TEST REPORT ON

METAL ROOFING SYSTEMS INC.
SYSTEM 2500 ROOF PANELS
(24 GA., 2" HIGH, 16" WIDE FLAT PAN PANEL)
AT 1' 0" & 5' 0" PURLIN SPACING
WITH 180º SEAM
IN ACCORDANCE WITH ASTM E1592-05

TESTED FOR:
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TEST CONDUCTED AT:
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TEST WITNESSED BY:
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TESTING DATES: May 28 & 29, 2008
REPORTING DATE: May 30, 2008
ENCON® Project C1588-1

ACCREDITED
TL-327

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TEST SUMMARY

1.1 SUMMARY

Tests were conducted on Metal Roofing Systems' System 2500 (2" high seam, 16" wide, 24 Ga., 50 ksi) standing seam metal roof panels at ENCON® Technology, Inc.'s Test Facility, Tulsa, Oklahoma. These tests meet the provisions of ASTM E 1592-05 and were run for different purlin spacing. The tests are listed below according to their configurations and date tested.

Test #1: 16" wide, 24 ga. System 2500 panel at 5' 0" purlin spacing with 180º seam. Tested on May 28, 2008.

Test #2: 16" wide, 24 ga. System 2500 panel at 1' 0" purlin spacing with 180º seam. Tested on May 29, 2008.

The above defined tests were witnessed by Bala Sockalingam, Ph.D., P.E., of ENCON Technology.

1.2 ROOF SYSTEM DESCRIPTION

Metal Roofing's System 2500 roof system consisted of 16" wide, 24 ga., 50 ksi (nom.) yield panels joined together at the sidelaps to form a flat pan profile with a 2" high seam. The panels are attached to the 16 ga. (nom) purlins at 5' 0" & 1' 0" spacing with two piece sliding clips and (2) #10-16 self-drilling screws per clip. The panel sidelaps were mechanically seamed to form a 180º seam.

1.3 TEST RESULTS

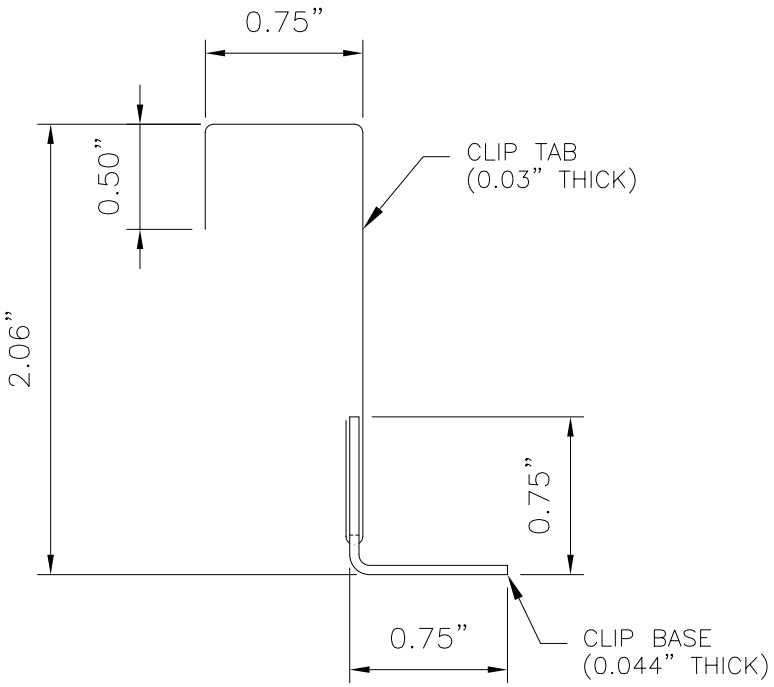
The panels were loaded to a failure condition and observations made. In both tests, the failure mode was the bending failure of the clip base. The ultimate and design loads for all tests are shown on Table 1.

Table 1. Test Results for 16" wide, 24 ga. System 2500 Panel

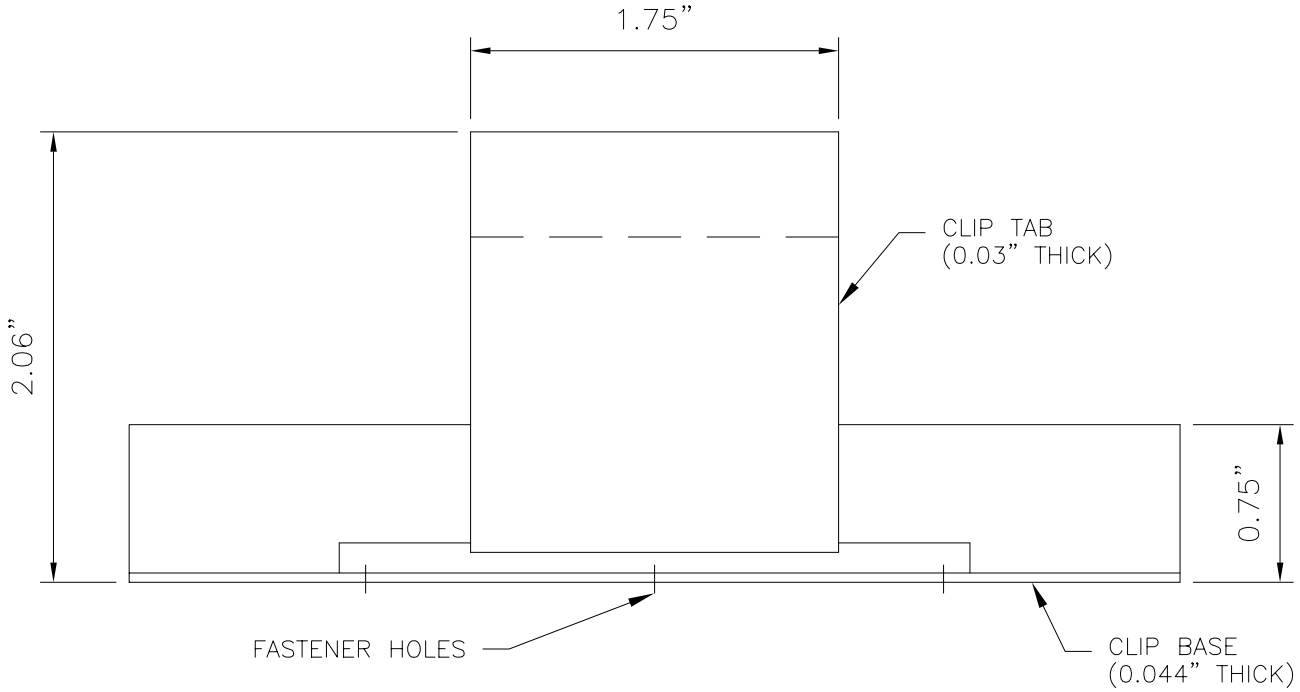
Test	Purlin Spacing	Ultimate Load (psf)	Design Load (psf)
1	5' 0"	40.2	20.1
2	1' 0"	180.5	90.3

Notes:
1. The design load is calculated by dividing the ultimate load by the factor of safety of 2.
2. The design loads have not been increased by 33% for wind load.

