TO : Metal Forming, Inc.
100 International Drive Peachtree
City, Georgia 30269

Attn.: Mr. Frank Callis

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

DATE : December 8, 2005

SUBJECT : 1-1/2" SNAP LOCK @ 16" wide x 0.040" Aluminum ASTM E-1592
Procedure for the Determination of Wind Uplift Capacity @ 2.0 ft & 5.0 ft o/c clips

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

PURPOSE : To determine both the Ultimate and Allowable Wind Uplift Capacity of the submitted metal roof system when fastened at various panel clip spacing's.

TEST DATE : November 11, 2005 (4 spans f 5.0 ft o/c)
(4 spans 1 2.0 ft o/e)

TEST SPECIMEN : Metal Forming, Inc. 1 1/2" deep SNAP LOCK
@ 16" wide x 0.040" Aluminum

TEST CHAMBER Composed of a stationary floor mounted steel channel frame capped with a secondary steel channel frame with simulated purlins. The "purlins" attached to a rail on the secondary steel channel frame and consisted of 3" x 3" x 3/16" structural steel tubes in combination with slip-fit/sheaf-screwed 16 gauge steel brake-formed channels representing a light gauge steel purlin flange face.

The composite combination *of* structural steel tubes and 16 gauge steel channels was designed to behave as purlin supports for the test panel specimen,

TEST CHAMBER : (continued)

The test pressures were applied to the specimen via a perimeter-taped 4 mil plastic film (Visqueen) designed to accurately configure to the profile of the test panels. The loose lay-up of the Visqueen film allowed the panel shape and the sidejoint elements a •full degree-of-freedom relative to profile distortion and sidejoint rotation during the loading process.

PURLIN MEMBERS : 16 gauge steel brake-formed channel-sections fit over and were shear-screwed to the sidewalls of the 3" x 3" x 3/16" structural-tubes. These assemblies were precisely placed at 5.0 ft or 2.0 ft centers to represent the maximum and minimum purlin spacing extremes for the roof panel being tested.

PRESSURE INDICATOR : Two (2) pressure sensors were attached to the test chamber and consisted of the following.....

One (1) Digital Pressure Indicator manufactured by Micro-Pneumatic Logic, Inc. Model MPL-3200 with a full-range accuracy of 1/10" H20 and traceable to the National Bureau of Standards

One (1) Alta-Robbins, Inc. U-Tube Water Manometer Model 100 SS with, a 24" scale,

DIGIMATIC CALIPEE : Mitutoyo Series Model No. CD-6" B with a full-range accuracy of 0.001 in.

installation : The secondary frame was inverted and panels were installed with one (1) piece 18 gauge steel hook-style clips which were screw-' attached to the top flanges of the 16 gauge steel channel sections using two (2) 10-16 x 1" long Pancake Head self-drilling screws with a #2 Phillips drive slot and #3 drill point.
Side joints consisted of mating snap-together male/female interlocking rib elements engaged with hand pressure. Continuity fasteners were located at the extreme ends of panels and consisted of single self-drilling screws driven through the panel webs.

INSTALLATION : (continued)

Both ends of the test assembly were fastened to simulate "free" end conditions. A transparent/flexible plastic film (Visqueen @ 4 mils thick) was loosely applied (pleated) over panels and the secondary steel channel frame was rotated 180 degrees about the longitudinal axis and set down on the stationary floor mounted steel channel frame.

The edges of the Visqueen extended beyond the test assembly limits and were pinched airtight by the dead weight of the secondary steel channel frame.

PROCEDURE

The individual panels were installed into the test chamber as a five (5) 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 (80) 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.

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 1.65. Please note that this Factor-of-Safety value can vary by Project Specification and/or Design Professional.

The Allowable Uplift Pressure for the panel system was established at 2.0 ft & 5.0 ft, with intermediate Allowable Uplift Pressures being determined via linear interpolation between the two (2) test-established extremes.

E-1592 TEST RESULTS

Span, ft.	Ultimate Pressure, psf	Allowable Pressure, psf
2.0	62.4	37.8
5.0	33.8	20.4

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ALLOWABLE WIND UPLIFT LOAD/SPAN CHART :

Panel Span, feet	Allowable Wind Uplift Pressure, psf
2.0	37.8
2.5	34.9
3.0	32.0
3.5	29.1
4.0	26.2
4.5	23.3
5.0	20.4

General Notes :

1. The Allowable Pressure is *the* Ultimate Test Pressure divided by a Factor-of-Safety (Load Factor) of 1.65 Note that the Factor-of-Safety value can vary by Project Specification and/or Design Professional.

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 conducted by Design Dynamics, Inc. in strict accordance with the ASTM £-1592 procedure.

******** EMD OF REPORT ********

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ASTME-1592 TESTING
SNAP LOCK1 1/2"X195/8"
.040 ALUMINUM

Pressure in. H20	Pressure psf	Deflection (in.)			
		1	2	3 .	4
0.000	0.000	2.513	2.470	2.854	2.765
0.500	2.600	0.002	0.03	0.26	0.251
0.000	0.000	-0.004	0.028	0.009	0.006
1.000	5.200	0.020	0.062	0.429	0.439
0.000	0.000	0.004	0.014	0.016	0.007
1.500	7.800	0.035	0.099	0.603	0.625
0.000	0.000	0.006	0.015	0.033	0.024
2.000	10.400	0.038	0.107	0.714	0.734
0.000	0.000	0.005	0.031	0.034	0.021
2.500	13.000	0.048	0.133	0.833	0.85
0.000	0.000	0.009	0.016	0.032	0.018
3.000	15.600	0.057	0.171	0.958	0.982
0.000	0.000	0.005	0.022	0.031	0.019
3.500	18.200	0.069	0.205	1.043	1.069
0.000	0.000	0.010	0.421	0.036	0.015
4.000	20.800	0.081	0.234	1.116	1.148
0.000	0.000	0.011	0.029	0.036	0.026
4.500	23.400	0.092	0.266	1.225	1.258
0.000	0.000	0.019	0.029	0.039	0.041
5.000	26.000	0.115	0.308	1.398	1.433
0.000	0.000	0.023	0.041	0.039	0.047

5.500	28.600	0.145	0.346	1.535	1.561
0.000	0.000	0.029	0.054	0.052	0.067
6.000	31.200	0.188	0.421	1.76	1.79
0.000	0.000	0.042	' 0.077	0.058	0.095
6.500	33.800	0.241	0.553	2.126	2.123
0.000	0.000	0.060	0.115	0.101	0.143

