d², Inc.
design dynamics, Inc.
17772 Preston Rd., Suite 204
Dallas, TX 75252
Phone: (972) 447-9494
Fax: (972) 447-9498

August 27, 2005

Action Manufacturing, LLC
WINDBAR Division, Inc.
12656 E. Jamison Place, Unit 7
Englewood, Colorado 80112

Attn.: Mr. Jason Nagaki

Subject : ASTM E-1592 Wind Uplift Testing of an Architectural Standing Seam Roof Panel @ 1 3/4" deep x 18" wide x 24 ga. steel with Snap-Action Sidejoint Feature..... With and Without Your WINDBAR anti-lift Device.

Dear Jason,

I am forwarding this cover letter to consolidate the results of the four (4) ASTM E-1592 wind uplift test performed on a typical architectural standing seam panel as defined above.

We conducted the test series based on minimum and maximum clip spacings of 1.50' and 4.00' respectively, with and without the WINDBAR device.

This was done to determine the index of improvement which can be realized with the addition of your WINDBAR device relative to the specific panel specimen tested.

Obviously the numbers determined with this specific panel apply only to that panel/material/manufacturer.

To establish the improvement index for other panels would require the same testing protocol for the panel system in question.

The following chart shows the roof panel Ultimate Uplift Capacity with and without the WINDBAR for the minimum and maximum clip spacings (spans) evaluated.

Additionally, the chart indicates the increase in Ultimate Uplift Capacity value to be realized utilizing your device.

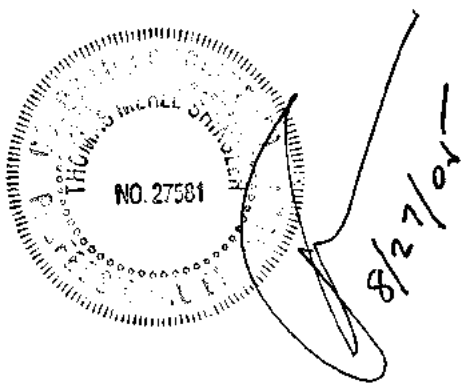
	Ultimate Uplift Capacity per E-1592, psf		
clip spacing	with WINDBAR	without WINDBAR	Increase
1.50'	250.0	80.6	3.10
4.00'	78.0	41.6	1.88

Based on these tested values, the WINDBAR device adds substantial wind uplift capacity to standing seam roof panels which are susceptible to uplift-induced profile distortion, sidejoint rotation and male/female joint disengagement.

Please give me a call @ (972) 740-5580 if you have any questions relative to this presentation.

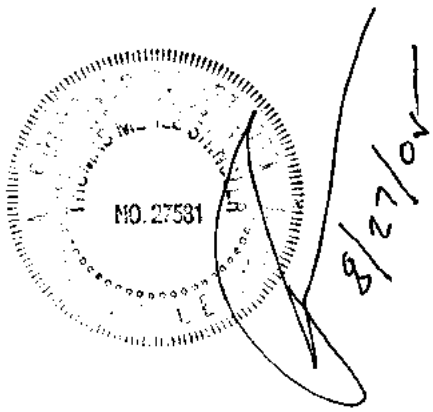
Sincerely,

Thomas M. Shingler, P.E.
Registered Structural Engineer
President
Design Dynamics, Inc.



TO : Action Manufacturing, LLC
WINDBAR Division
12656 E. Jamison Place, Unit 7
Englewood, Colorado 80112

Attn.: Mr. Jason Nagaki



FROM : Thomas M. Shingler, P.E.
Registered Structural Engineer
President
Design Dynamics, Inc.

DATE : August 27, 2005

SUBJECT : **WINDBAR** Applied @ Mid-Span to .....
Architectural Standing Seam Roof Panel
@ 1 3/4" deep x 18" wide x 24 ga. steel
With Snap-Action Sidejoint Feature
Utilizing the ASTM E-1592 Procedure
for the Determination of Wind Uplift Capacity
@ 1.50 ft & 4.00 ft o/c clips

TEST PROCEDURE : ASTM E-1592
STANDARD TEST METHOD FOR THE STRUCTURAL PERFORMANCE OF SHEET METAL ROOF AND SIDING SYSTEMS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE

PURPOSE : To determine the Ultimate Wind Uplift Capacity of the submitted metal roof system when fastened at various panel clip spacings.

TEST DATE : June 18, 2005

TEST SPECIMEN : Architectural Standing Seam Roof Panel
@ 1 3/4" deep x 18" wide x 24 gage steel
w/Snap-Action Sidejoint Feature

TEST CHAMBER : Composed of a floor mounted 10' wide x 21' long steel frame with a secondary 10' wide x 21' long steel frame with simulated purlins spanning across the 10' secondary frame width. The purlins consisted of 16 gage steel channel sections in combination with structural steel tube-shaped beams designed to support the test specimen at various purlin spacings.
The test pressures were applied to the specimen surfaces via a "loose fit" 6 mil clear plastic film designed to accurately configure to the panel profile and give both the panel shape and the sidejoint elements full degree of freedom during the loading process.

PURLIN MEMBERS : 16 gage steel channel-shaped sections side-stitched to the sidewalls of the structural tube beams, placed at 1.50 ft or 4.00 ft centers to represent the maximum and minimum purlin spacing extremes for the roof panel being tested.

PRESSURE INDICATOR : One (1) Digital Pressure Indicator manufactured by Micro-Pneumatic Logic, Inc. with a full-range accuracy of 1/10" H2O and traceable to the National Bureau of Standards.
One (1) Alta Robins, Inc. Model 100 SS High Pressure U-Tube Manometer with a 0 to 24 inches of H20 pressure range.

DIGIMATIC CALIPER : Mitutoyo Series Model No. CD-12" CP with a full-range accuracy of 0.001 in.

INSTALLATION : The test panels were installed onto the purlin members in a ribs-up position with one (1) piece sliding (running fit) clips which were screw-attached to the top surface of the 16 gage steel channel-shaped sections using two (2) #10-16 x 1" long self-drilling screws with a #2 Phillips drive slot and a #3 drill point.
Side joints consisted of mating male/female interlocking ribs via an aggressive snap-action.
Continuity fasteners were located at the extreme ends of panels and consisted of single self-drilling screws driven into the mating panel webs.
Both ends of the mock-up were "free" to simulate the worst-case panel behavior.
At panel mid-span (between clips) locations, WINDBAR rib clamps (12 gauge stainless steel clamp with 3/8" diameter stainless steel set screws w/cup points) were applied to the panel standing seams, followed by the application of 1" x 1" x 16 gauge galvanized steel transverse bars to the rib clamps.
The transverse bars were attached to the rib clamps using two (2) corrosion-protected #10 self-drilling screws per rib clamp.
Attached to the transverse bars, and occurring at panel mid-width, was a anti-lift brace which prevents the broad flat of the panel from "heaving" under test-simulated wind uplift pressure.
The anti-lift bracket was attached to the transverse bar using one (1) corrosion-protected #10 self-drilling screw.