24 GA. SYSTEM 2500 SSMR PANEL

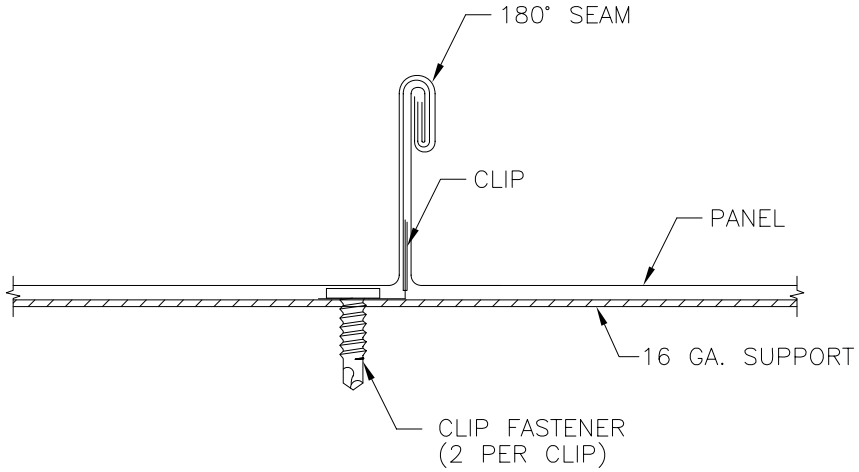


CLIP SIDE VIEW

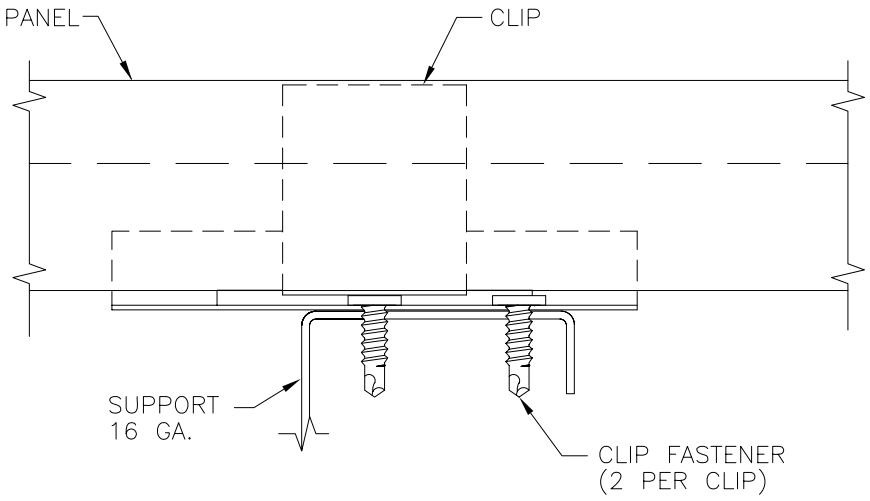


CLIP FRONT VIEW

SYSTEM 2500 CLIP



CLIP SECTION VIEW



CLIP SIDE VIEW

2.1 DESCRIPTION OF TEST

Tests were conducted to determine the structural performance of the SSMR Panel at various span configurations under uniform static pressure difference. The test method consisted of the following: (1) sealing the test specimen against one face of a test chamber; (2) supplying air to and exhausting air from the chamber at the rate required to maintain the test pressure difference across the specimen; and (3) observing, measuring, and recording the deflections, deformations, and nature of any failures of principal or critical elements of the panel profile or members of the anchor system.

The increments of load application were chosen such that a sufficient number of readings were obtained to determine the load deformation curve of the system. End and edge restraint was representative of field conditions, and the unit contained sufficient individual components to minimize the effect of variations in material and workmanship.

2.1.1 TEST CHAMBER

The test chamber consisted of a box as shown in the applicable drawings in Section V. It contains one open surface against which the test specimen is installed. Two static pressure taps are located at corners to measure the chamber pressure in such a manner that the readings are not affected by the velocity of the air supply to or from the chamber or other air movement. The air supply openings into the chamber are arranged so that the air does not impinge directly on the test specimen with significant velocity.

2.1.2 AIR SYSTEM

The compressed air supply consists of a number of individual compressor units capable of maintaining a constant air pressure difference for the required test period. A digital manometer is used to measure the test pressure difference with accuracy of 1/10".

2.1.3 DEFLECTION AND DISTORTION MEASUREMENT

Deflection and distortion measurements were taken by means of a level and staffs calibrated to 1/100 of an inch, which were attached to the topside of the specimen. The deflection staffs were placed so that movement of the support members did not influence their readings. Reading locations are as shown on the drawings in Section V.

2.1.4 TEST PROCEDURE

A nominal air pressure of 7.8 psf, which was equivalent to four times the dead weight of the specimen, was applied to the test panel for at least a minimum of 60 seconds and until the panel had stabilized and readings were taken. These readings were considered as bench mark readings and the load corresponding to these readings were considered as "Reference Zero Load."

The air pressure was then increased by load increments as shown on recorded data and held for 60 seconds and until the panel had stabilized and the first set of readings were measured for the test panel. The air pressure was then reduced to zero or no load and then once again to the Reference

Zero Load and the bench mark readings were taken.

This procedure was repeated several times each time increasing the air pressure by a load increment over the previous load. It was ensured that benchmark readings were taken between each incremental increase in order to keep track of permanent deflections. This load sequence was continued until the panel was subjected to maximum air pressure resulting in its failure.

2.1.5 TEST SPECIMEN

The test specimen was of sufficient size to determine the performance of all typical parts of the roof system excluding support elements such as purlins, eave struts, rake angles and similar structural parts supporting the roof system. Conditions of structural support of the roof specimen were simulated as accurately as possible. The test specimen included roof panels, concealed anchor clips and perimeter attachment of the roof to its structural supports. All of the parts of the test specimen were actual size and material. The overall dimension of the specimen was 7.75' x 25.0' for 5' 0" span test and 7.75' x 10.0' for 1' 0" span test. The panels were supported by secondary structures (purlins). The details of methods of construction and anchorage are depicted in the enclosed test drawings

At the discontinuous end of test panel representing the building "cut side" (Detail 1/6), the only attachment to the underlying purlin was the panel clip. This "cut side" was constructed as if an actual building panel was physically severed into two pieces leaving the test edge of the panel discontinuous in a substantially unsupported condition. Endwall edges "cut end" (Details 1/3 and 1/4) were attached to rake angles or other structural elements by clamps. One eave/sidewall (Detail 1/5) and the panels in the main field of the test setup including the panel clips and its attachment to the secondary structure (purlins) were constructed similar to the panel mounting system that would be used to mount the panel to an actual building structure.

The panel clip is hooked to the male lip of the panel and is attached to the purlin. See Drawings 1/1 and 1/2 for typical location of panel clips and Drawings 1/3 and 1/4 for locations of the panel clip relative to the various edge conditions. Plastic sheeting (max 6 mil thick) was used to keep the air pressure chamber airtight. The sheeting was placed between the purlins and panels. The sheeting between panel clips was pleated to allow the sheeting to flow into the panel sidelap when air pressure was applied to the panels.