Purlin Spacing: 5'-0"

Node 1: At rib, at purlin

Node 2: At rib, midspan between purlins

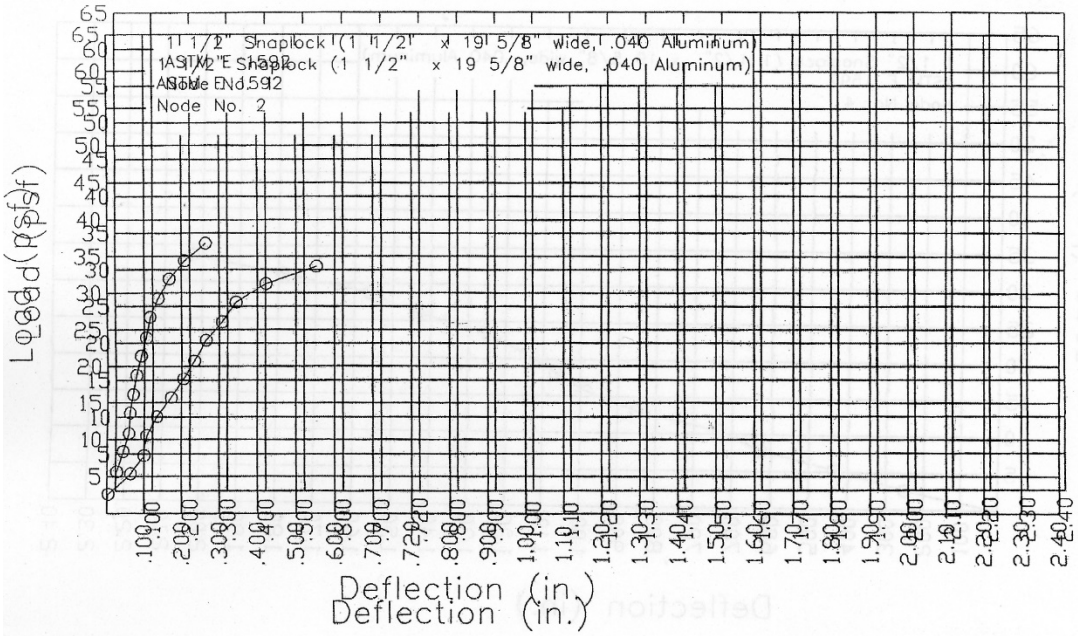
Node 3: At panel center, at purlin

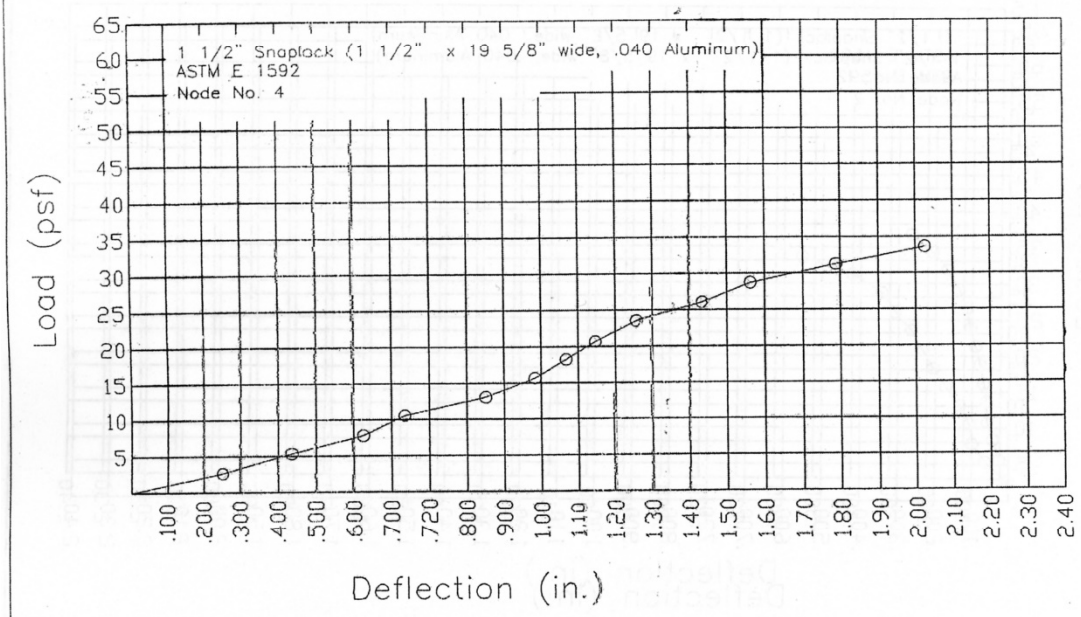
Node 4: At panel center, between purlins

Center panel of chamber monitored • . .

Chamber consisted of full width panels - 5 ribs

Mode of failure: Joint disengagement for full length of panel.