INSTALLATION : continued

The theory behind the **WINDBAR** is that the anti-lift brace will keep the panel broad flat from raising under uplift and therefore diminish panel joint separation and disengagement.

Following the panel and **WINDBAR** installation, the secondary frame was raised, rotated 180 degrees, set down on the floor mounted frame and the visqueen sealed to the floor mounted frame which in-turn was sealed to the lab floor.

PROCEDURE : The individual panels were installed into the test chamber as a six (6) panel wide array per standard field techniques. Specific deflection measurement targets were established on key panels.
These targets and their locations are illustrated on an enclosed sketch.
Two (2) identical pressure gages were installed onto the test chamber for cross checking of test pressures and insuring accuracy of pressure data.
Initially the system was preloaded to (-) 5 psf to insure proper seating of the panels, clips and plastic film.

After the preloading process, initial deflection measurements were taken at the four (4) key panel locations. These initial deflection readings represented the zero position/zero load specimen status from which all readings were referenced.

Individual data sheets and graphic plots of the deflection readings are enclosed with this report.

A "step loading" procedure was used with pressure increments as indicated on enclosed data sheets.

At each incremental pressure level, the test pressure was maintained for an excess of sixty (60) seconds.

After the sixty (60) second pressure "hold" period, measurements were recorded at each of the four (4) critical panel locations.

PROCEDURE : continued

Also during this time period....broad-flat areas of the panels, sidejoints and clips were visually checked for signs of localized distress.

At the end of each pressure "hold" phase, the test chamber was returned to a zero pressure status and deflection measurements were once again recorded to check for meaningful "set" in the system.

Ever-increasing pressure values were applied and deflection values recorded both at the pressure as well as at zero.

This procedure continued until the Ultimate Uplift Pressure of the panel or a panel system component demonstrated "distress".

The Allowable Uplift Capacity for the tested panel system is the Ultimate Uplift Pressure divided by a Factor-of-Safety of 2.00.

The Allowable Uplift Pressure for the panel system was established at 1.50 ft & 4.00 ft. with intermediate Allowable Uplift Pressures being determined via linear interpolation between the two (2) test-established extremes.

E-1592 TEST RESULTS : with **WINDBAR**

Span, ft.	Ultimate Pressure, psf	Allowable Pressure, psf	Panel Failure Mode
1.50	250.0	125.0	maximum chamber capacity..... predicted clip/sidejoint interaction failure
4.00	78.0	39.0	disengagement

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

Panel Span, feet	Allowable Wind Uplift Pressure, psf
1.5	125.0
2.0	107.8
2.5	90.6
3.0	73.4
3.5	56.2
4.0	39.0

General Notes :

1. The Allowable Pressure is the Ultimate Test Pressure divided by a Factor-of-Safety (Load Factor) of 2.00

2. The published Allowable Wind Uplift Pressure considers panel buckling strength, sidejoint disengagement resistance and clip/sidejoint interactive strength only.

3. The clip-to-substrate fastener capacity must be investigated by a design professional and consider the clip pry coefficient where applicable.

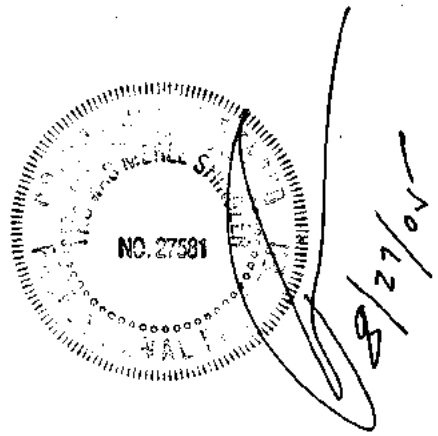
4. Tests were observed and data deciphered by Thomas M. Shingler, P.E. of Design Dynamics, Inc. in strict accordance with the ASTM E-1592 procedure.

********** END OF REPORT **********

file : RIDDELL2

TO : Action Manufacturing, LLC
WINDBAR Division
12656 E. Jamison Place, Unit 7
Englewood, Colorado 80112

Attn.: Mr. Jason Nagaki



FROM : Thomas M. Shingler, P.E.
Registered Structural Engineer
President
Design Dynamics, Inc.

DATE : August 27, 2005

SUBJECT : **Without WINDBAR** Applied @ Mid-Span to .....
Architectural Standing Seam Roof Panel
@ 1 3/4" deep x 18" wide x 24 ga. steel
With Snap-Action Sidejoint Feature
Utilizing the ASTM E-1592 Procedure
for the Determination of Wind Uplift Capacity
@ 1.50 ft & 4.00 ft o/c clips

TEST PROCEDURE : ASTM E-1592
STANDARD TEST METHOD FOR THE STRUCTURAL PERFORMANCE OF SHEET METAL ROOF AND SIDING SYSTEMS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE

PURPOSE : To determine the Ultimate Wind Uplift Capacity of the submitted metal roof system when fastened at various panel clip spacings.

TEST DATE : June 18, 2005

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@ 1 3/4" deep x 18" wide x 24 gage steel
w/Snap-Action Sidejoint Feature

TEST CHAMBER : Composed of a floor mounted 10' wide x 21' long steel frame with a secondary 10' wide x 21' long steel frame with simulated purlins spanning across the 10' secondary frame width. The purlins consisted of 16 gage steel channel sections in combination with structural steel tube-shaped beams designed to support the test specimen at various purlin spacings.
The test pressures were applied to the specimen surfaces via a "loose fit" 6 mil clear plastic film designed to accurately configure to the panel profile and give both the panel shape and the sidejoint elements full degree of freedom during the loading process.

PURLIN MEMBERS : 16 gage steel channel-shaped sections side-stitched to the sidewalls of the structural tube beams, placed at 1.50 ft or 4.00 ft centers to represent the maximum and minimum purlin spacing extremes for the roof panel being tested.

PRESSURE INDICATOR : One (1) Digital Pressure Indicator manufactured by Micro-Pneumatic Logic, Inc. with a full-range accuracy of 1/10" H2O and traceable to the National Bureau of Standards.
One (1) Alta Robins, Inc. Model 100 SS High Pressure U-Tube Manometer with a 0 to 24 inches of H2O pressure range.

DIGIMATIC CALIPER : Mitutoyo Series Model No. CD-12" CP with a full-range accuracy of 0.001 in.

INSTALLATION : The test panels were installed onto the purlin members in a ribs-up position with one (1) piece sliding (running fit) clips which were screw-attached to the top surface of the 16 gage steel channel-shaped sections using two (2) #10-16 x 1" long self-drilling screws with a #2 Phillips drive slot and a #3 drill point.
Side joints consisted of mating male/female interlocking ribs via an aggressive snap-action.
Continuity fasteners were located at the extreme ends of panels and consisted of single self-drilling screws driven into the mating panel webs.
Both ends of the mock-up were "free" to simulate the worst-case panel behavior.
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PROCEDURE : The individual panels were installed into the test chamber as a six (6) panel wide array per standard field techniques. Specific deflection measurement targets were established on key panels.
These targets and their locations are illustrated on an enclosed sketch.
Two (2) identical pressure gages were installed onto the test chamber for cross checking of test pressures and insuring accuracy of pressure data.