2.1.6 SPECIMEN WIDTH & LENGTH

The specimen width contained no less than five full panels and five structural elements. Edge seals did not constrain the specimen any more than normal gable attachment. With two ends crosswise restraint, the panels spanned 5 equal spans of 5' 0". With only one end crosswise restraint, the panels spanned 10 equal spans of 1' 0"**.**

2.1.7 SPECIMEN ORIENTATION AND SEALING

The test specimen was installed in its "as used" orientation, i.e., the interior side of the specimen faced the applied air pressure. The panel was secured to the test jig by the same number and type of

concealed anchor clips as are normally used for installation of the test specimen on a building. The use of tape or film did not restrict differential movement between adjoining members.

2.1.8 FAILURE

Failure was considered to have occurred when components separated or permanent distortion interfered with the function of the system or the system was unable to carry additional load. Permanent deformation of the panel across the flat (area between the ribs) which does not adversely affect roof watertightness or roof performance was not considered failure.

2.2 FACTOR OF SAFETY

The design loads was calculated with factor of safety of 2 as per *AISI-NAS 2001 Specifications and 2004 Supplement.*

TEST RESULTS

3.1 SPECIMEN IDENTIFICATION

Manufacturer:	Metal Roofing Systems
Model Type:	System 2500 Panel
Dimensions:	2" high seam, 16" wide flat pan profile with 180º seam
Panel Gauge:	24 ga.
Base Metal Thickness:	0.020"
Panel Yield Strength:	53.5 ksi
Elongation in 2":	24 %
Panel Coating:	Painted Finish
Clip Type:	System 2500 two piece sliding clip
Clip Material:	Clip tab - 0.030" thick, 1.75" wide Clip base - 0.044" thick, 5.0" wide
Fasteners:	(2) #10-16 SDS
Purlin:	16 ga. (0.058" thick)

Note: All the test materials were supplied by Metal Roofing Systems and were not sampled by ENCON.

3.2 TEST RESULTS FOR 16" WIDE, 24 GA. PANELS AT 5' 0" PURLIN SPACING

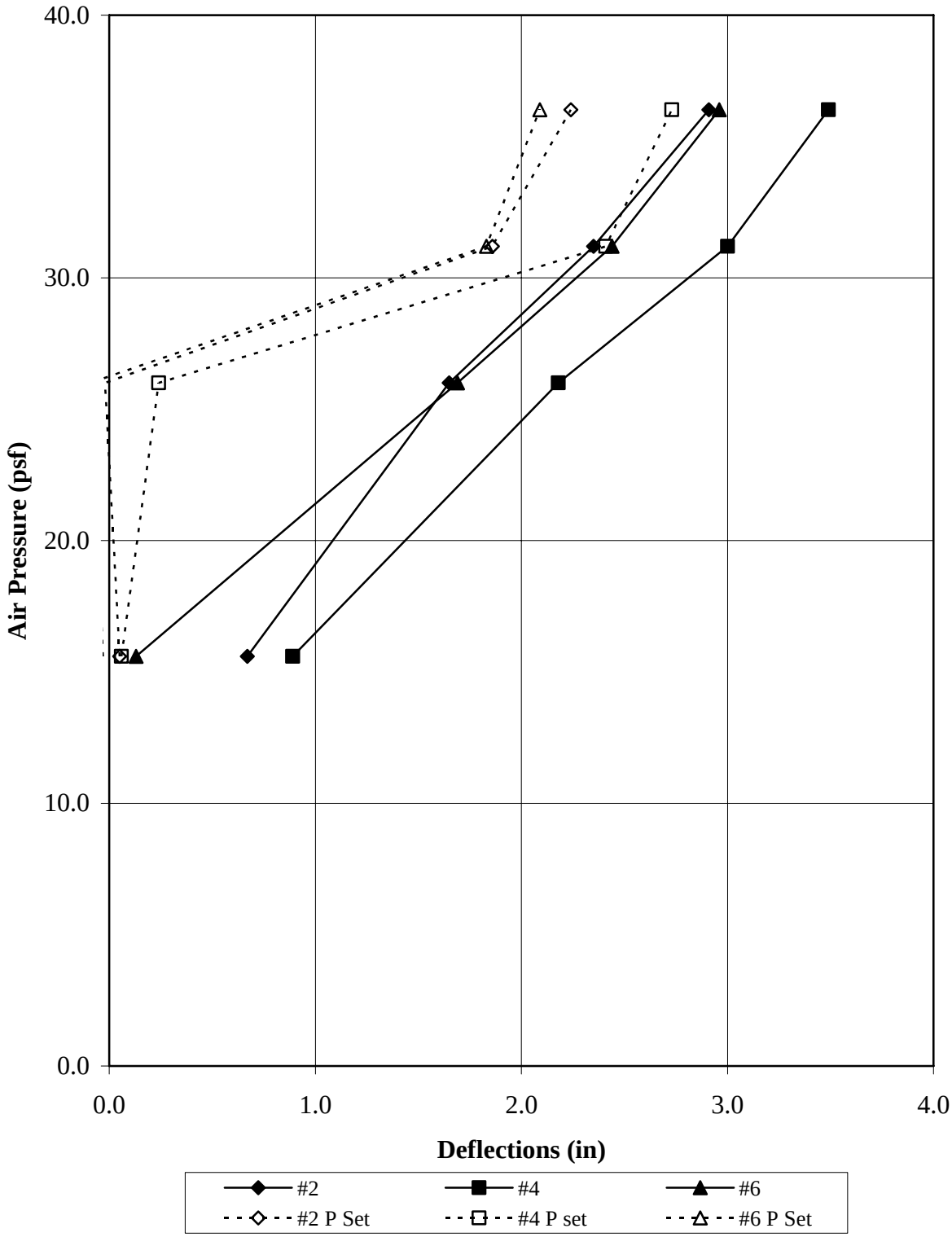
Testing of 24 Ga., Metal Roofing Systems System 2500 Panel
@ 5'-0" Purlin Spacing with 180° Seam

Air Pressure Test #1 Conducted On May 28, 2008

No.	Pressure	Time	Deflection (in)						
	psf	Sec	1	2	3	4	5	6	Remarks
1	15.6	60.0	0.09	0.67	0.14	0.89	0.12	0.13	
2	7.8		0.05	0.05	0.07	0.06	0.07	-0.03	
3	26.0	60.0	0.24	1.65	0.27	2.18	0.24	1.69	
4	7.8		0.13	-0.02	0.12	0.24	0.11	-0.09	
5	31.2	60.0	0.67	2.35	0.71	3.00	0.56	2.44	
6	7.8		0.39	1.86	0.42	2.41	0.32	1.83	
7	36.4	60.0	1.04	2.91	1.07	3.49	0.89	2.96	
8	7.8		0.85	2.24	0.81	2.73	0.64	2.09	
9	40.2	0.0							