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 592
Node No. 2
Load (psf)
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592
Node No. 4
Load (psf)
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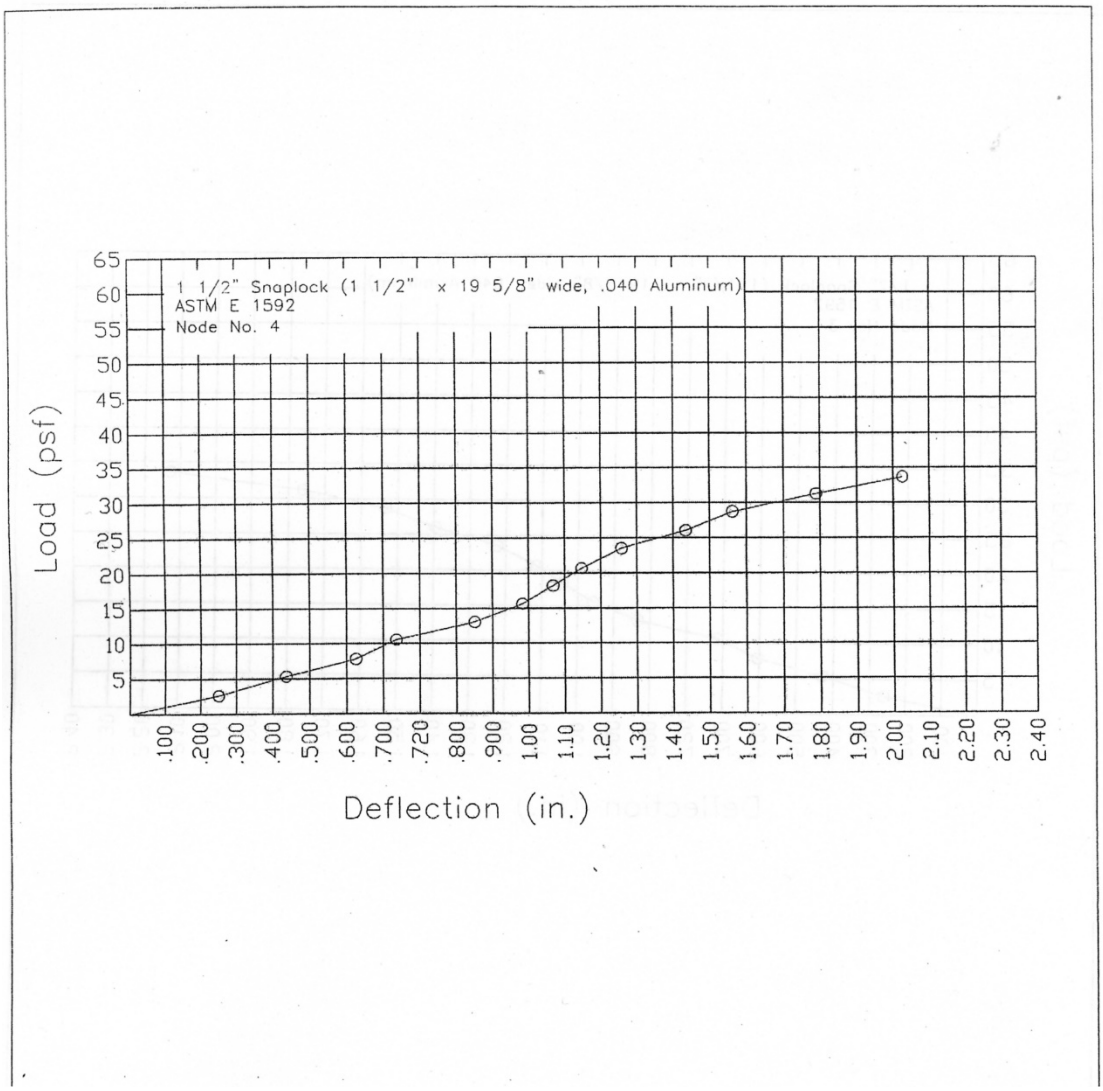
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
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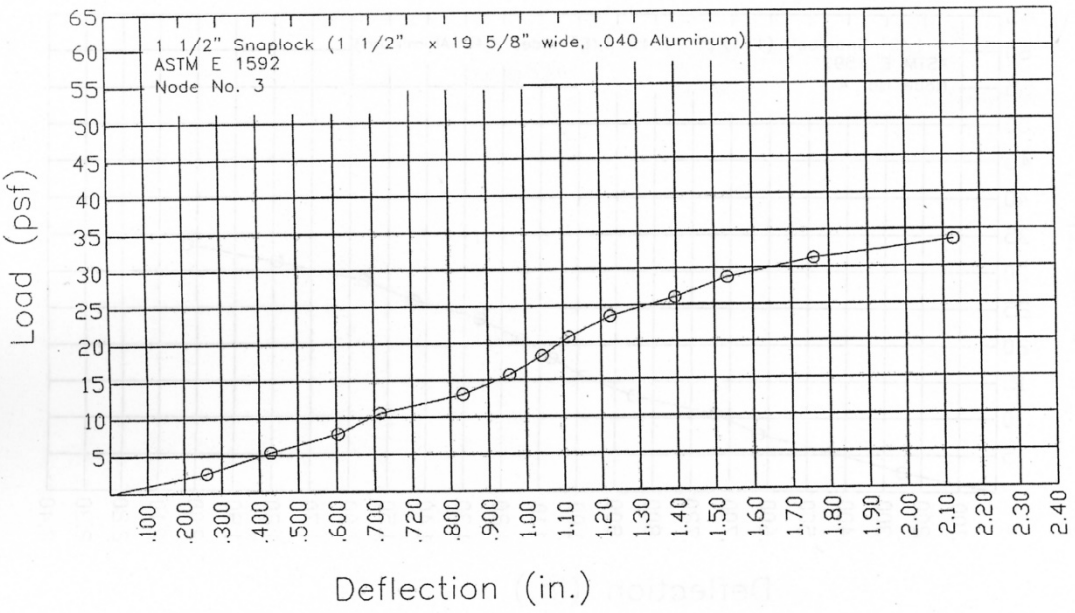
