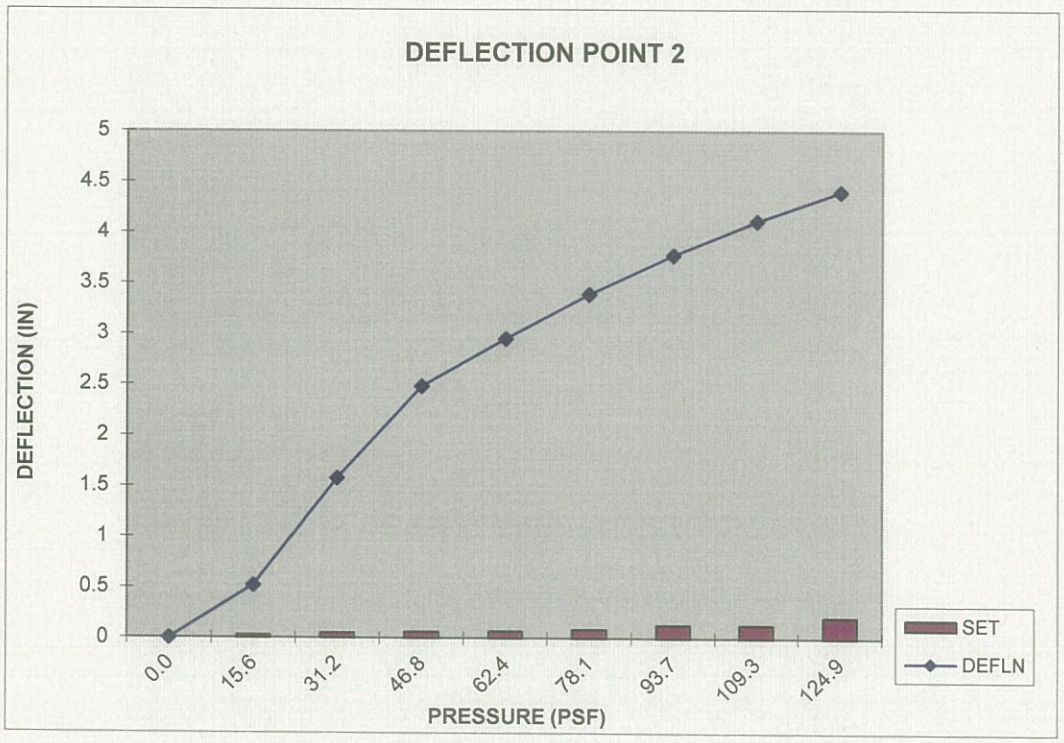
	DEFLECTION DIAL READINGS (INCHES)					
LOAD (PSF)	D-1	D-2	D-3	D-4	D-5	D-6
0.0	0.000	0.000	0.000	0.000	0.000	0.000
15.6	0.032	0.521	0.025	0.600	0.034	0.527
0.0	0.010	0.025	0.006	0.031	0.008	0.021
31.2	0.069	1.579	0.062	1.625	0.064	1.636
0.0	0.016	0.049	0.010	0.066	0.014	0.041
46.8	0.099	2.488	0.095	2.490	0.094	2.585
0.0	0.025	0.063	0.018	0.075	0.017	0.050
62.4	0.105	2.957	0.126	2.935	0.119	3.080
0.0	0.005	0.067	0.025	0.071	0.021	0.051
78.1	0.153	3.396	0.174	3.393	0.160	3.555
0.0	0.020	0.087	0.036	0.094	0.029	0.070
93.7	0.206	3.782	0.220	3.824	0.210	3.998
0.0	0.047	0.130	0.056	0.178	0.048	0.112
109.3	0.263	4.117	0.273	4.171	0.278	4.404
0.0	0.067	0.129	0.077	0.161	0.063	0.103
124.9	0.332	4.412	0.323	4.554	0.364	4.800
0.0	0.115	0.206	0.127	0.470	0.098	0.226

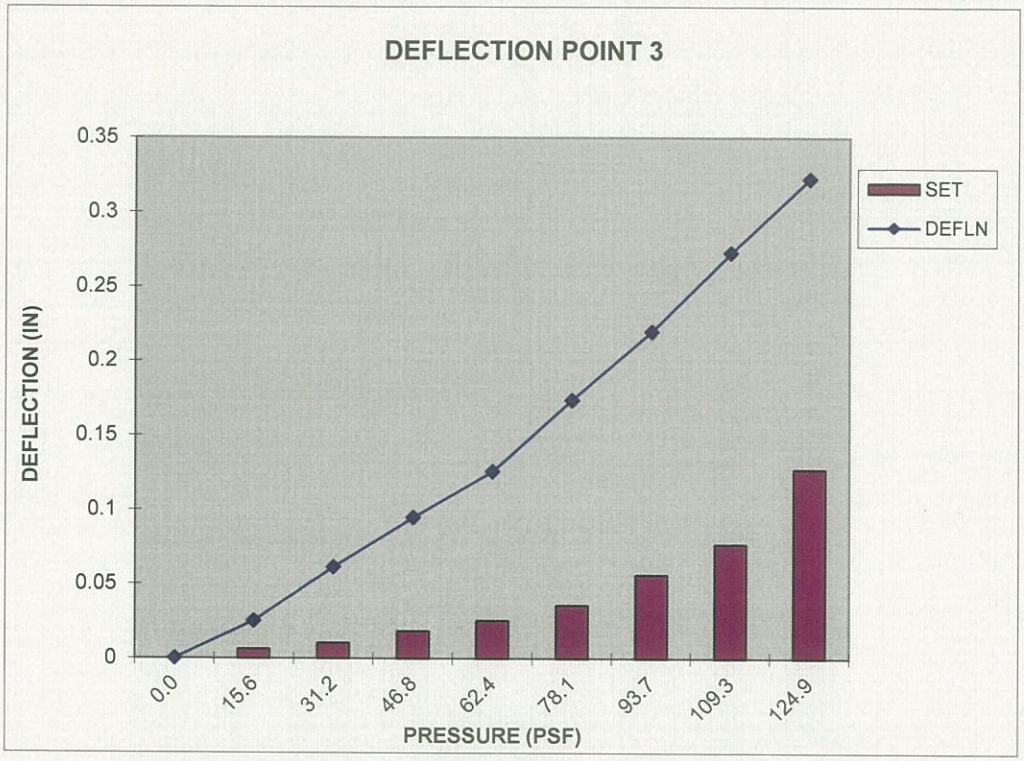
RESULTS:
Based on FM 4474Test Method Appendix D
Maximum Test Load Rating (held for 1 min.) = 135.0 psf