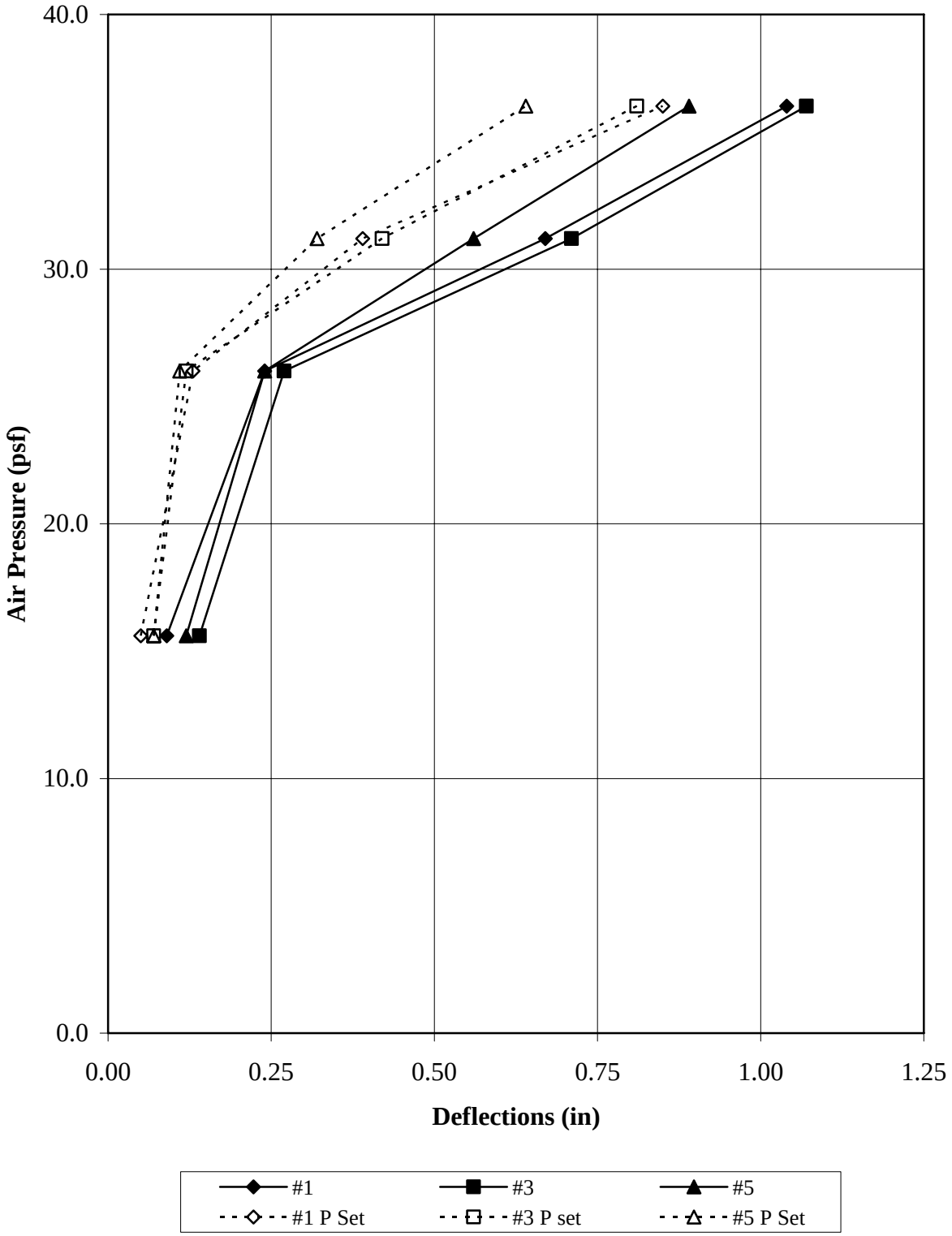
Failure Mode: Bending failure of clip base

Load vs Panel Flat Deflections
5' 0" Span (24 ga.) with 180º Seam



Note: P Set denotes permanent deflection after each load cycle.

Load vs Panel Rib Deflections
5' 0" Span (24 ga.) with 180º Seam



Note: P Set denotes permanent deflection after each load cycle.

3.3 TEST RESULTS FOR 16" WIDE, 24 GA. PANELS AT 1' 0" PURLIN SPACING

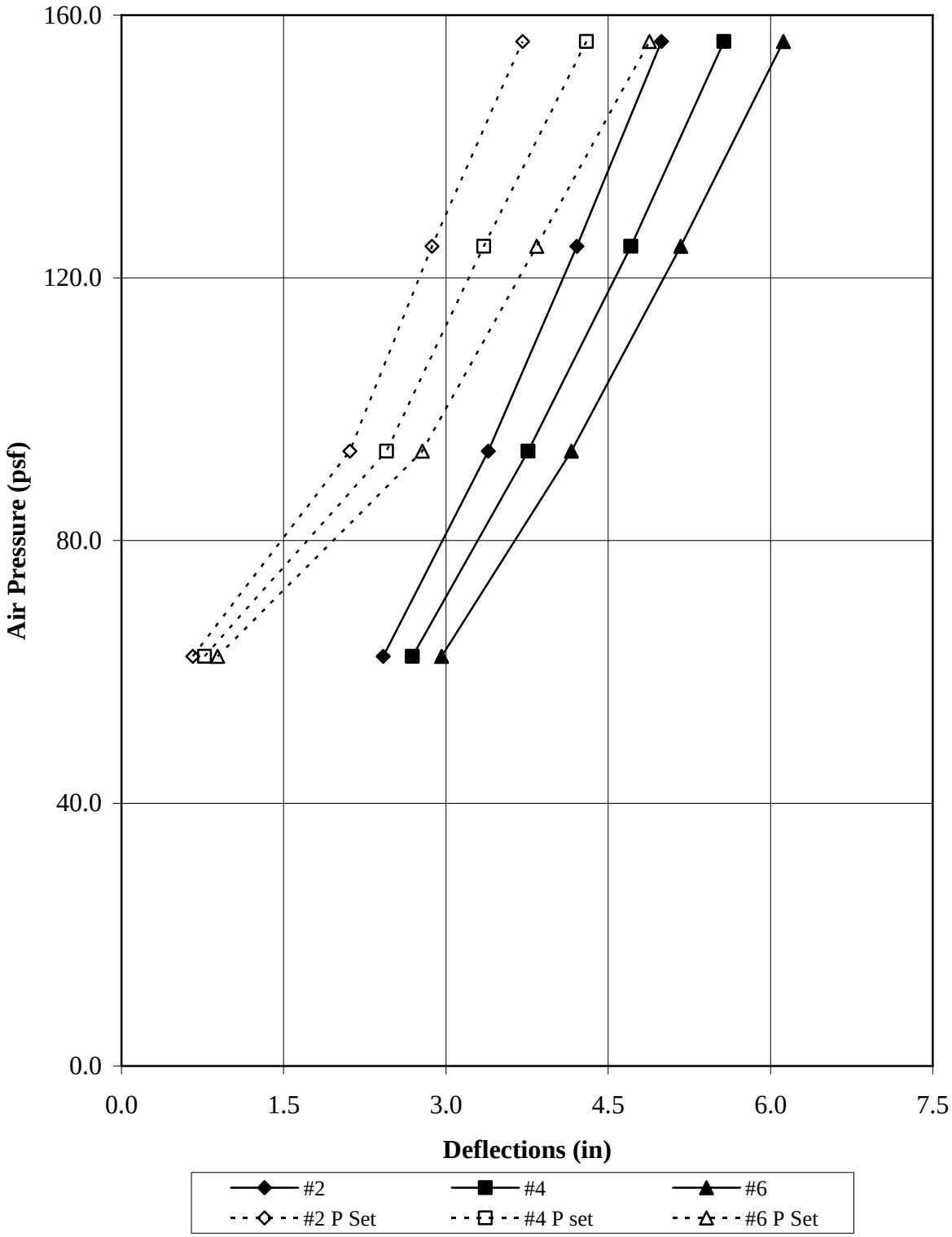
Testing of 24 Ga., Metal Roofing Systems System 2500 Panel
@ 1'-0" Purlin Spacing with 180° Seam