1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
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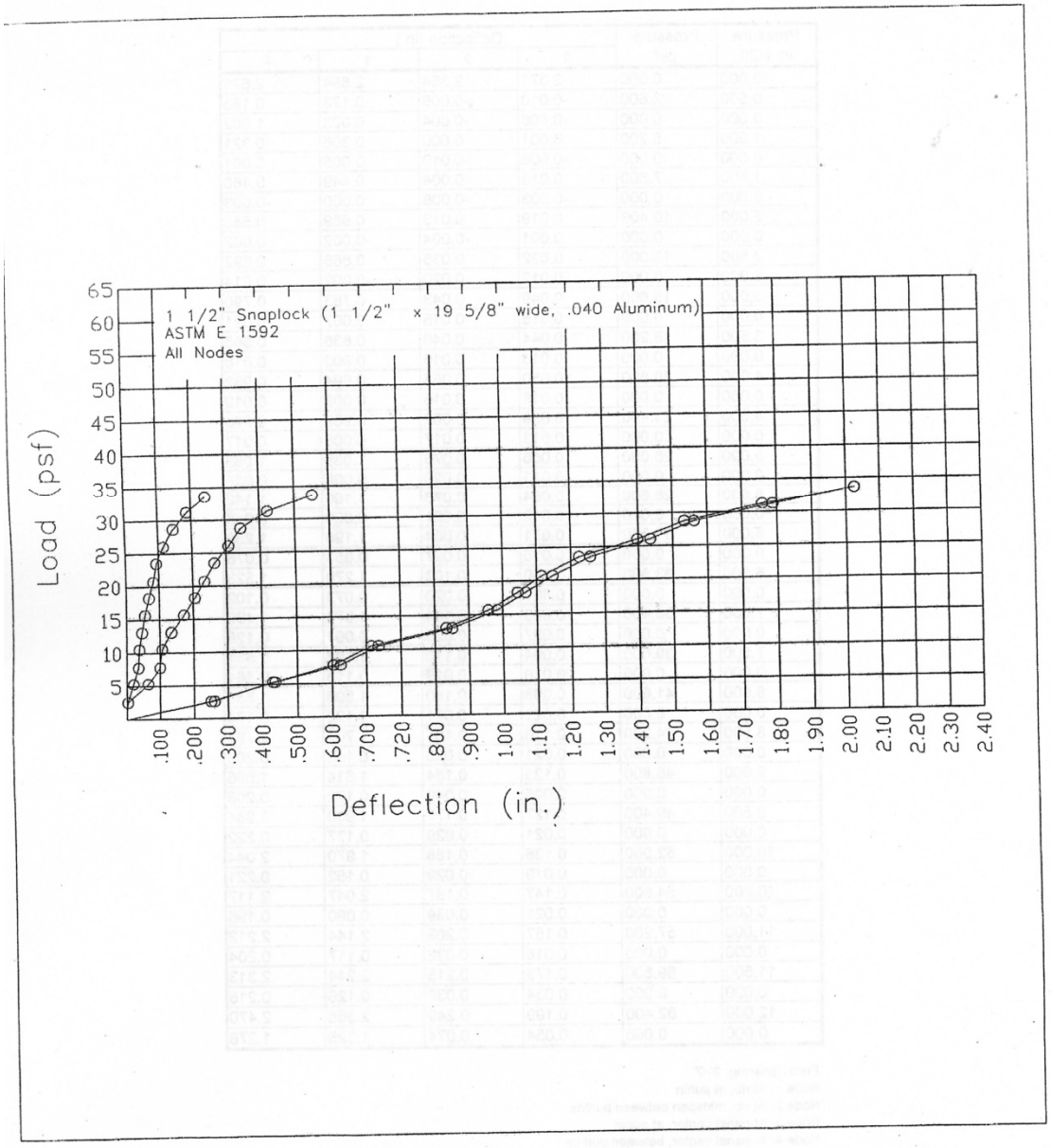
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592
All Nodes
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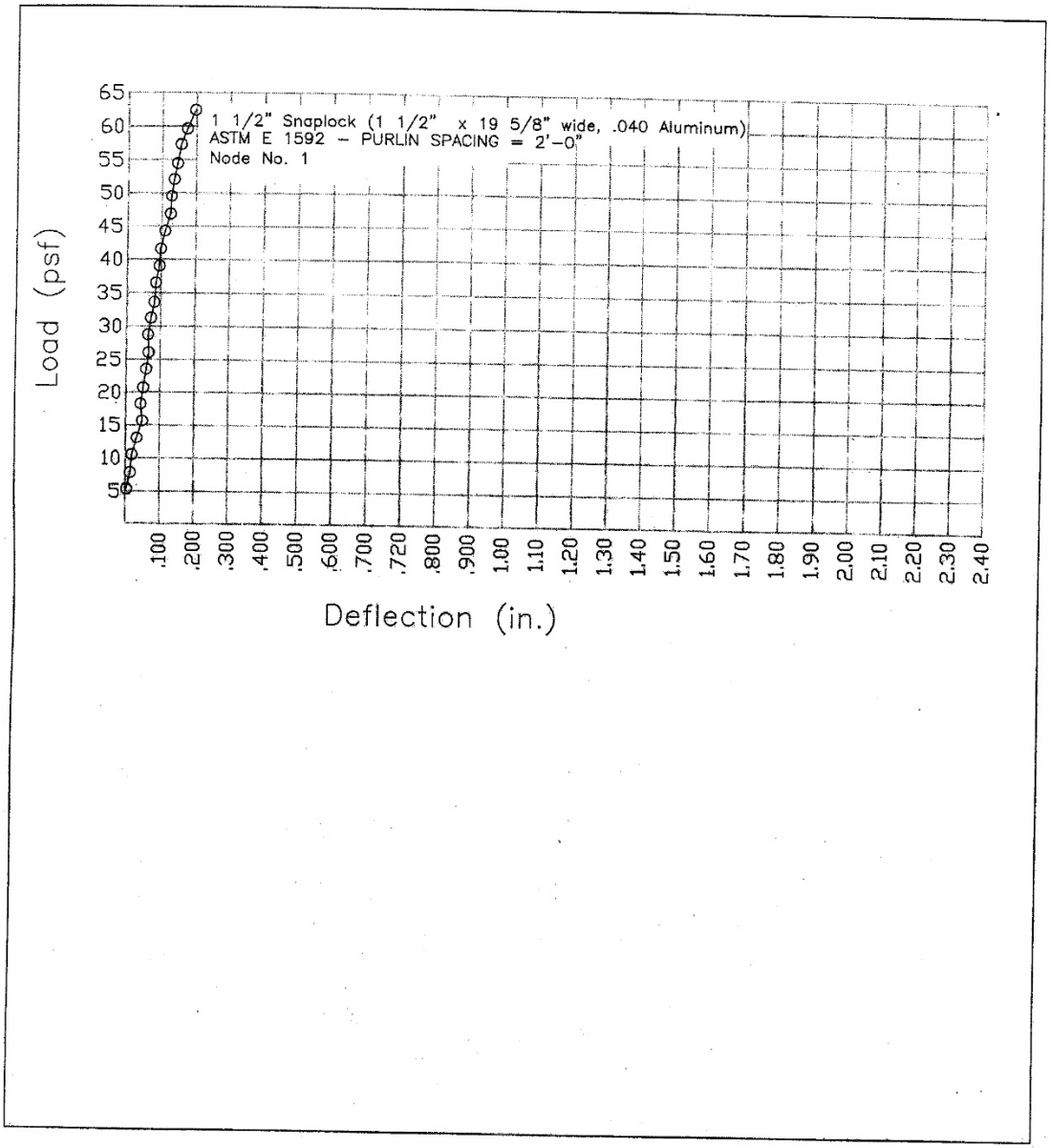
Deflection (in.)