PROCEDURE : Continued

Initially the system was preloaded to (-) 5 psf to insure proper seating of the panels, clips and plastic film.

After the preloading process, initial deflection measurements were taken at the four (4) key panel locations. These initial deflection readings represented the zero position/zero load specimen status from which all readings were referenced.

Individual data sheets and graphic plots of the deflection readings are enclosed with this report.

A "step loading" procedure was used with pressure increments as indicated on enclosed data sheets.

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After the sixty (60) second pressure "hold" period, measurements were recorded at each of the four (4) critical panel locations.

Also during this time period....broad-flat areas of the panels, sidejoints and clips were visually checked for signs of localized distress.

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The Allowable Uplift Capacity for the tested panel system is the Ultimate Uplift Pressure divided by a Factor-of-Safety of 2.00.

The Allowable Uplift Pressure for the panel system was established at 1.50 ft & 4.00 ft, with intermediate Allowable Uplift Pressures being determined via linear interpolation between the two (2) test-established extremes.

E-1592 TEST RESULTS : without WINDBAR

Span, ft.	Ultimate Pressure, psf	Allowable Pressure, psf	Panel Failure Mode
1.50	80.6	40.3	disengagement
4.00	41.6	20.8	disengagement

ALLOWABLE WIND UPLIFT LOAD/SPAN CHART : without WINDBAR

Panel Span, feet	Allowable Wind Uplift Pressure, psf
1.5	40.3
2.0	36.4
2.5	32.5
3.0	28.6
3.5	24.7
4.0	20.8

General Notes :

1. The Allowable Pressure is the Ultimate Test Pressure divided by a Factor-of-Safety (Load Factor) of 2.00

2. The published Allowable Wind Uplift Pressure considers panel buckling strength, sidejoint disengagement resistance and clip/sidejoint interactive strength only.

3. The clip-to-substrate fastener capacity must be investigated by a design professional and consider the clip pry coefficient where applicable.

4. Tests were observed and data deciphered by Thomas M. Shingler, P.E. of Design Dynamics, Inc. in strict accordance with the ASTM E-1592 procedure.

******** END OF REPORT ********

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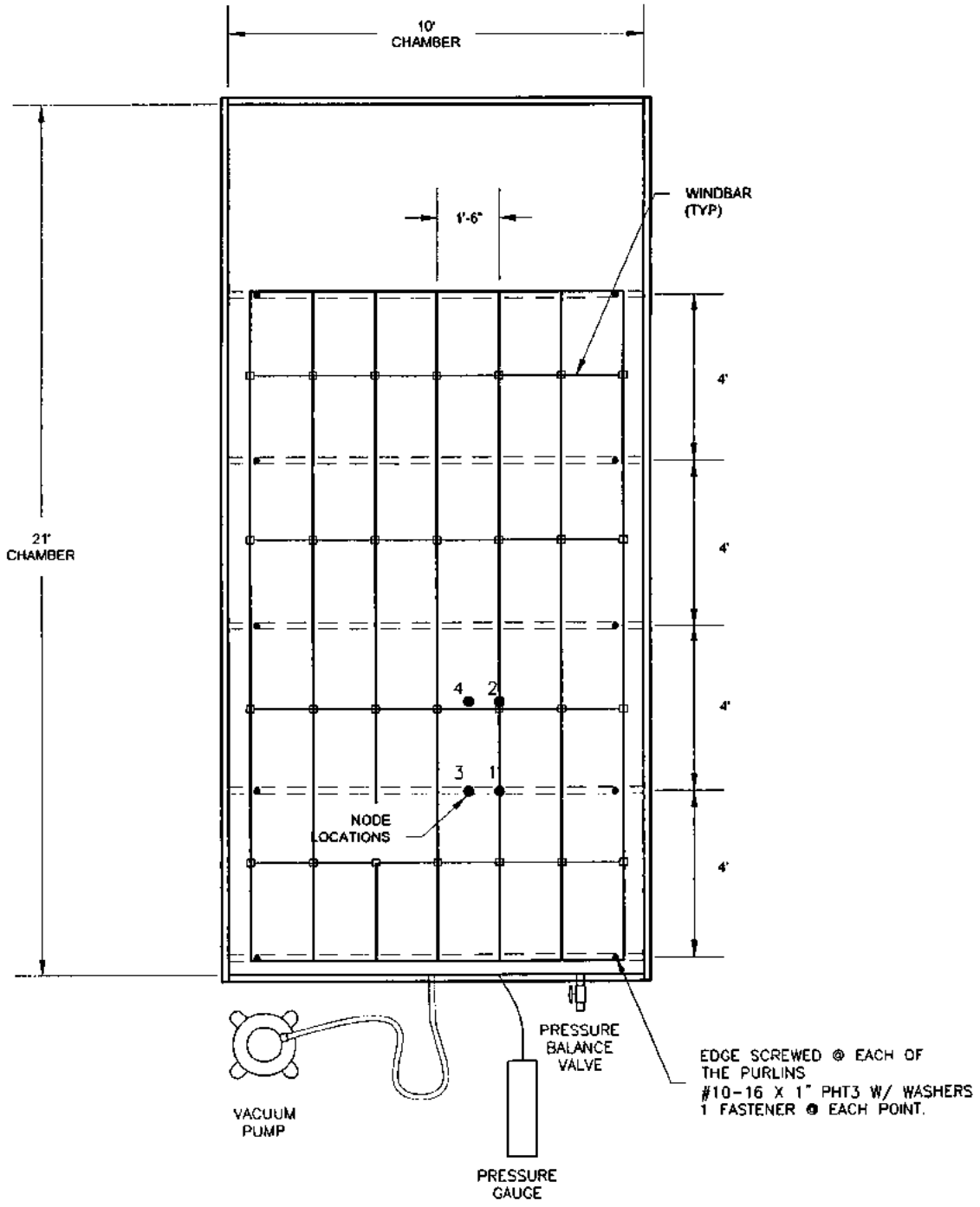
ASTM E-1592
FOR RIDDELL & CO.