Air Pressure Test #2 Conducted On May 29, 2008

No.	Pressure	Time	Deflection (in)						
	psf	Sec	1	2	3	4	5	6	Remarks
1	62.4	60.0	0.13	2.42	0.15	2.69	0.14	2.96	
2	7.8		0.03	0.66	0.02	0.77	0.03	0.89	
3	93.6	60.0	0.27	3.39	0.34	3.76	0.37	4.16	
4	7.8		0.04	2.11	0.07	2.45	0.09	2.78	
5	124.8	60.0	0.48	4.21	0.61	4.71	0.70	5.17	
6	7.8		0.27	2.87	0.34	3.35	0.38	3.84	
7	156.0	60.0	0.75	4.99	0.95	5.57	1.08	6.12	
8	7.8		0.45	3.71	0.55	4.30	0.63	4.88	
9	180.5	0.0							

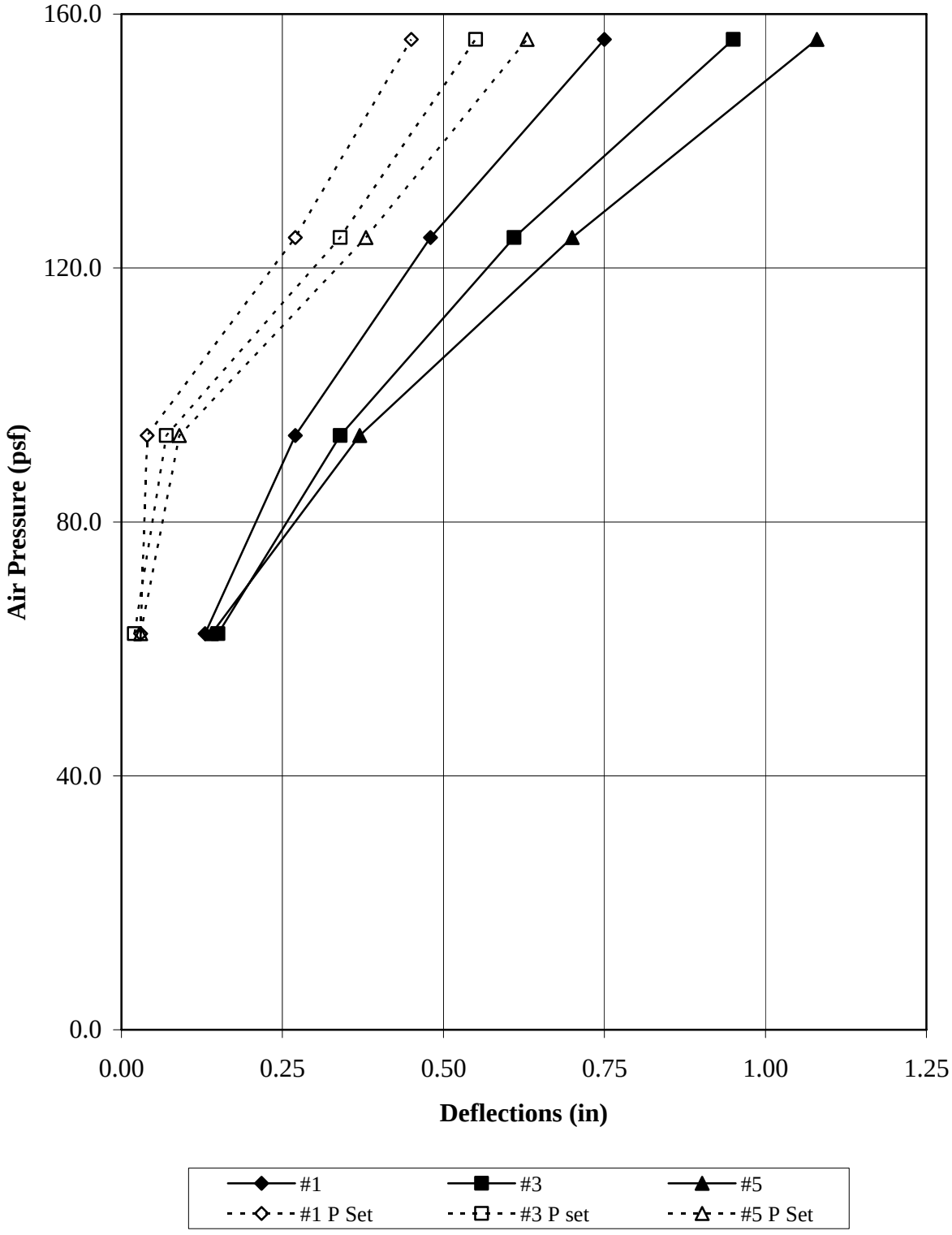
Failure Mode: Bending failure of clip base