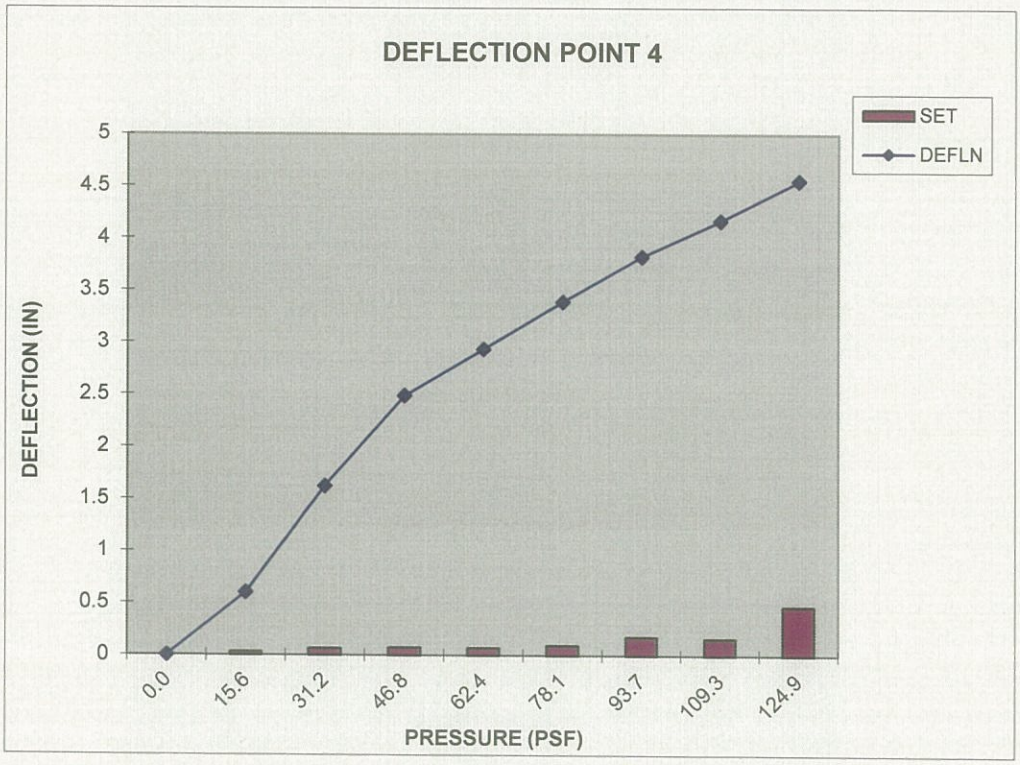
Additional Test Pressure that was held for a minute was 145.6 psf

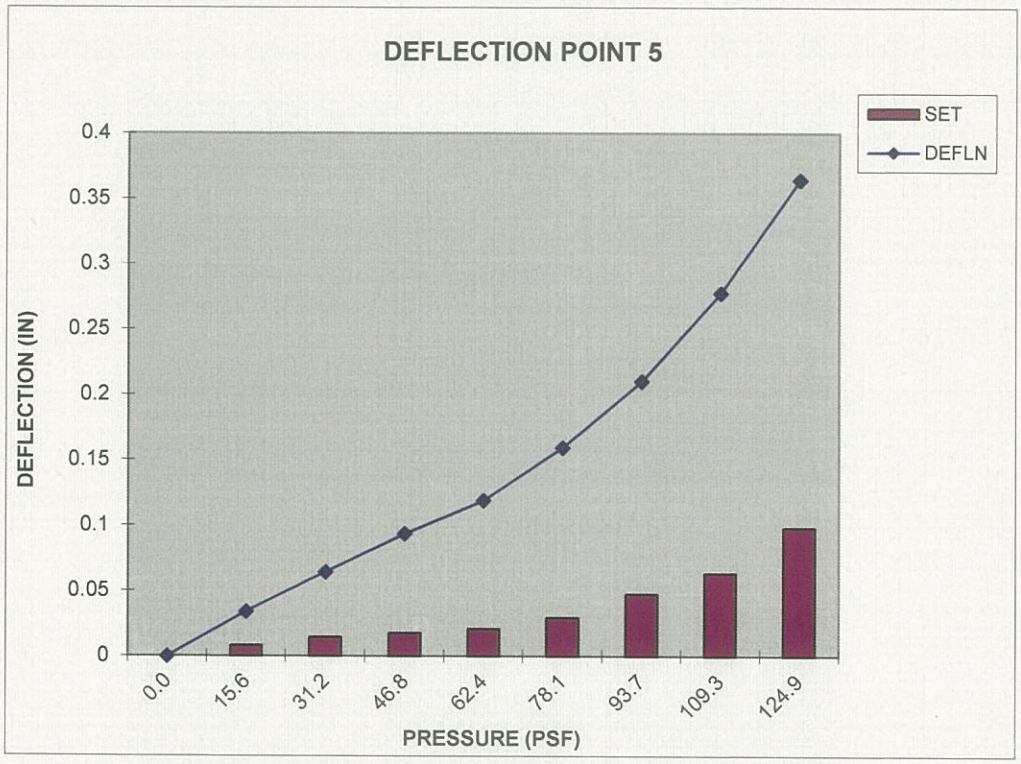
Maximum Test Load = 149.7 psf (Panel disengaged from clip – Clip straightened out)

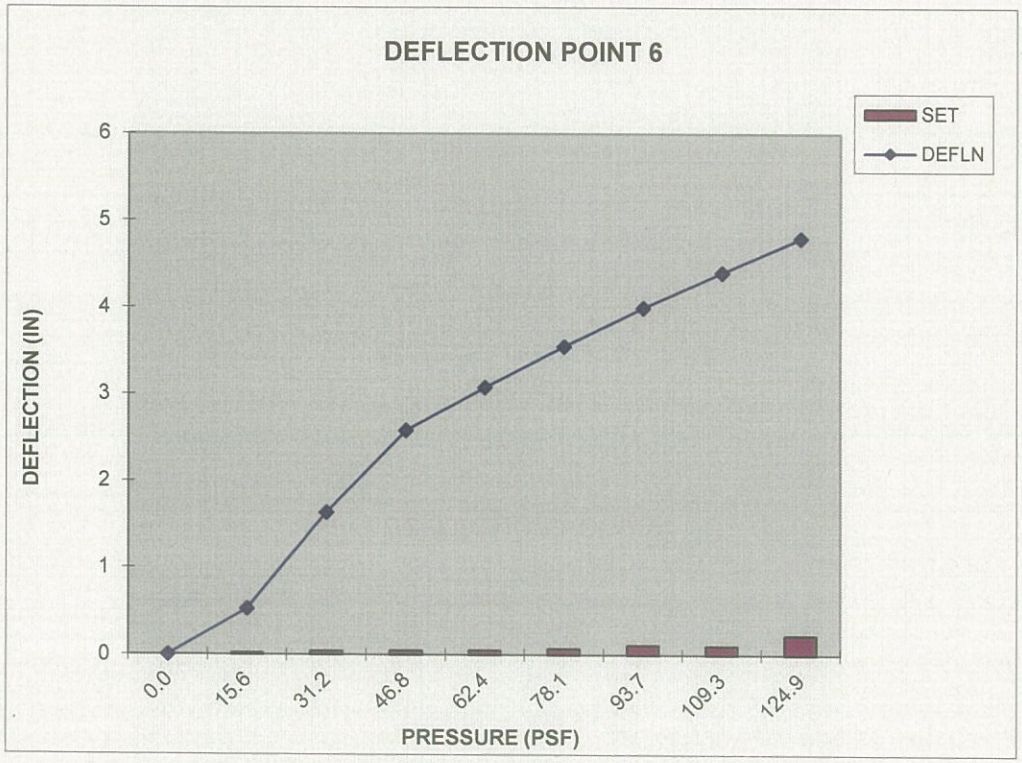

DEFLECTION POINT 1
DEFLECTION (IN)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 2
DEFLECTION (IN)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 3
DEFLECTION (IN)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 4
DEFLECTION (IN)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 5
SET
DEFLN
DEFLECTION (IN)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
PRESSURE (PSF)