Pressure in. H20	Pressure psf	Deflection (in.)			
		1	2	3	4
0.000	0.000	2.371	2.354	2.694	2.671
0.500	2.600	-0.010	-0.005	0.173	0.183
0.000	0.000	-0.006	-0.004	0.003	1.002
1.000	5.200	0.001	0.000	0.306	0.321
0.000	0.000	-0.006	-0.010	0.005	0.001
1.500	7.800	0.013	0.004	0.449	0.468
0.000	0.000	-0.003	-0.008	0.000	-0.003
2.000	10.400	0.019	0.013	0.559	0.583
0.000	0.000	0.001	-0,004	-0.002	0.002
2.500	13.000	0.032	0.035	0.666	0.692
0.000	0.000	0.012	0.020	-0.002	0.014
3,000	15,600	0.049	0.043	0.763	0.790
0.000	0.000	0.016	0.015	0.007	0.021
3.500	18.200	0.044	0.048	0.836	0.865
0.000	0.000	0.013	0.016	0.000	0,018
4.000	20.800	0.050	0.055	0.904	0,932
0.000	0.000	0.018	0.016	0,003	0.019
4.500	23.400	_ 0.059	0.062	0,969	0.996
0.000	Q.0Q0	0.013	0.017	0.008	0.017
5.0QO	26.000	0.066	0,076	1 ,035	1.068
0.000	0.000	0.013	0.020	0.008	0.025
5.500	28,600	0.064	0.076	1.109	1.142
0.000	0,000	0.012	0,021	0,026	0.048
6.000	31 .200	0.071	0.084	1.198	1 ,233
0.000	0.000	0.016	6.027	0 053·	0.076
6.500	33.800	0.080	0.103	1,279	1,323
0.000	0,000	0.467	0,020	0.073.	0.1iQ2
7,000	3i:,400	O.OB3	0.104	1.373:	1.430
0.000	0,000	O.Q27	0.025	0.091	0,118
7.500	39,000	0.094	0.110	1.482	1 .531
0.000	0.000	0.010	0.019	0.113	0.161
8.000	41.600	0.098	0.130	1 .595	1.65:8
0.000	0.000	0.021	0.021	0.138	0.174
8.500	44.200	.0.110	0.151	1 .701	1.781
0.000	0,000	0,021	0.02:5	0.151	0.203
9.000	46.800	0.125	0.184	1.814	1 ,885
0.000	0.000	0.025	0,040	0,172	0.206
9.500	49.400	0.127	Q.177	1.900	1 .964
0.000	0.000	0,021	' 0.029	0.177	0.222
10.000	52.000	0.136	0,18:8	1 ,970	2,044
0.000	0.000	0,019	0,029	0.1S2	0.221
10.500	54.600	0.147	0,187	2.047	2.117
0.000	0.000	0,021	0.039	0,0§0	0.196
1 1 .000	57.200	0.157	0.206	2.144	2.212
0.000	0.000	0,018	0.032	0.117	0.204
11.500	59.800	0.173	0.215	2.244	2.313
0.000	O.Q00	0.034	0.036	0,126	0,215
12.000	62.400	0.199	0.249	2.368	2.470
0.000	0.000	0.054	0,074	1.025	1,278