Load vs Panel Flat Deflections
1' 0" Span (24 ga.) with 180º Seam

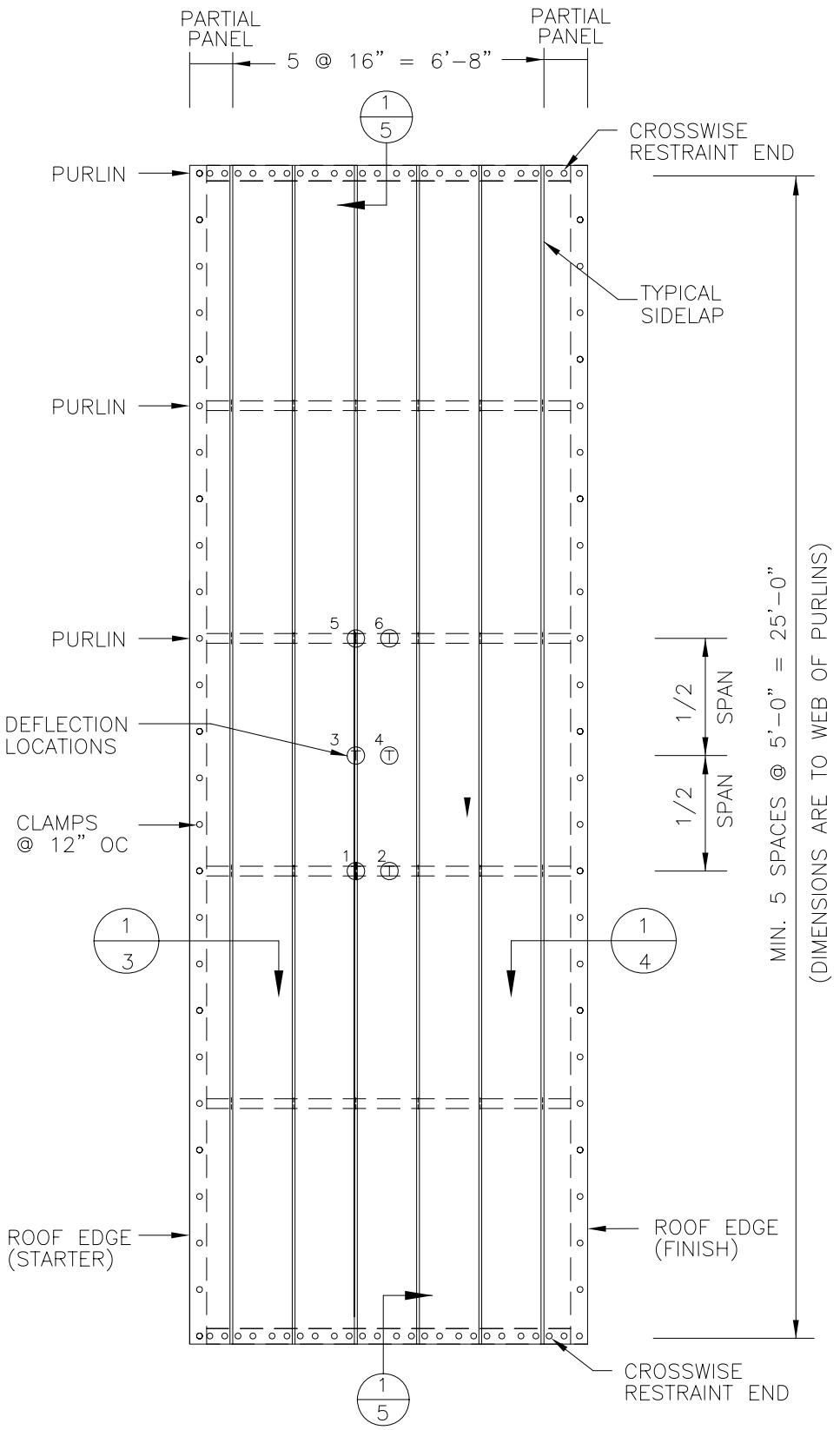


Note: P Set denotes permanent deflection after each load cycle.

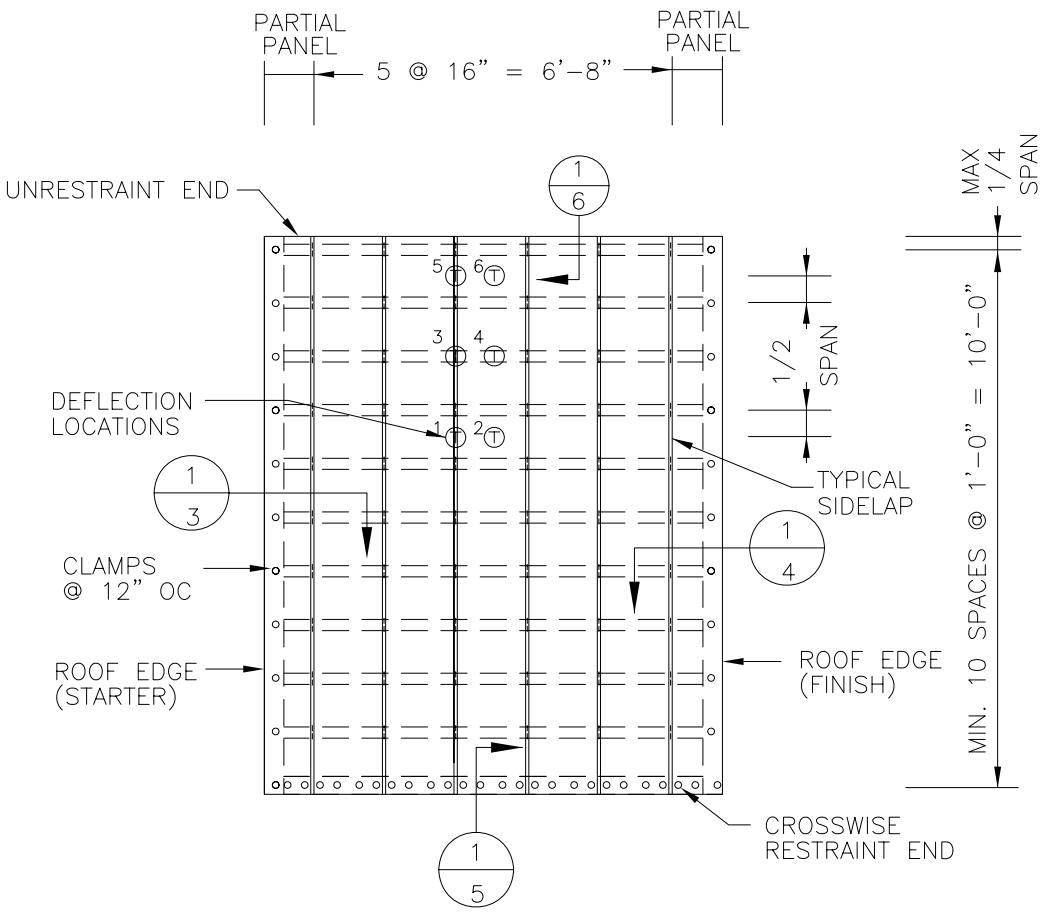
Load vs Panel Rib Deflections
1' 0" Span (24 ga.) with 180º Seam



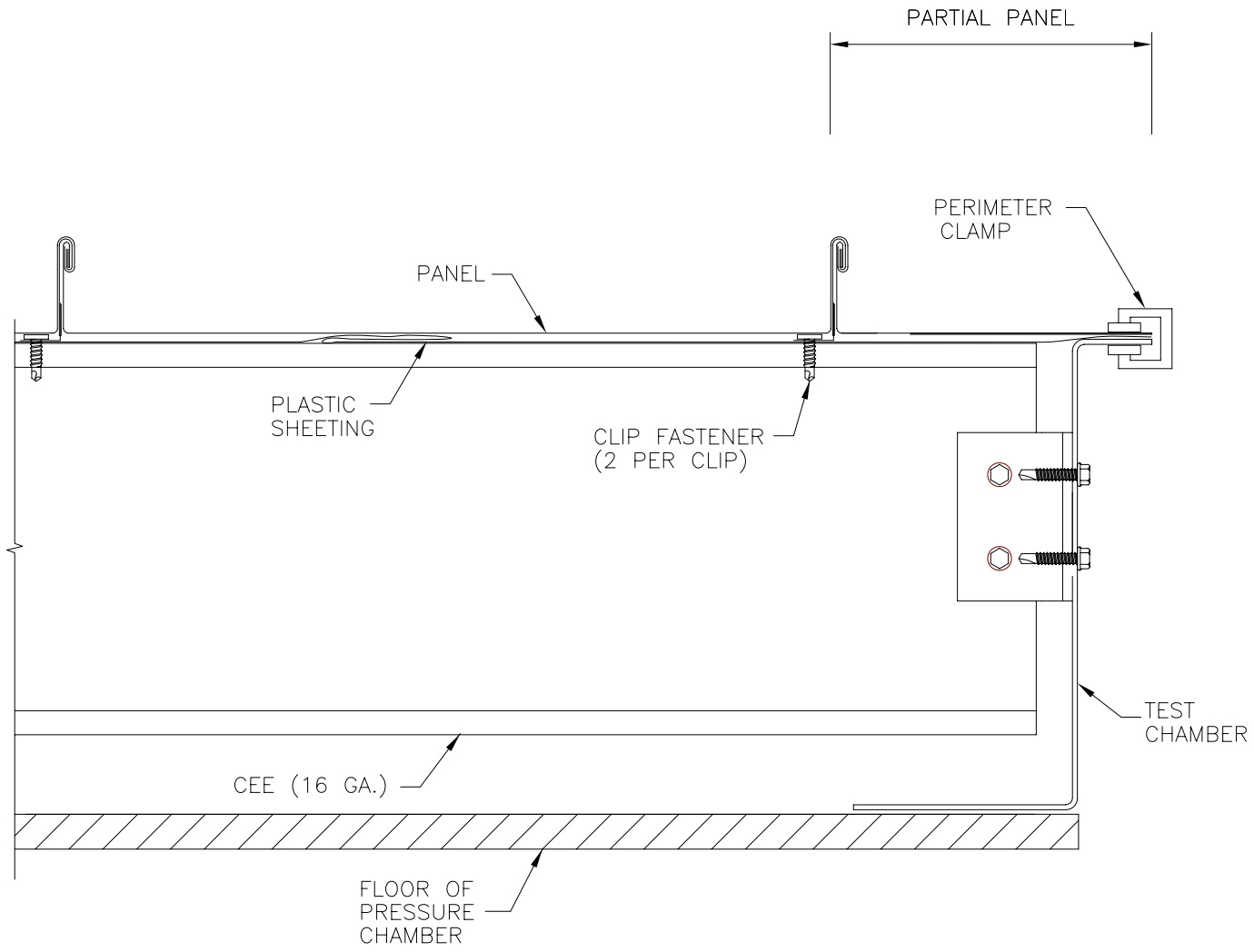
Note: P Set denotes permanent deflection after each load cycle.