DEFLECTION POINT 6
SET
DEFLN
DEFLECTION (IN)
6
5
4
3
2
1
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
PRESSURE (PSF)

Project No. T147-19

TEST #4

Specimen: T-PANEL - Metal Roof Panel, 16" wide x 22 ga. steel with continuous Clip

Clip Spacing: 2 ft o/c

NEGATIVE (UPLIFT) PRESSURE

PETERSEN ALUM. T-PANEL 16" WIDE X 22 GA. STEEL (12 SPANS @ 2' O.C.) CONT. CLIP

	DEFLECTION DIAL READINGS (INCHES)					
LOAD (PSF)	D-1	D-2	D-3	D-4	D-5	D-6
0.0	0.000	0.000	0.000	0.000	0.000	0.000
15.6	0.002	0.475	0.011	0.496	0.005	0.487
0.0	0.002	0.013	0.003	0.013	0.001	0.013
31.2	0.010	1.128	0.028	1.181	0.015	1.136
0.0	0.006	0.018	0.006	0.019	0.005	0.017
46.8	0.016	1.730	0.045	1.769	0.025	1.728
0.0	0.010	0.029	0.012	0.026	0.009	0.024
62.4	0.025	2.149	0.066	2.153	0.038	2.145
0.0	0.013	0.039	0.017	0.036	0.013	0.031
78.1	0.036	2.447	0.089	2.441	0.056	2.444
0.0	0.015	0.062	0.024	0.057	0.017	0.051
93.7	0.043	2.667	0.106	2.661	0.068	2.666
0.0	0.016	0.079	0.028	0.075	0.021	0.066
109.3	0.048	2.876	0.123	2.875	0.082	2.882
0.0	0.020	0.103	0.034	0.113	0.028	0.087
124.9	0.055	3.084	0.142	3.074	0.094	3.093
0.0	0.022	0.118	0.039	0.130	0.033	0.099
140.5	0.059	3.313	0.163	3.271	0.104	3.327
0.0	0.021	0.144	0.043	0.163	0.035	0.121
156.1	0.060	3.488	0.175	3.460	0.111	3.506
0.0	0.022	0.194	0.047	0.204	0.038	0.161
171.7	0.059	3.710	0.183	3.680	0.117	3.744
0.0	0.029	0.266	0.055	0.262	0.044	0.223

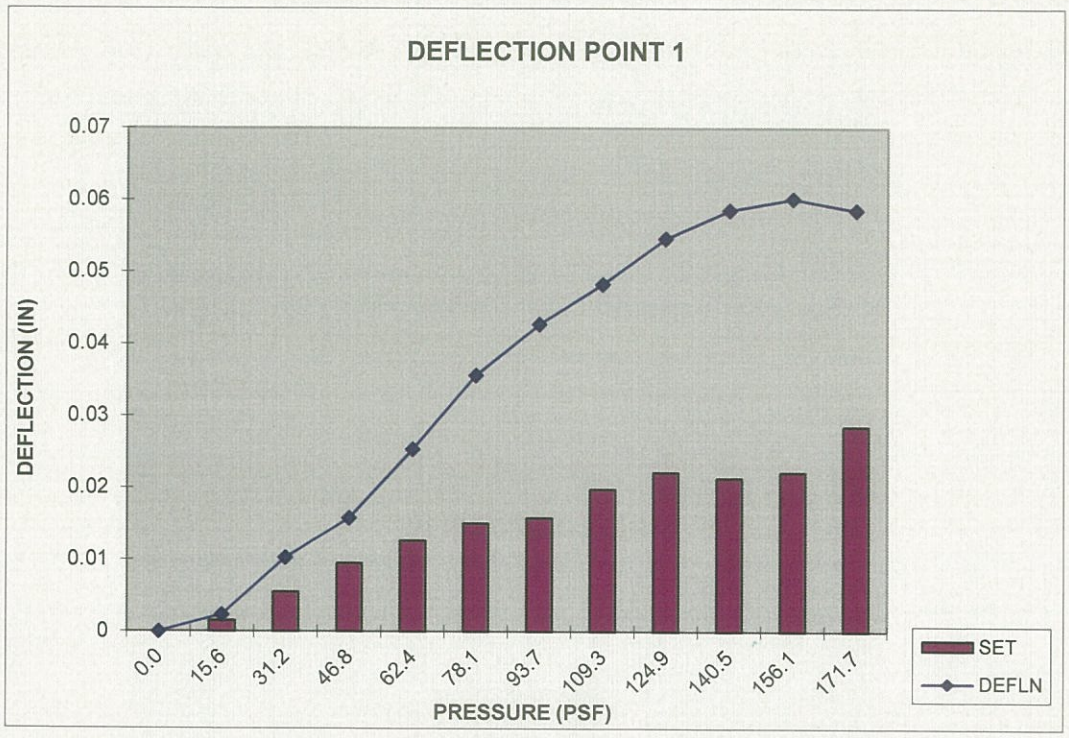
RESULTS:

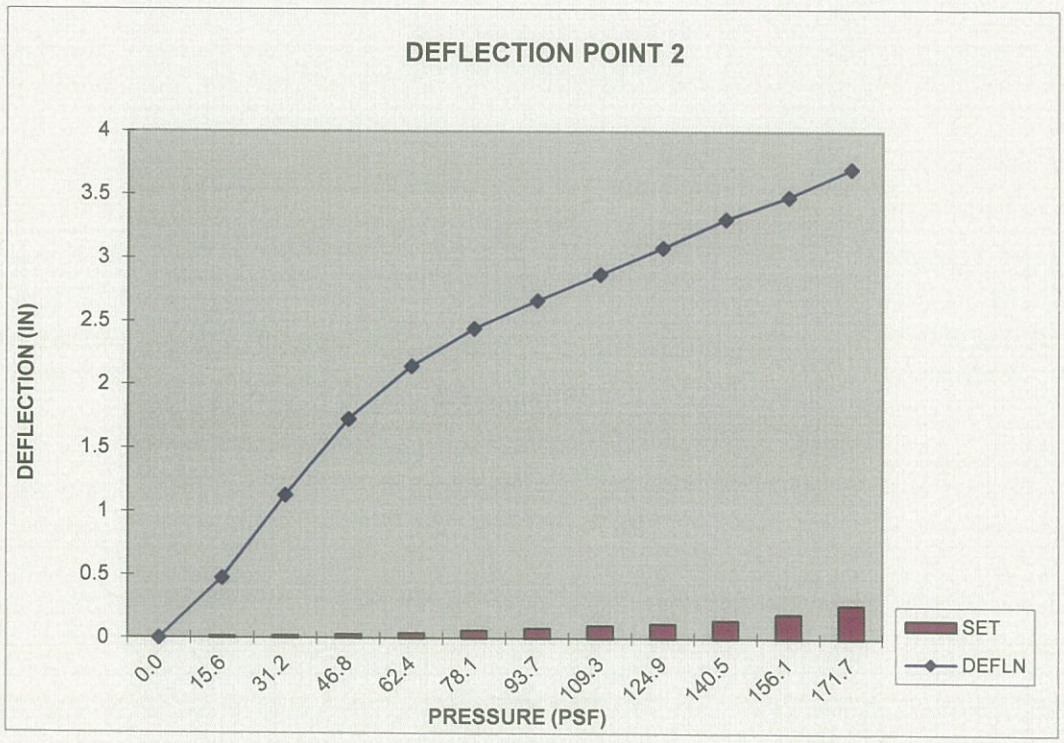
Based on FM 4474Test Method Appendix D

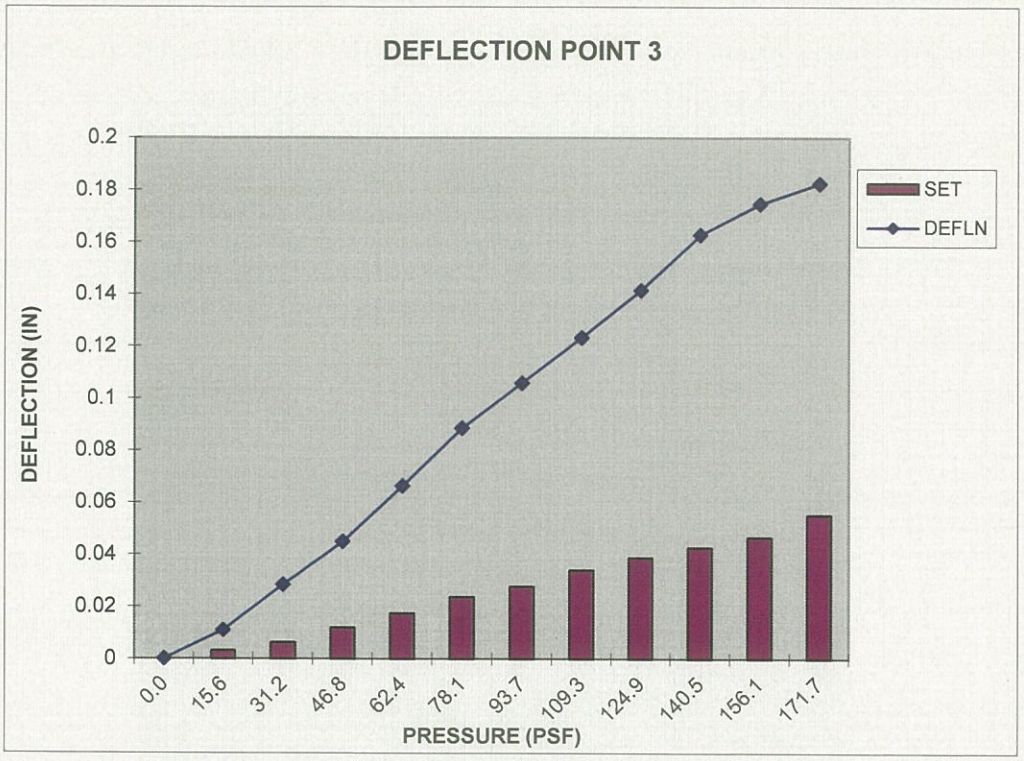
Maximum Test Load Rating (held for 1 min.) = 285.0 psf

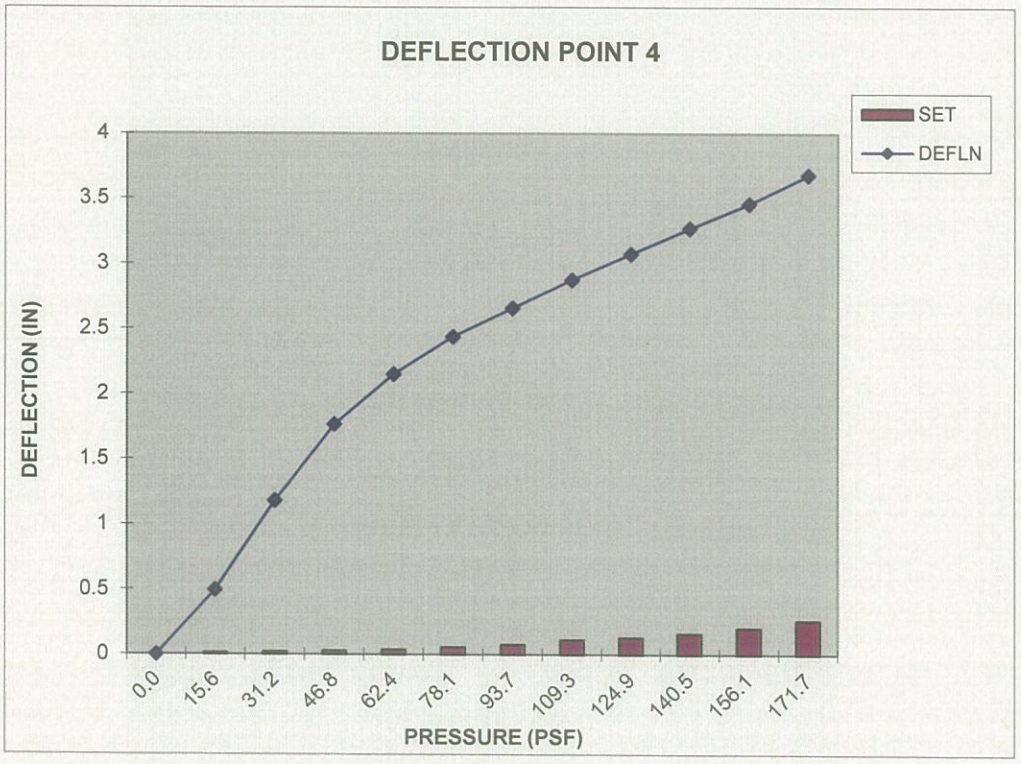
Additional Test Pressure that was held for a minute was 295.9 psf