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'-0"
Node No. 1
Load (psf)
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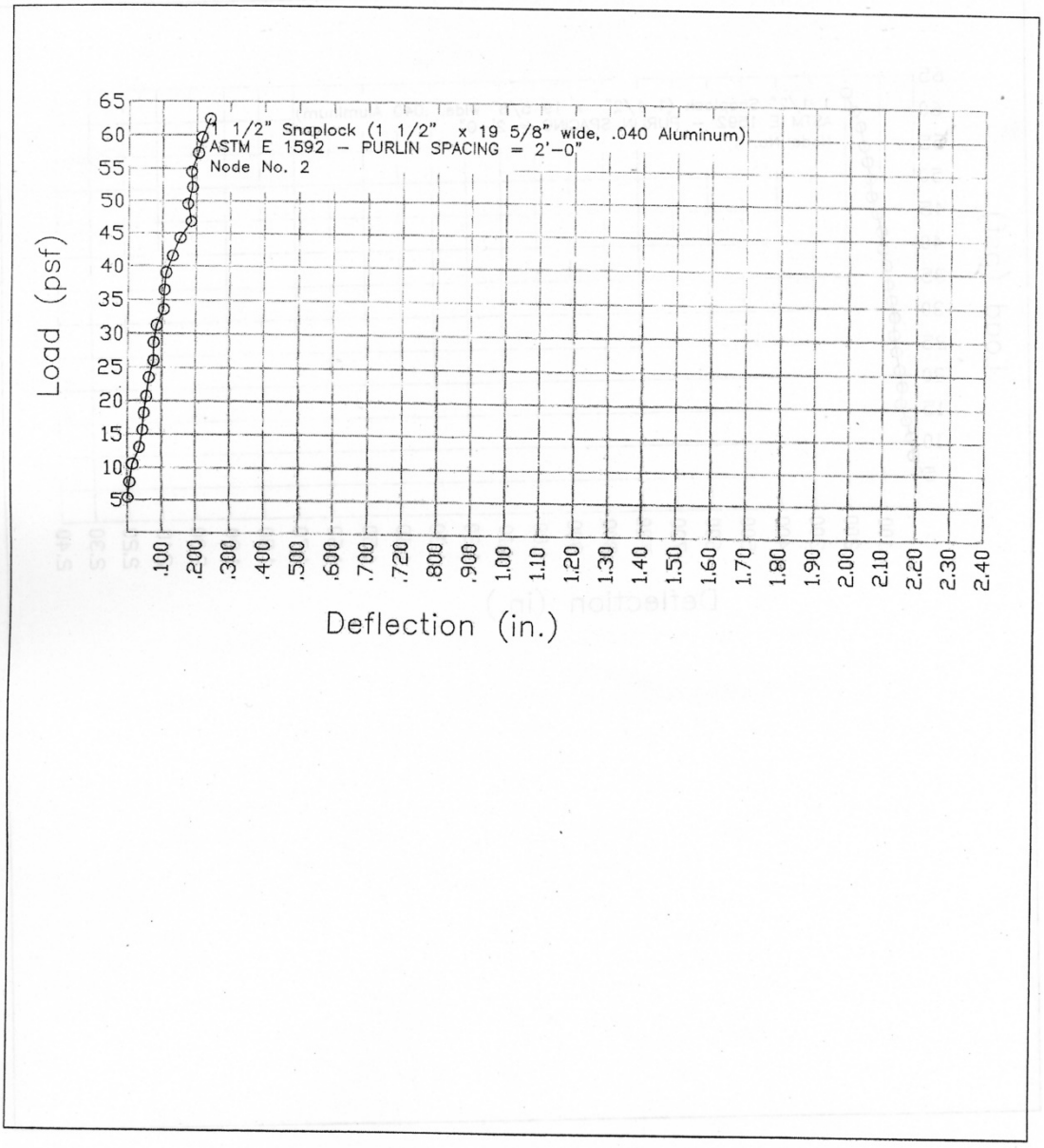
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'–0"
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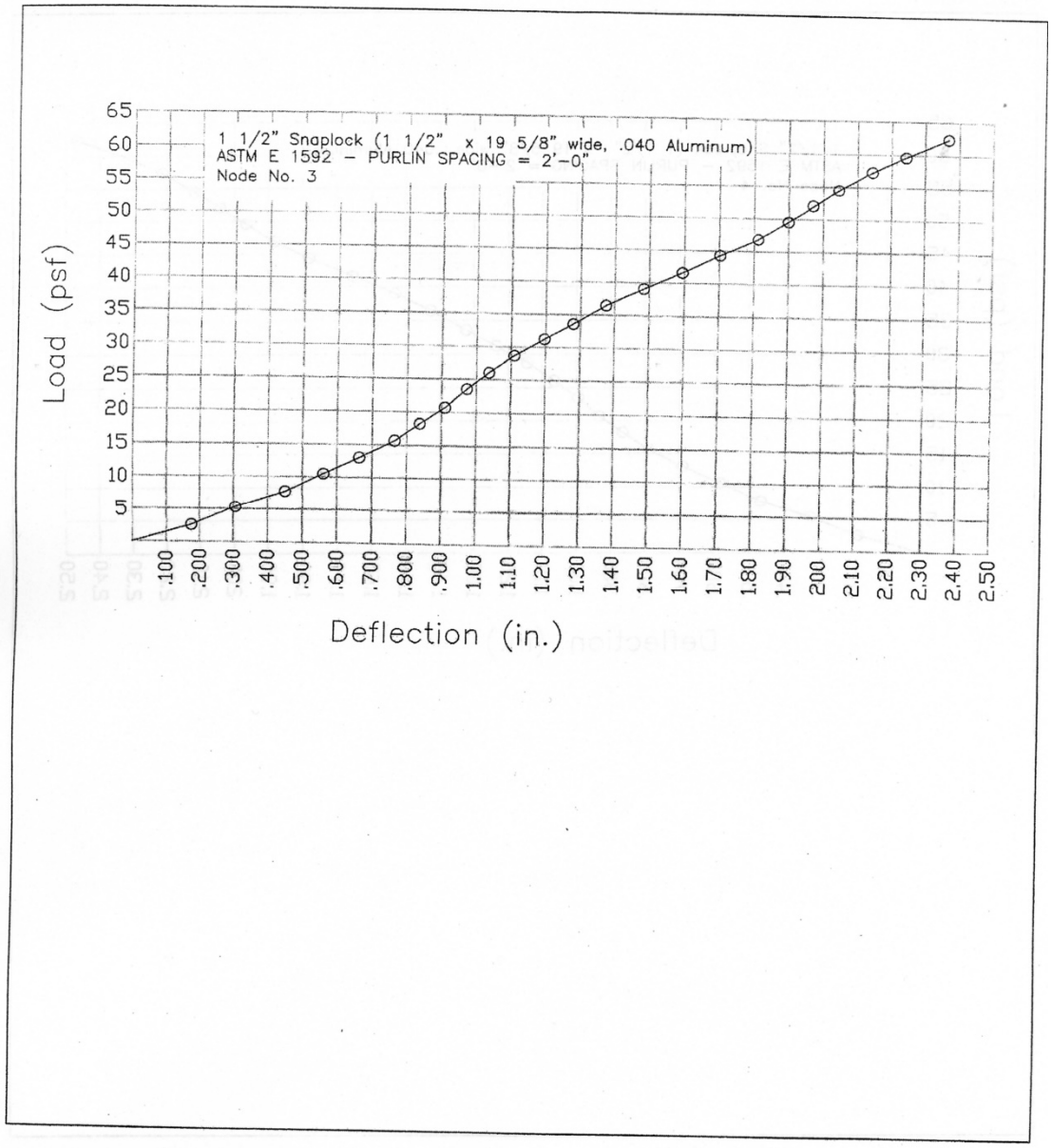
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'-0"