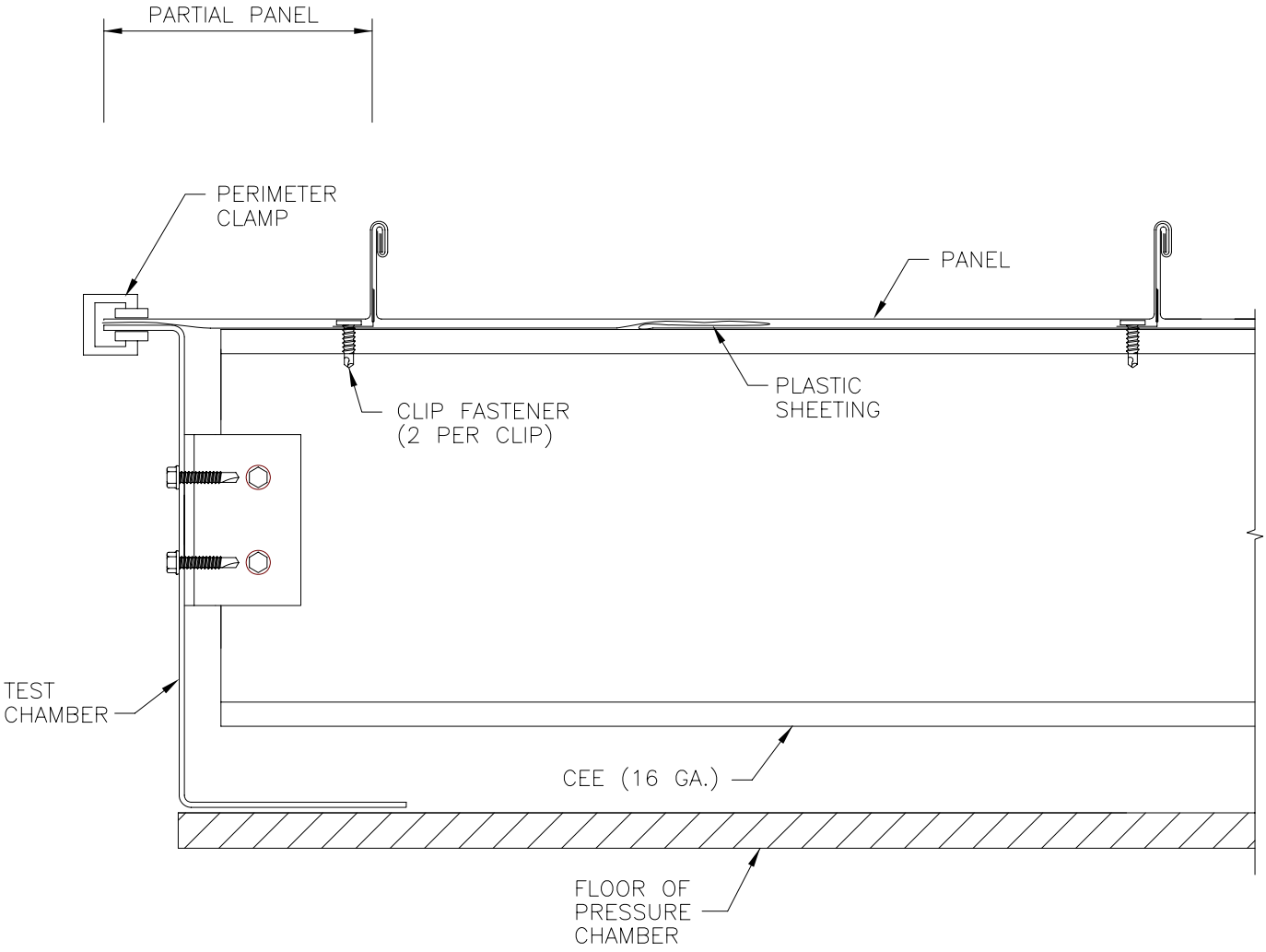
1/1 PLAN VIEW OF TEST ROOF
5' 0" PURLIN SPACING