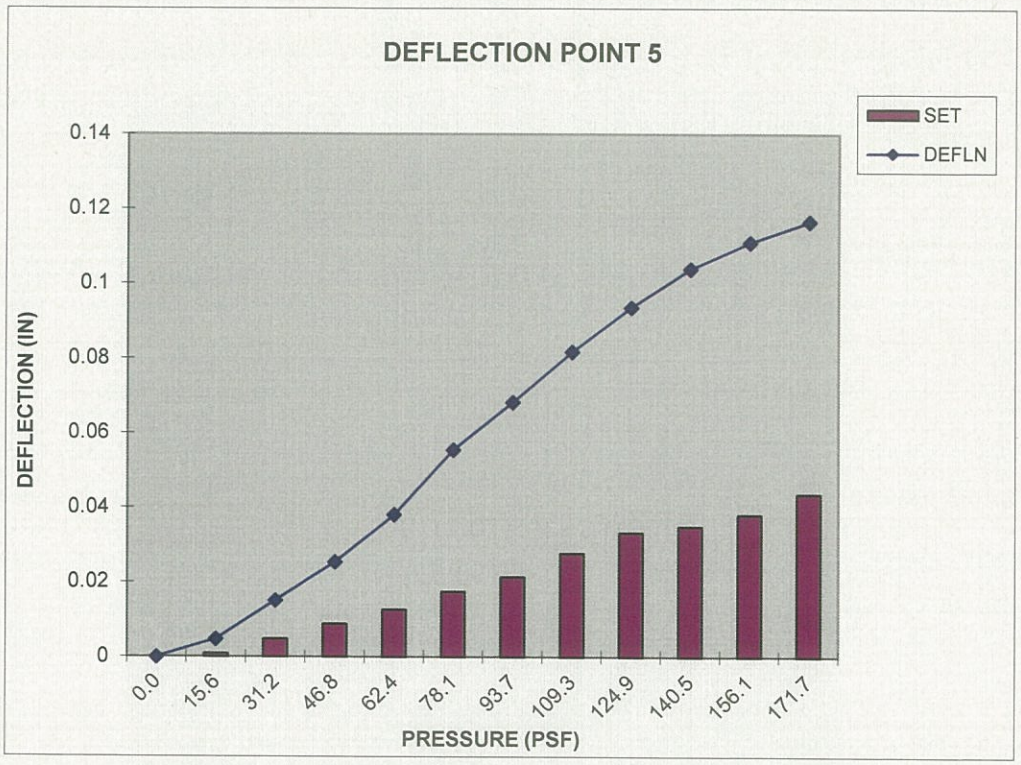
Maximum Test Load = 295.9 psf (No Failures)

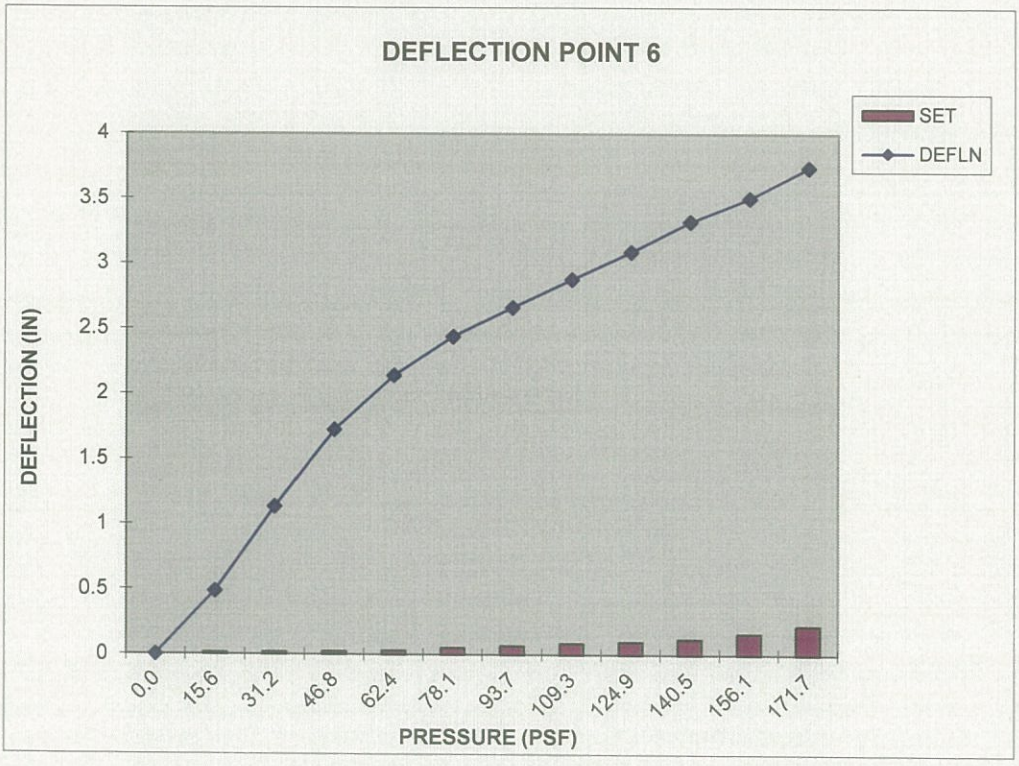

DEFLECTION POINT 1
DEFLECTION (IN)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
156.1
171.7
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 2
DEFLECTION (IN)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
156.1
171.7
PRESSURE (PSF)
SET
DEFLN