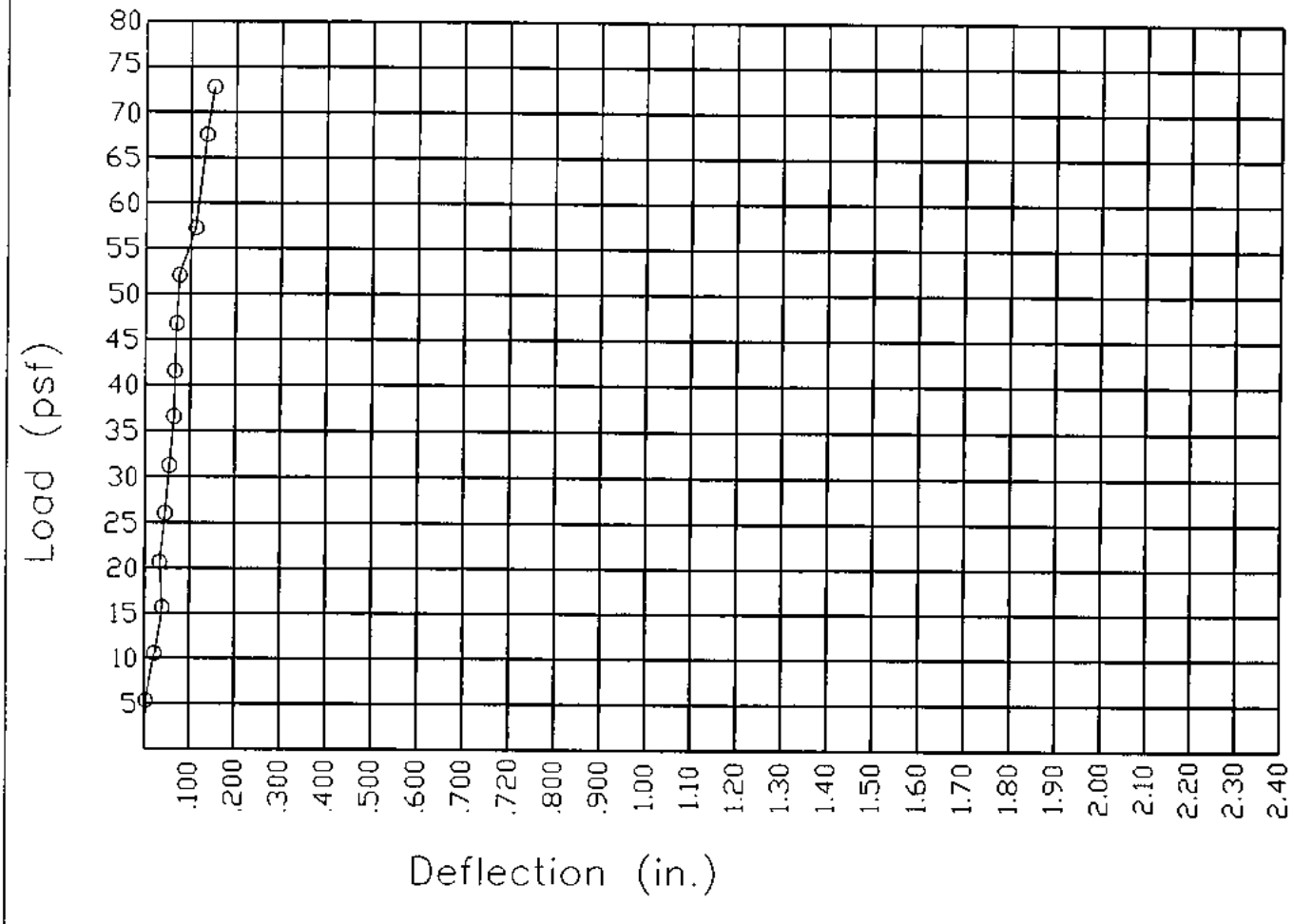


ASTM E-1592 TESTING
SL175 1 3/4" x 18" WITH WINDBAR
24 GA. STEEL

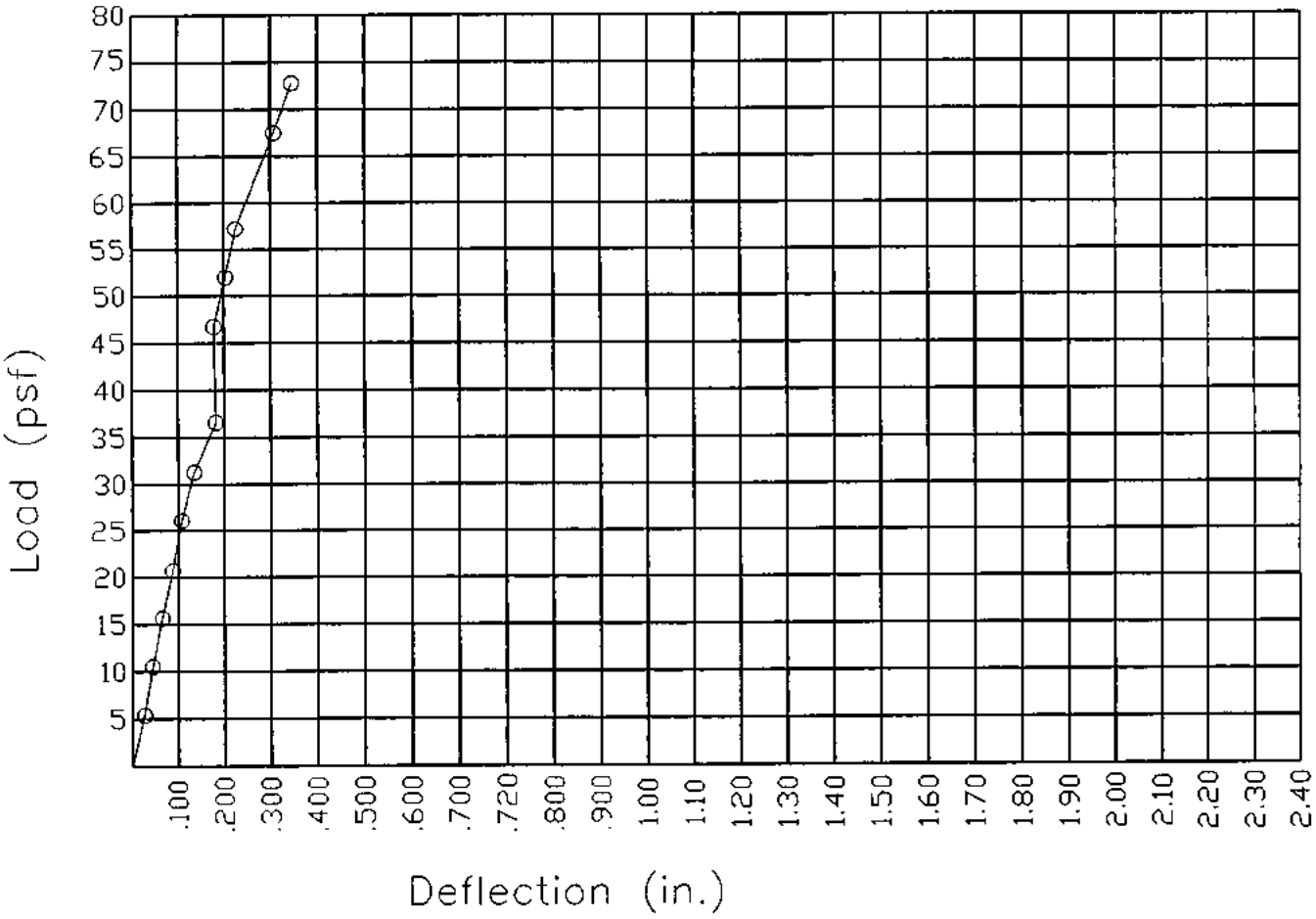
Pressure in. H20	Pressure psf	Deflection (in.)			
		1	2	3	4
0.000	0.000	4.210	4.164	4.378	4.430
1.000	5.200	0.015	0.025	0.201	0.004
2.000	10.400	0.027	0.032	0.307	0.023
3.000	15.600	0.040	0.043	0.407	0.070
4.000	20.800	0.034	0.065	0.461	0.064
5.000	26.000	0.046	0.089	0.522	0.085
6.000	31.200	0.055	0.109	0.612	0.115
7.000	36.400	0.065	0.134	0.664	0.144
8.000	41.600	0.066	0.182	0.709	0.170
9.000	46.800	0.070	0.179	0.749	0.193
10.000	52.000	0.085	0.201	0.826	0.239
11.000	57.200	0.111	0.226	0.877	0.355
12.000	62.400				
13.000	67.600	0.137	0.308	0.997	0.347
14.000	72.800	0.151	0.344	1.081	0.387
15.000	78.000				

Purlin Spacing: 4'-0"
Node 1: At rib, at purlin
Node 2: At rib, midspan between purlins
Node 3: At panel center, at purlin
Node 4: At panel center, between purlins
Center panel of chamber monitored
Failure at 15.00 in H2O
Mode of failure: Joint disengagement of 3 panels.