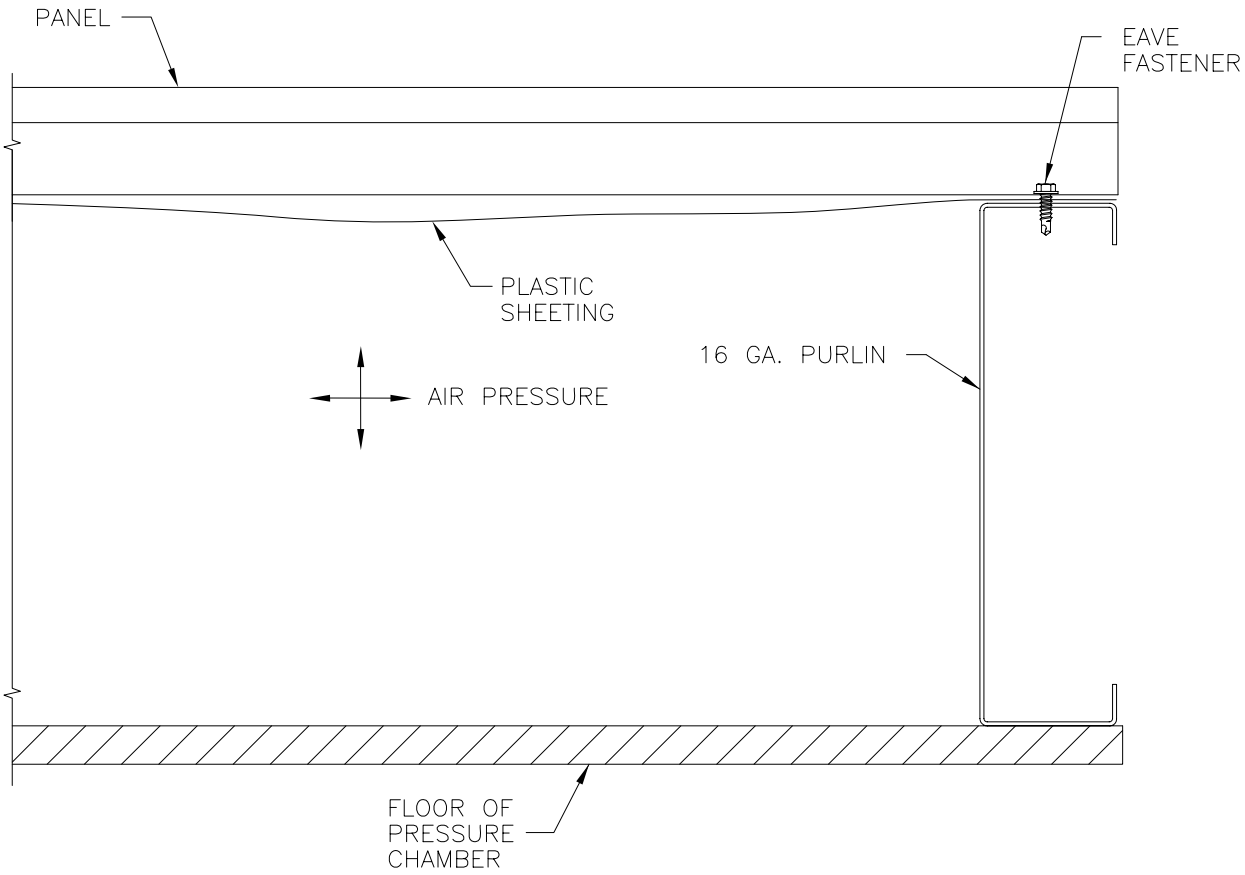
1/2 PLAN VIEW OF TEST ROOF
1' 0" PURLIN SPACING



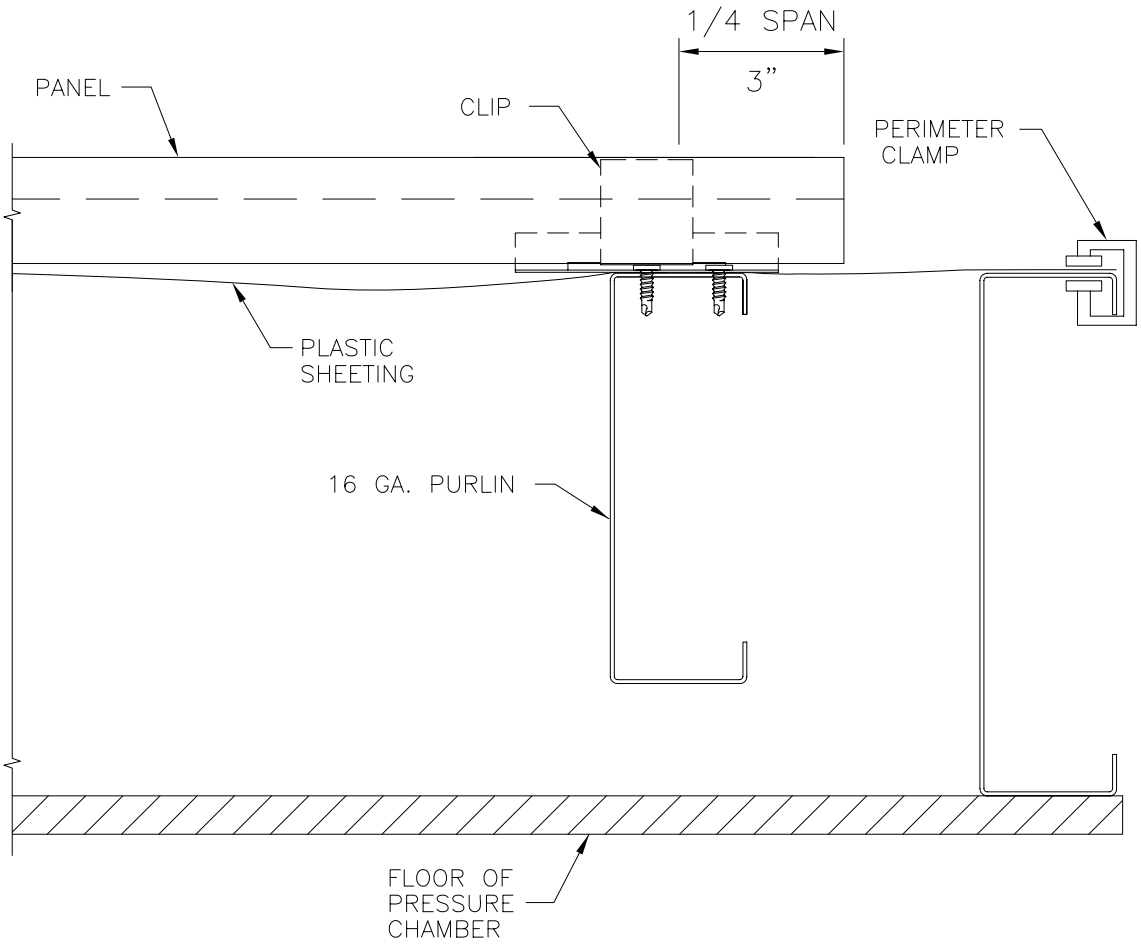
1/3 DETAIL OF "START RAKE" OF TEST ROOF



1/4 DETAIL OF "FINISH RAKE" OF TEST ROOF



1/5 DETAIL OF "CROSSWISE RESTRAINT ENDS"



1/6 DETAIL OF "CROSSWISE UNRESTRAINT ENDS"

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LABORATORY REPORT

Attn: Bala Sockalingam
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6717 S. Yale Ave., Suite 200
Tulsa, OK 74136-3327

Report No.: 08051019-001-v1
Date Received: 5/28/2008
Date Reported: 5/29/2008
P.O. No.: Verbal

Sample Description: System 2500 Panel

Tensile Test (Rectangular) per ASTM E8-08

Parameter	Result
Thickness, inch	0.020
Width, inch	0.503
Tensile Strength, psi	62,000
Yield Strength, psi at 0.2% offset	53,500
Elongation in 2 inches, %	24

Approved by: _____
Jeffrey Simmons, Laboratory Director
Sherry Laboratories

APPENDIX

5.3 TEST CONDITIONS

A. OWNERSHIP OF ENCON WORK PRODUCT

All test results developed as a part of this work shall be CUSTOMER's property. All samples submitted to ENCON for testing shall become the property of ENCON. CUSTOMER understands that any test program including procedures and test machines incorporated as a part of this work is a result of continuing long-term research and development by ENCON and because of this all ENCON test procedures, test drawings and other intellectual property relating to this work is and shall remain the property of ENCON. Test samples were disposed of shortly after completion of the tests unless other arrangements were agreed to in writing prior to the test.

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ENCON guarantees it used its best effort to accomplish this test work. Work done by ENCON was carefully completed by personnel believed to be competent. ENCON tests were based on what was currently believed to be good engineering practices in use at the time of the test.

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APPENDIX

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