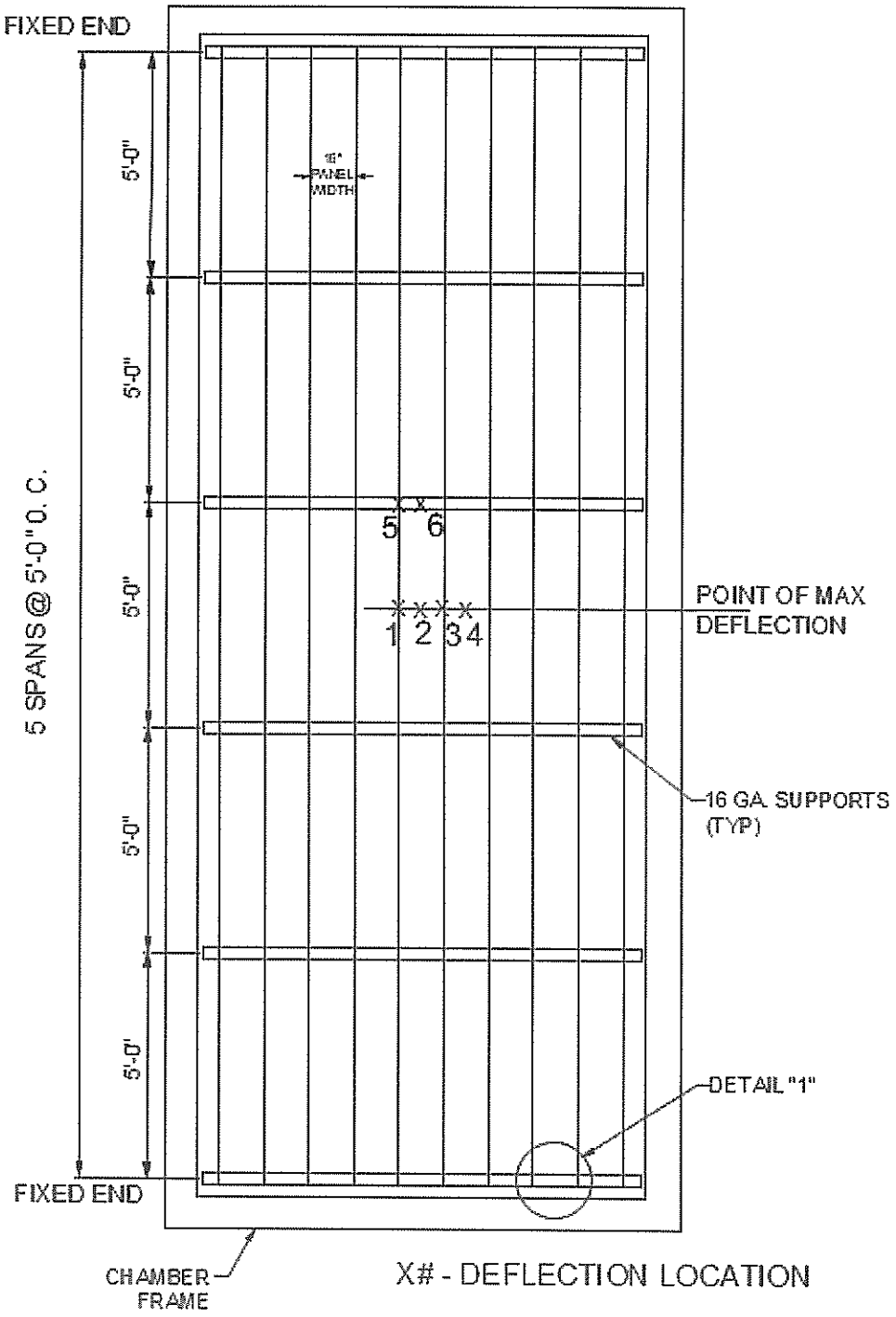

DEFLECTION POINT 3
DEFLECTION (IN)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
156.1
171.7
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 4
DEFLECTION (IN)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
156.1
171.7
PRESSURE (PSF)
SET
DEFLN


DEFLECTION POINT 5
SET
DEFLN
DEFLECTION (IN)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
156.1
171.7
PRESSURE (PSF)

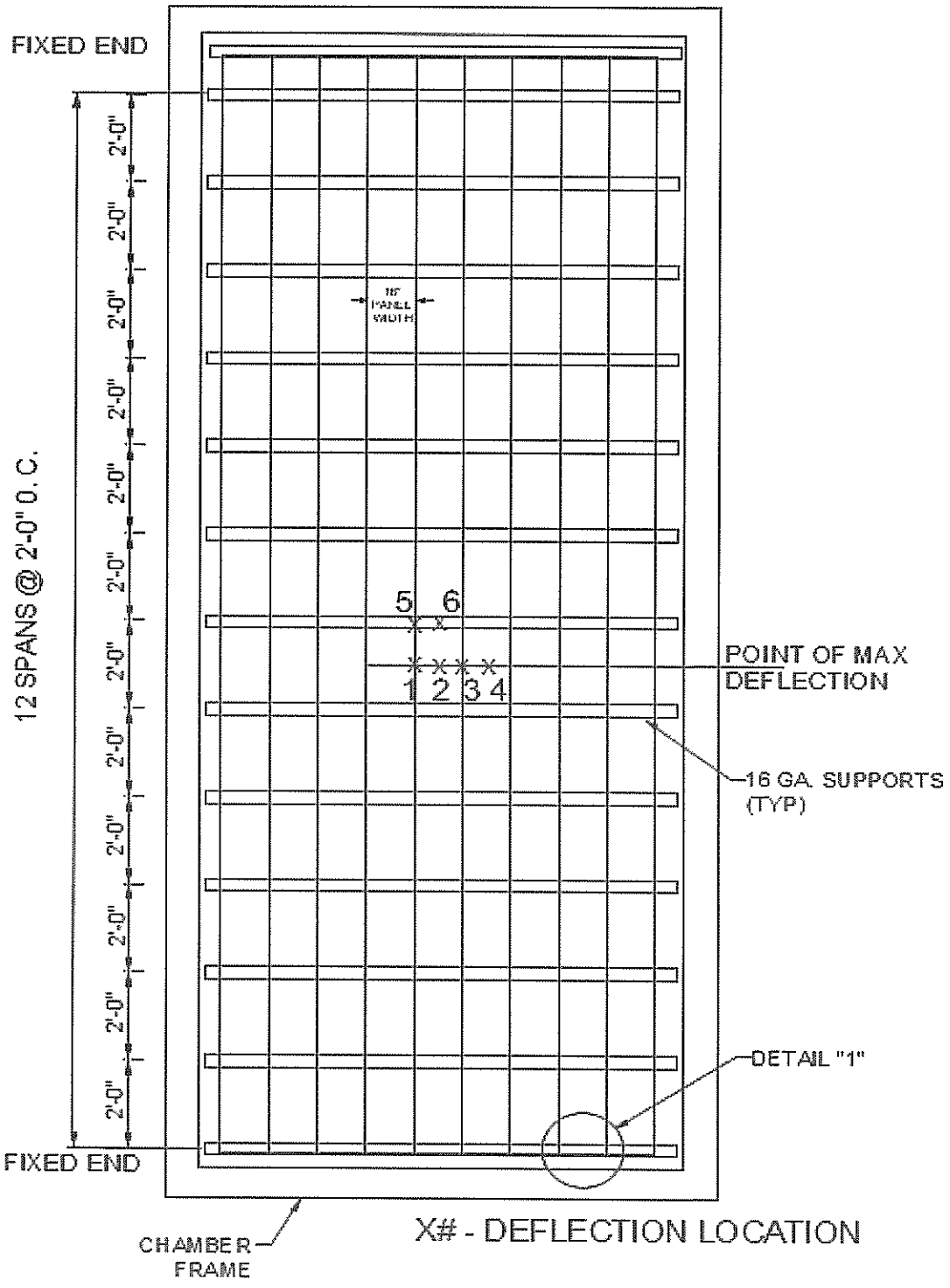

DEFLECTION POINT 6
SET
DEFLN
DEFLECTION (IN)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0
15.6
31.2
46.8
62.4
78.1
93.7
109.3
124.9
140.5
156.1
171.7
PRESSURE (PSF)