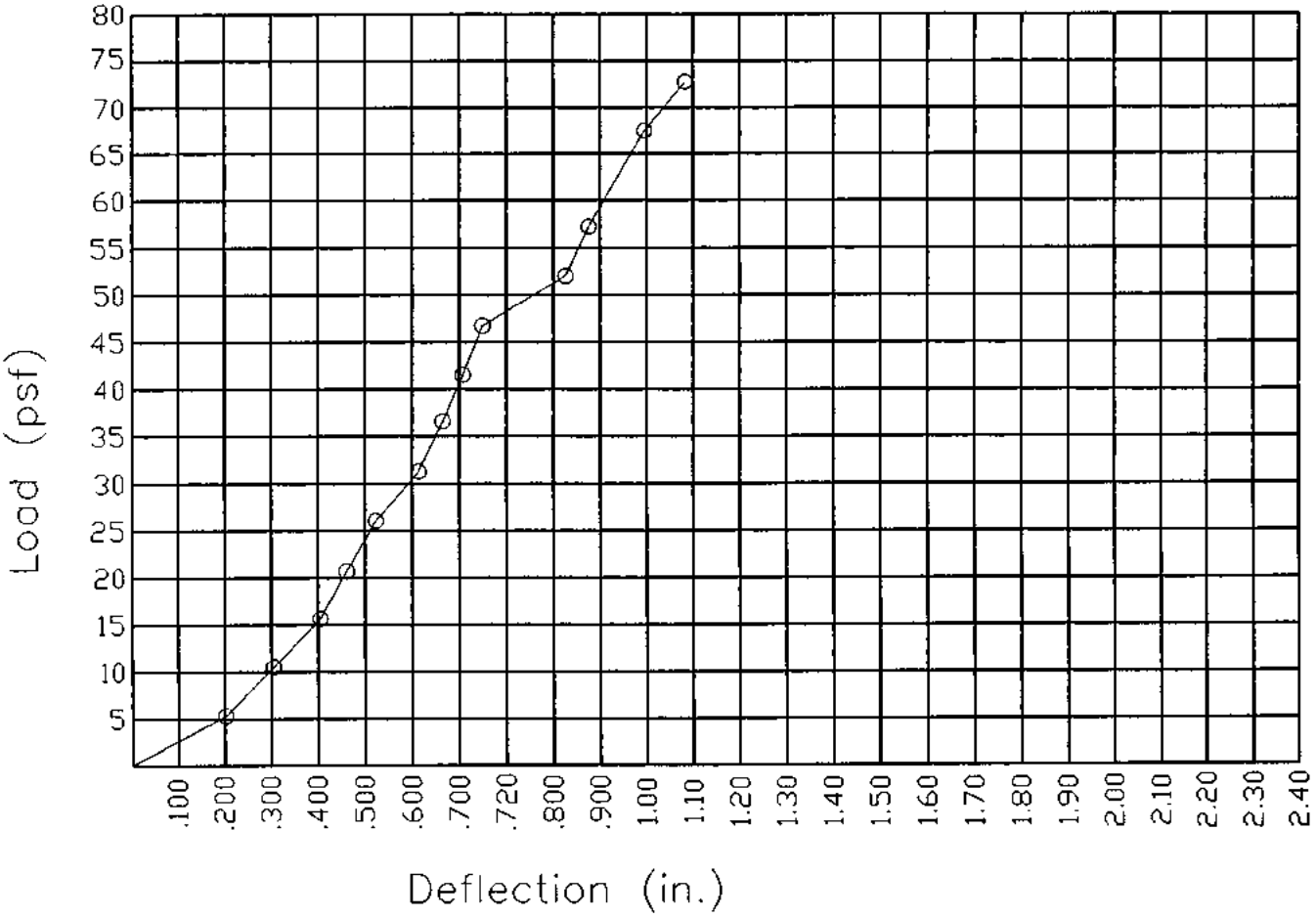
SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 4'–0"
Node No. 1



SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 4'–0"
Node No. 2



SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 4'-0"
Node No. 3



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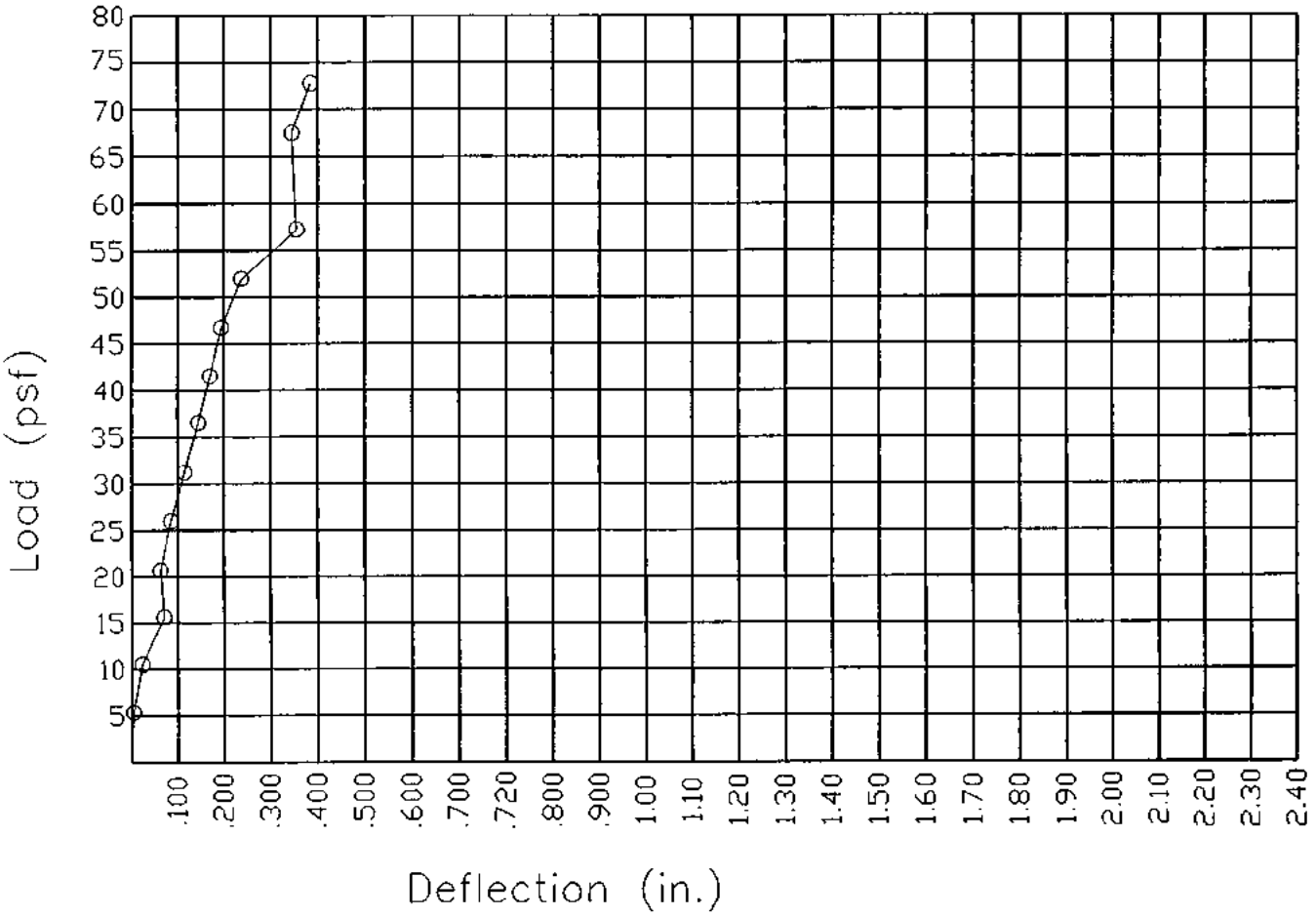
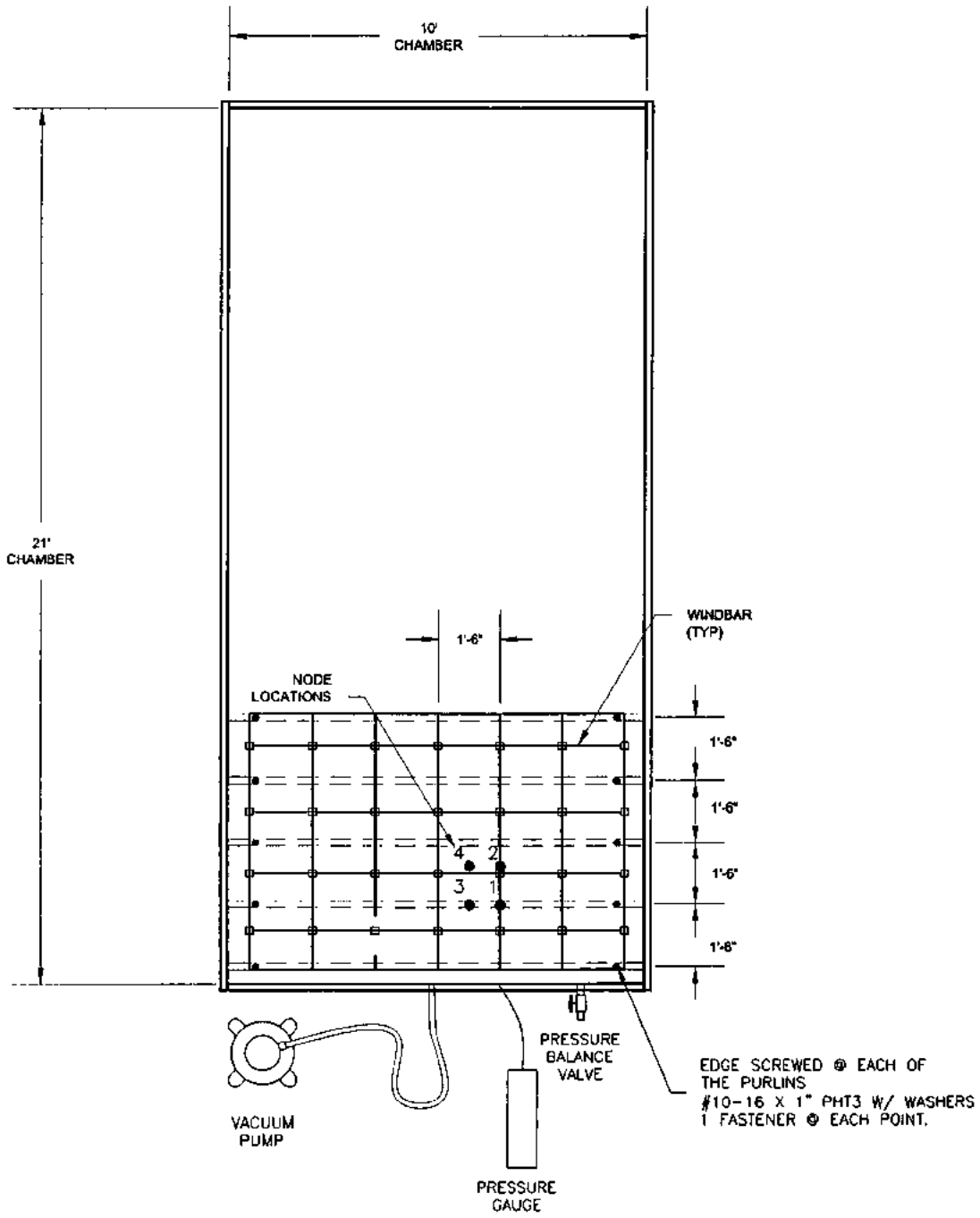
ASTM E 1592 – Purlins @ 4'-0"
Node No. 4



ASTM E-1592
FOR RIDDELL & CO.