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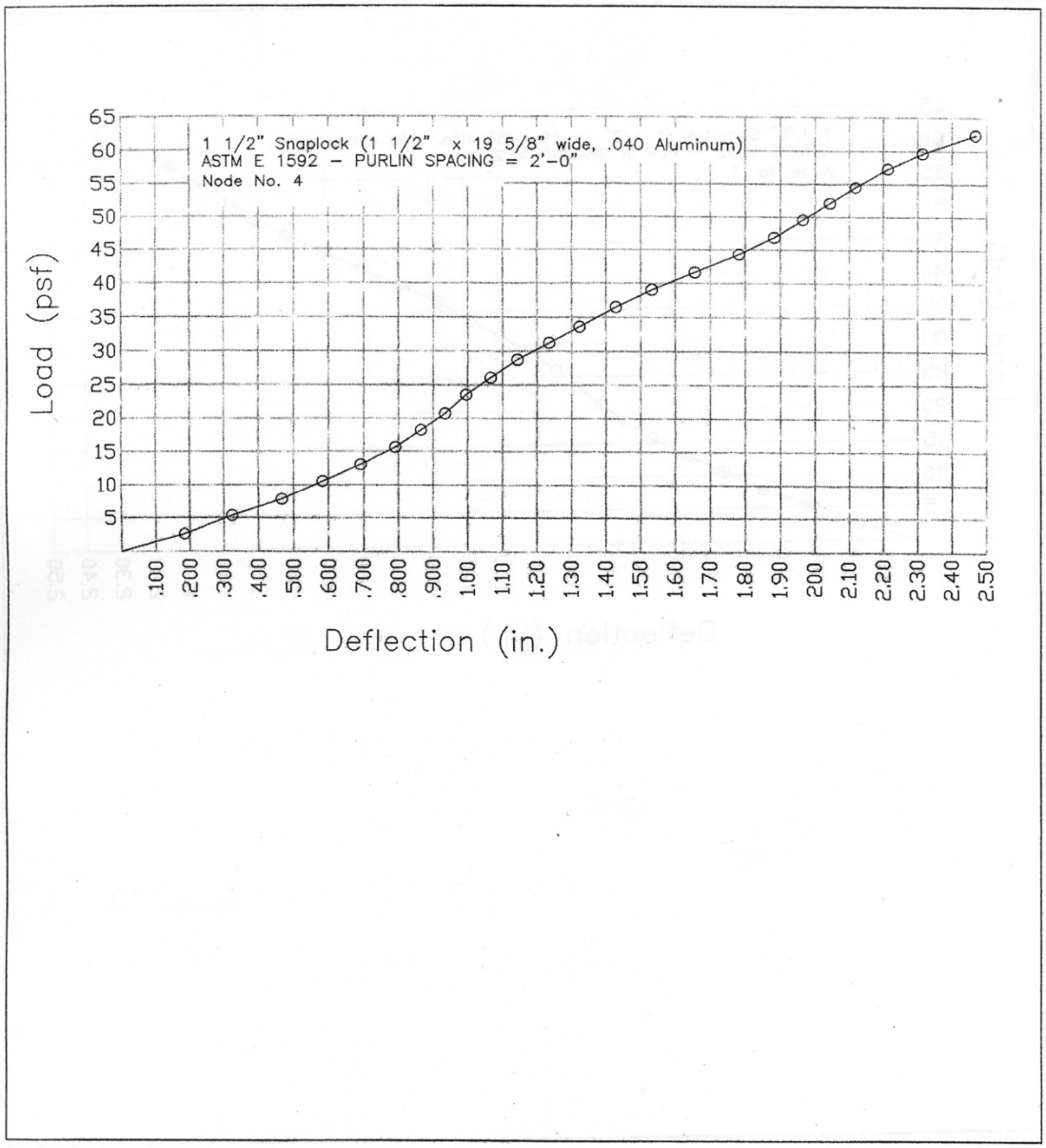
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'-0"
Node No. 4
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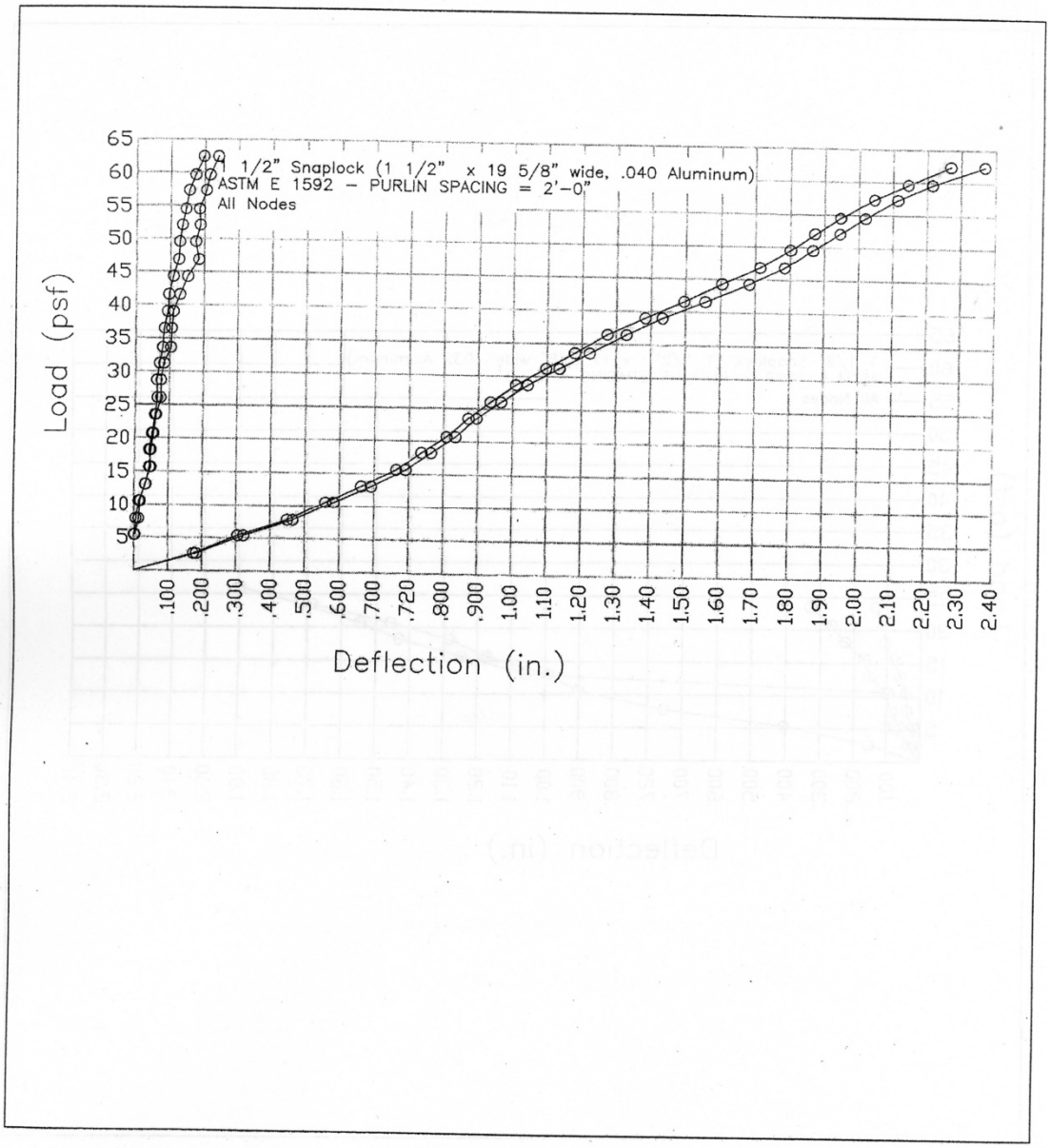
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 19 5/8" wide, .040 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'-0"