TEST #1 & #2

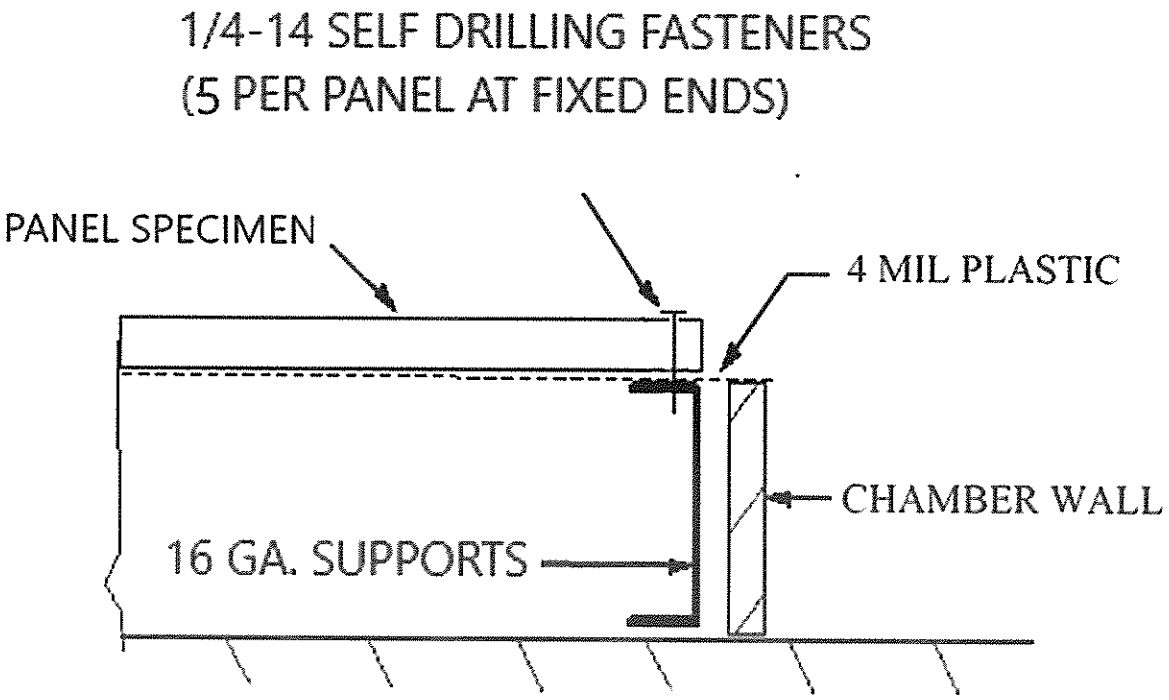


PLAN VIEW

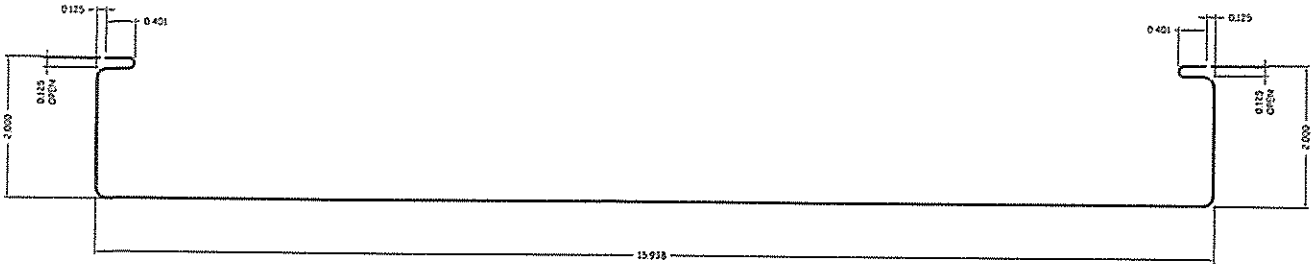
TEST #3 & #4



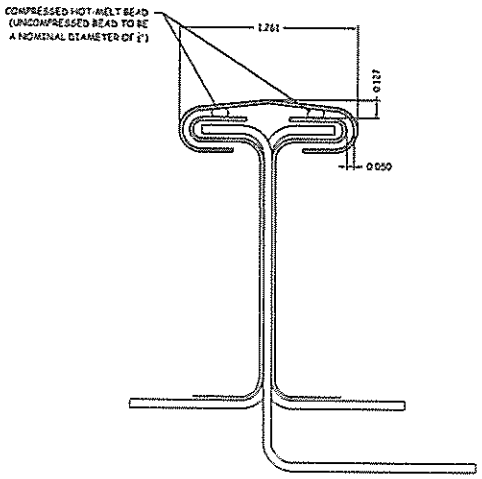
PLAN VIEW


1/4-14 SELF DRILLING FASTENERS
(5 PER PANEL AT FIXED ENDS)
PANEL SPECIMEN
4 MIL PLASTIC
CHAMBER WALL
16 GA. SUPPORTS

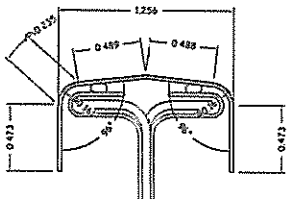
DETAIL 1

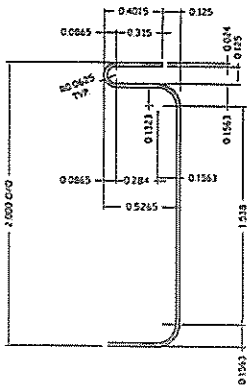


16" T PANEL



STUDY AT SIDE JOINT W/ CLIP CAP (AFTER SEAMING)