ASTM E-1592 TESTING
SL175 1 3/4" x 18" WITH WINDBAR
24 GA. STEEL

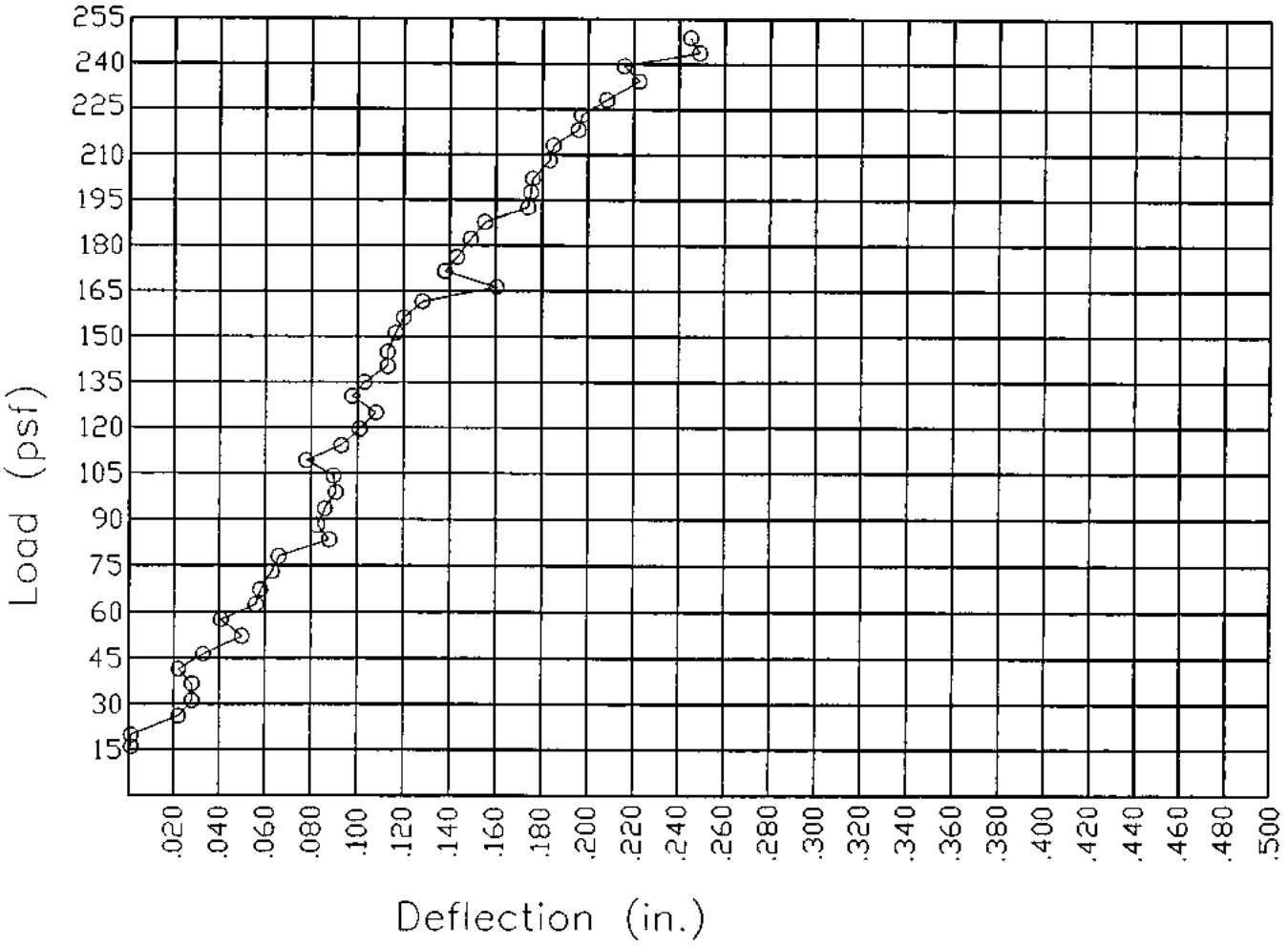
Pressure	Pressure	Deflection (in.)			
in. H20	psf	1	2	3	4
0.000	0.000	4.172	4.177	4.442	4.435
1.000	5.200	-0.004	0.002	0.077	0.029
2.000	10.400	-0.008	0.005	0.119	0.046
3.000	15.600	0.008	0.016	0.153	0.073
4.000	20.800	0.008	0.019	0.173	0.090
5.000	26.000	0.022	0.028	0.202	0.105
6.000	31.200	0.028	0.028	0.220	0.114
7.000	36.400	0.028	0.033	0.245	0.120
8.000	41.600	0.022	0.040	0.260	0.134
9.000	46.800	0.033	0.048	0.283	0.123
10.000	52.000	0.050	0.063	0.294	0.143
11.000	57.200	0.041	0.053	0.300	0.143
12.000	62.400	0.056	0.058	0.323	0.144
13.000	67.600	0.058	0.063	0.328	0.245
14.000	72.800	0.063	0.081	0.343	0.153
15.000	78.000	0.066	0.076	0.360	0.167
16.000	83.200	0.088	0.081	0.378	0.165
17.000	88.400	0.083	0.098	0.376	0.181
18.000	93.600	0.086	0.097	0.388	0.186
19.000	98.800	0.091	0.123	0.395	0.190
20.000	104.000	0.078	0.095	0.424	0.190
21.000	109.200	0.088	0.098	0.422	0.195
22.000	114.400	0.093	0.101	0.436	0.190
23.000	119.600	0.101	0.123	0.443	0.200
24.000	124.800	0.108	0.138	0.447	0.211
25.000	130.000	0.098	0.108	0.480	0.233
26.000	135.200	0.103	0.133	0.492	0.235
27.000	140.400	0.113	0.105	0.496	0.228
28.000	145.600	0.113	0.113	0.515	0.243
29.000	150.800	0.117	0.153	0.523	0.247
30.000	156.000	0.120	0.138	0.545	0.258
31.000	161.200	0.128	0.130	0.543	0.265
32.000	166.400	0.160	0.166	0.573	0.279
33.000	171.600	0.138	0.173	0.589	0.300
34.000	176.800	0.143	0.153	0.599	0.290
35.000	182.000	0.149	0.161	0.611	0.313
36.000	187.200	0.155	0.163	0.618	0.332