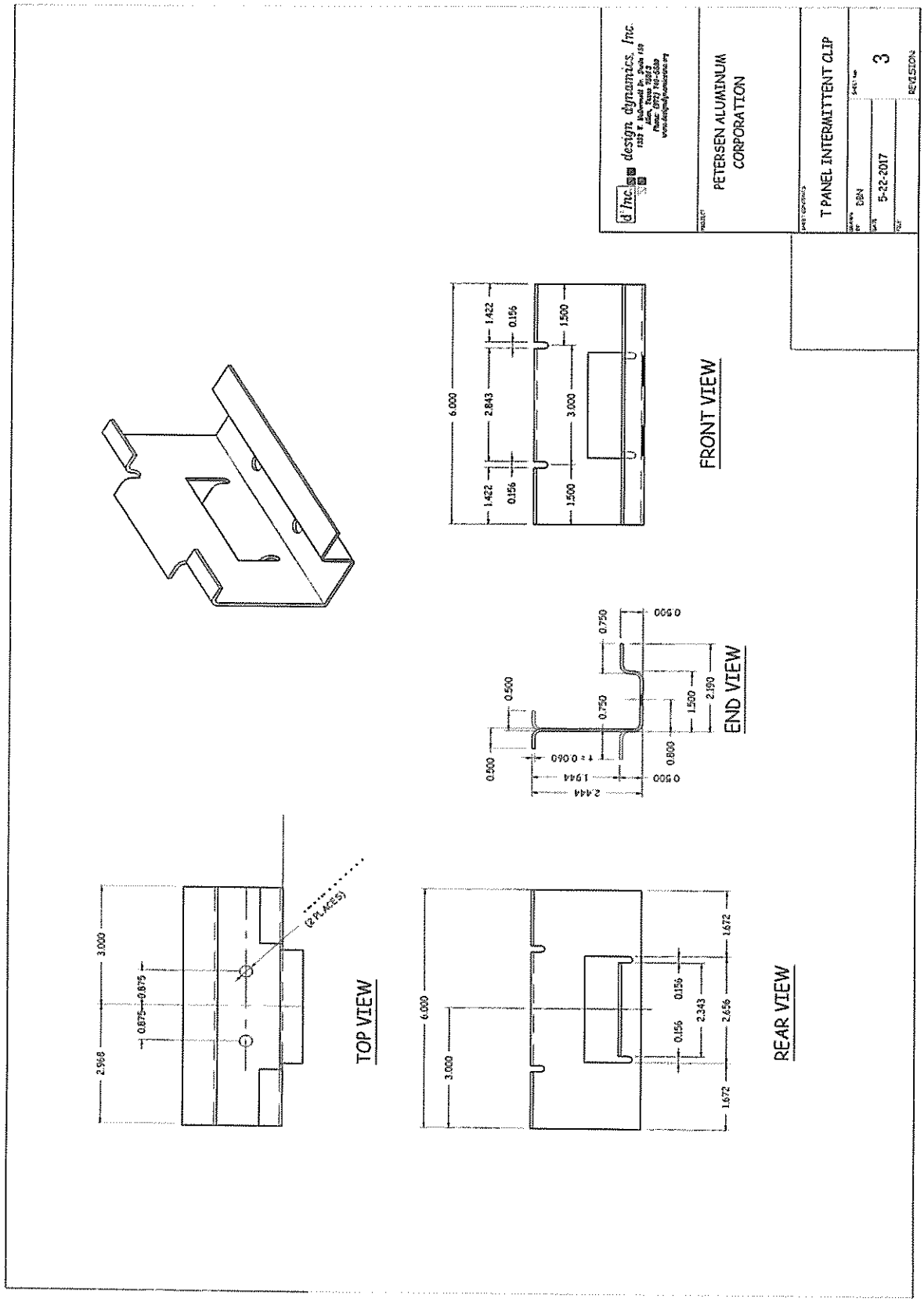




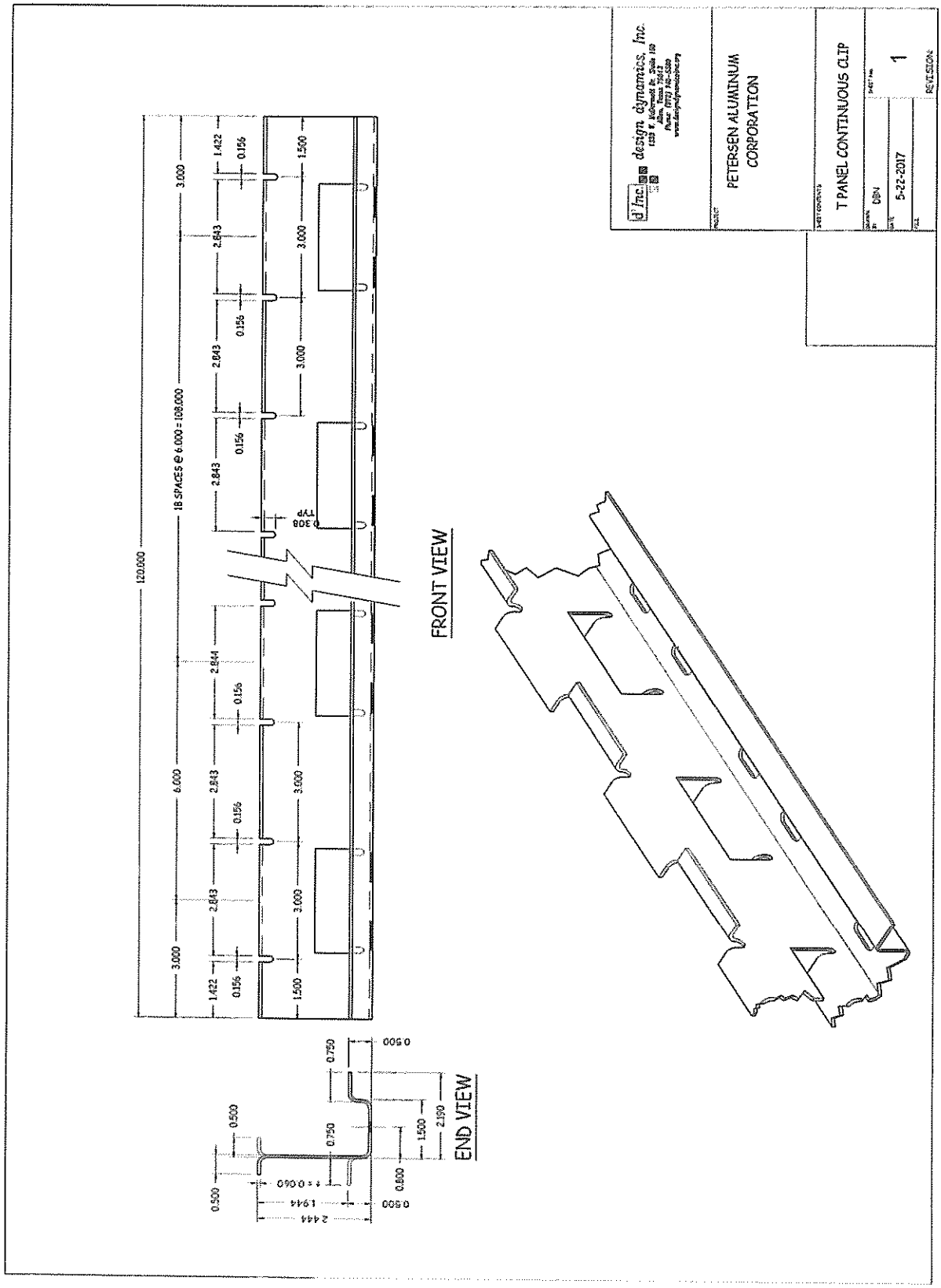
ENLARGED SIDE JOINT DETAIL

PANEL PROFILE

Project No. T147-19



Project No. T147-19



Project No. T147-19

TENSILE TEST REPORT

Client: Petersen Aluminum
10551 PAC Rd.
Tyler, TX. 75707

Test Date: March 13, 2019

Test Method: ASTM A370-10

Material Description: T-PANEL - Metal Roof Panel, 16" wide x 22 ga. steel

Sample No.	Width (in)	Thickness (in)	Yield Load (lb)	Max. Load (lb)	0.2% Offset Yield Strength (psi)	Tensile Strength (psi)	Elongation (% in 2 inches)
19010	0.507	0.027	741.2	858.4	54,144	62,704	29.9

Equipment Used: Tensile Machine #QT7-061196-020
Caliper #1074379
Extensometer #10311744D
Micrometer #110596927