ASTM E-1592 TESTING
SL175 1 3/4" x 18" WITH WINDBAR
24 GA. STEEL

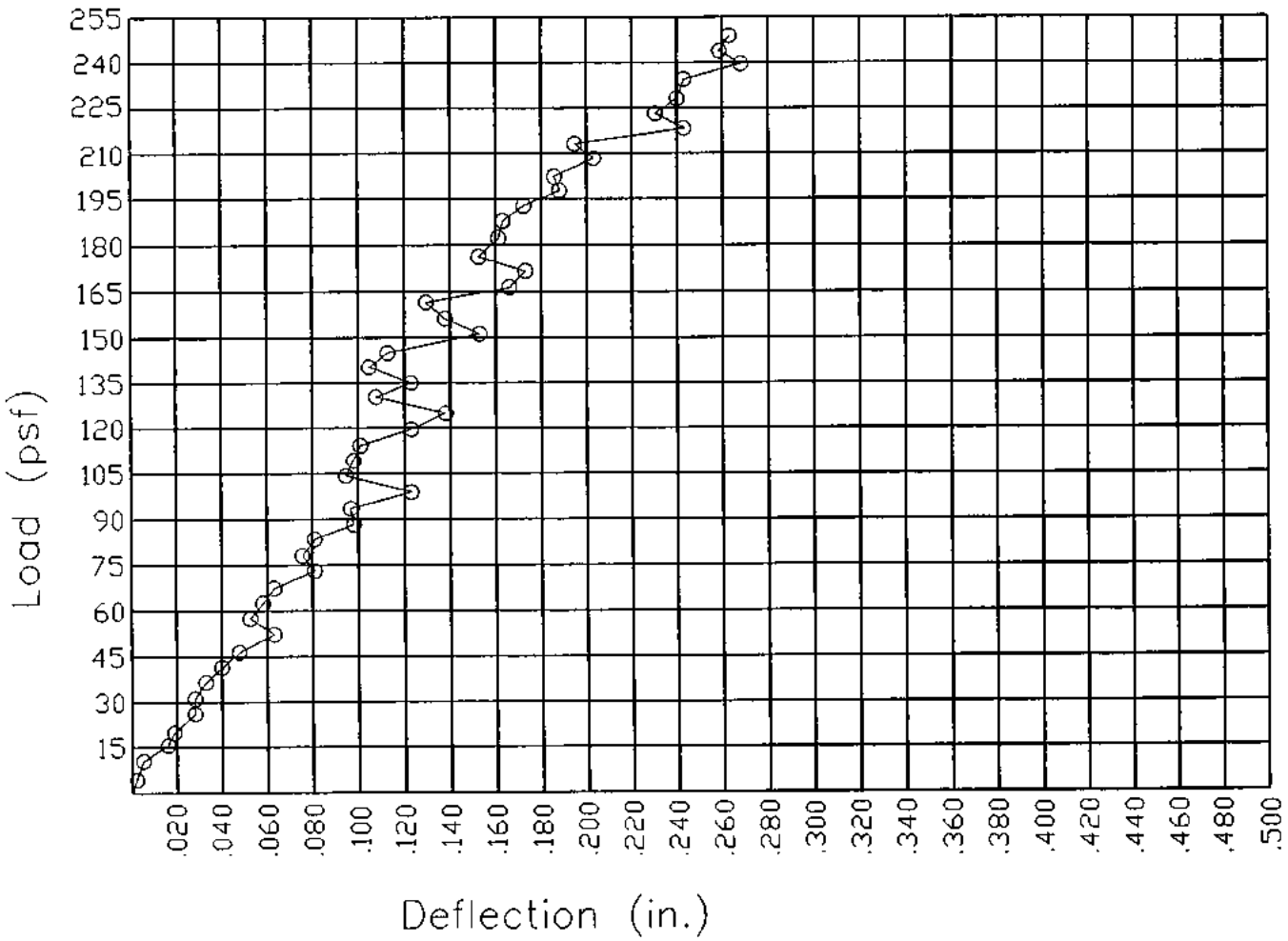
Pressure in. H20	Pressure psf	Deflection (in.)			
		1	2	3	4
37.000	192.400	0.174	0.172	0.655	0.335
38.000	197.600	0.175	0.188	0.668	0.339
39.000	202.800	0.176	0.186	0.680	0.353
40.000	208.000	0.183	0.203	0.706	0.371
41.000	213.200	0.185	0.195	0.735	0.390
42.000	218.400	0.196	0.243	0.742	0.393
43.000	223.600	0.197	0.231	0.756	0.409
44.000	228.800	0.208	0.240	0.785	0.415
45.000	234.000	0.222	0.243	0.802	0.442
46.000	239.200	0.216	0.268	0.816	0.447
47.000	244.400	0.249	0.259	0.831	0.455
48.000	249.600	0.245	0.263	0.856	0.460

Purlin Spacing: 1'-6"
Node 1: At rib, at purlin
Node 2: At rib, midspan between purlins
Node 3: At panel center, at purlin
Node 4: At panel center, between purlins
Center panel of chamber monitored
Chamber capacity reached at 48.00 in H2O
Mode of failure: Clip / Sidejoint interaction failure predicted.

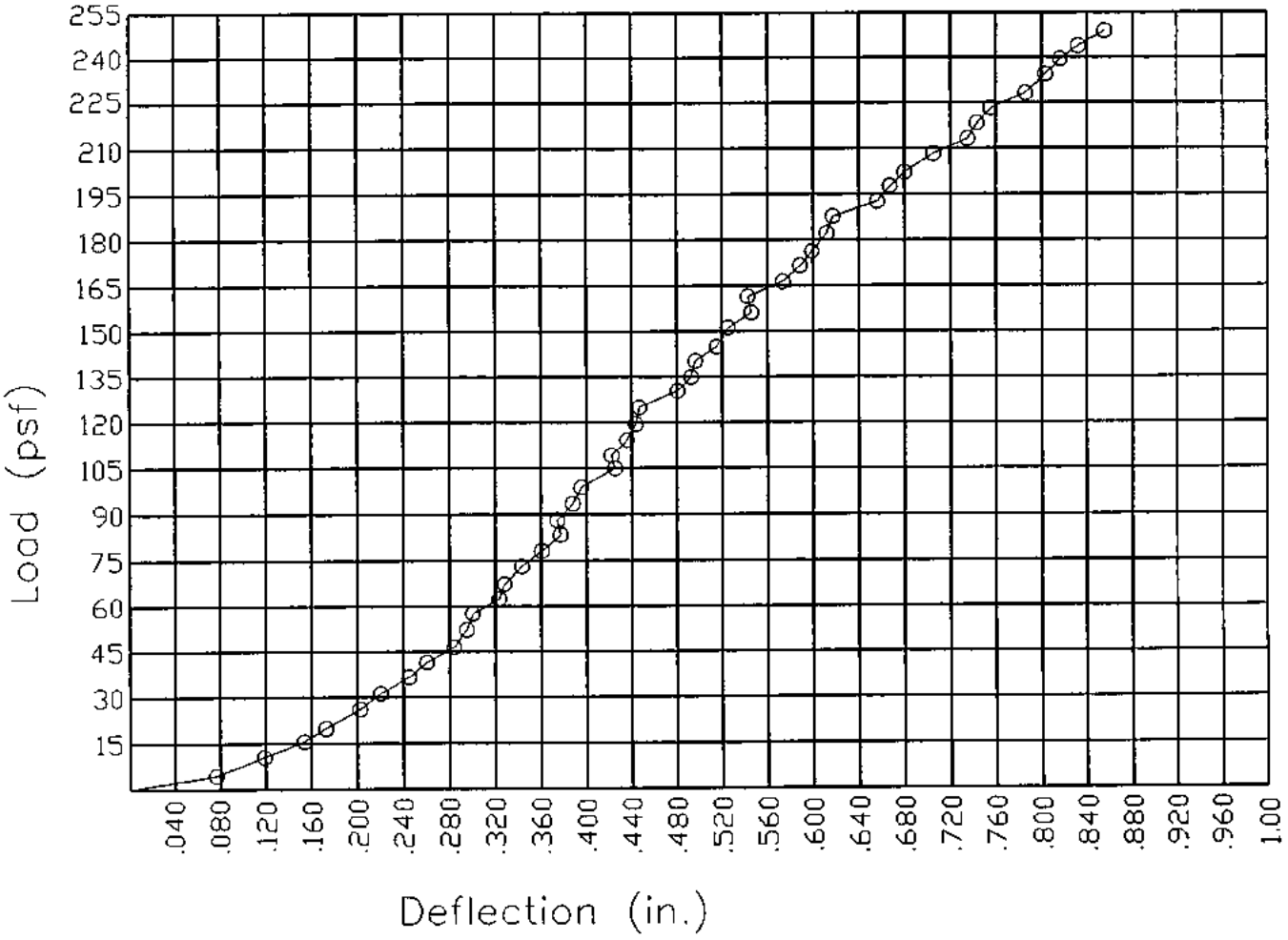
SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 1'-6"
Node No. 1



SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 1'6"
Node No. 2



SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 1'6"
Node No. 3



SL175 1 3/4" X 18" X 24 GA W/ WINDBAR
ASTM E 1592 – Purlins @ 1'6"
Node No. 4