All Nodes
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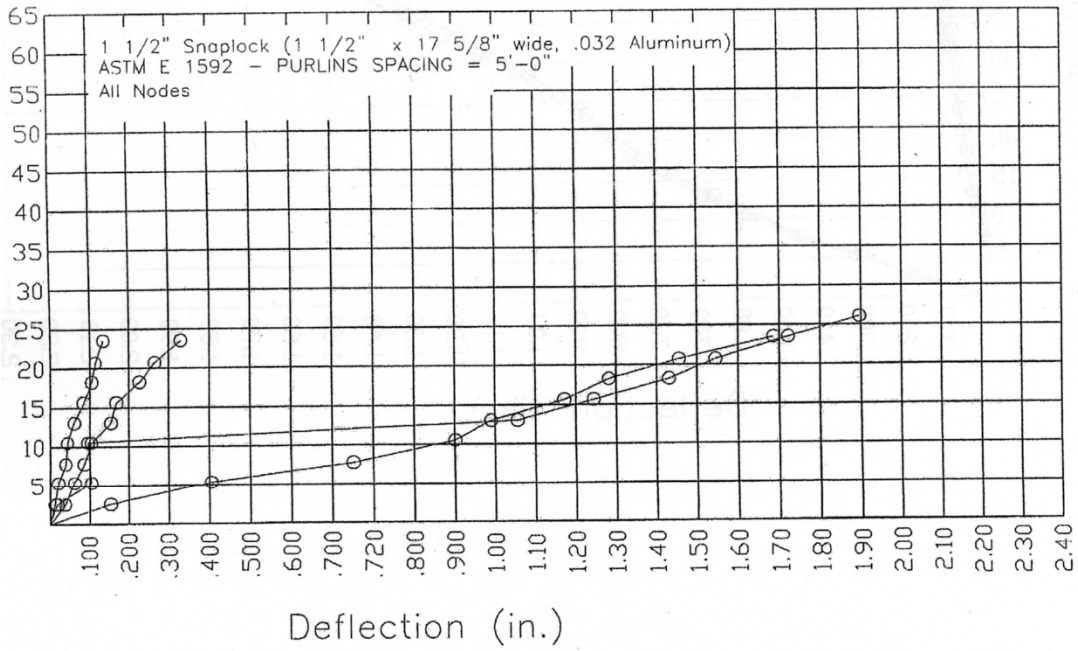
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 17 5/8" wide, .032 Aluminum)
ASTM E 1592 – PURLINS SPACING = 5'–0"
All Nodes
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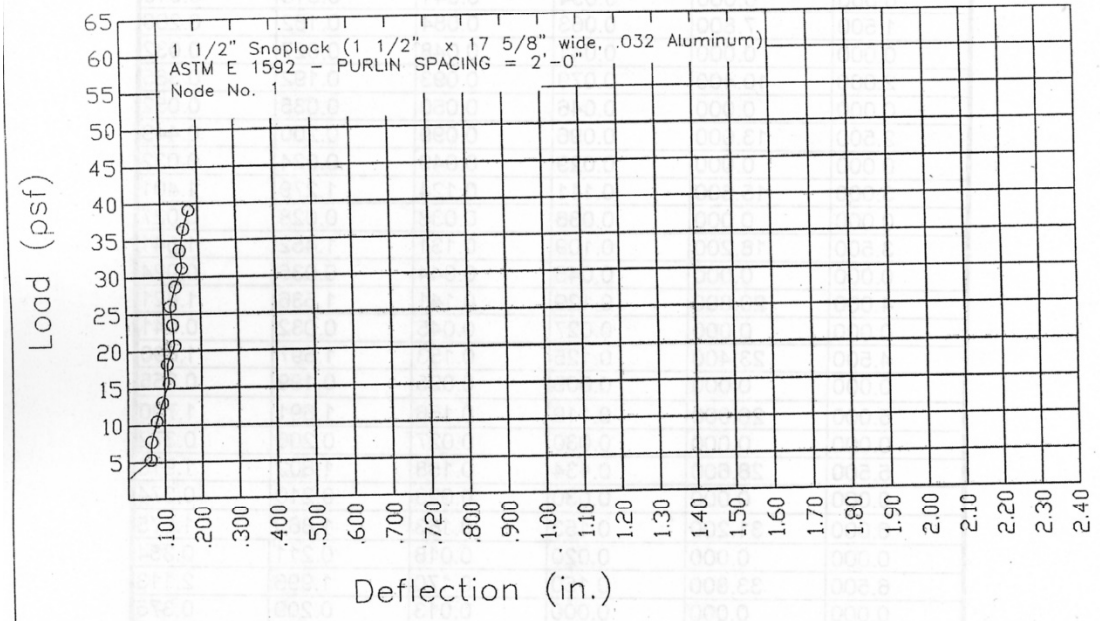
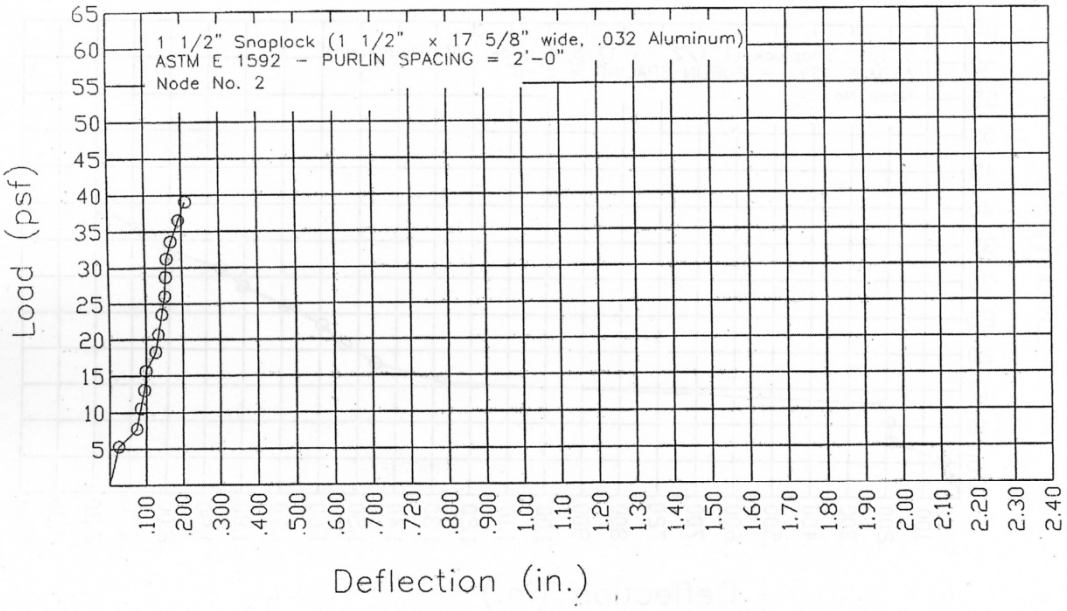
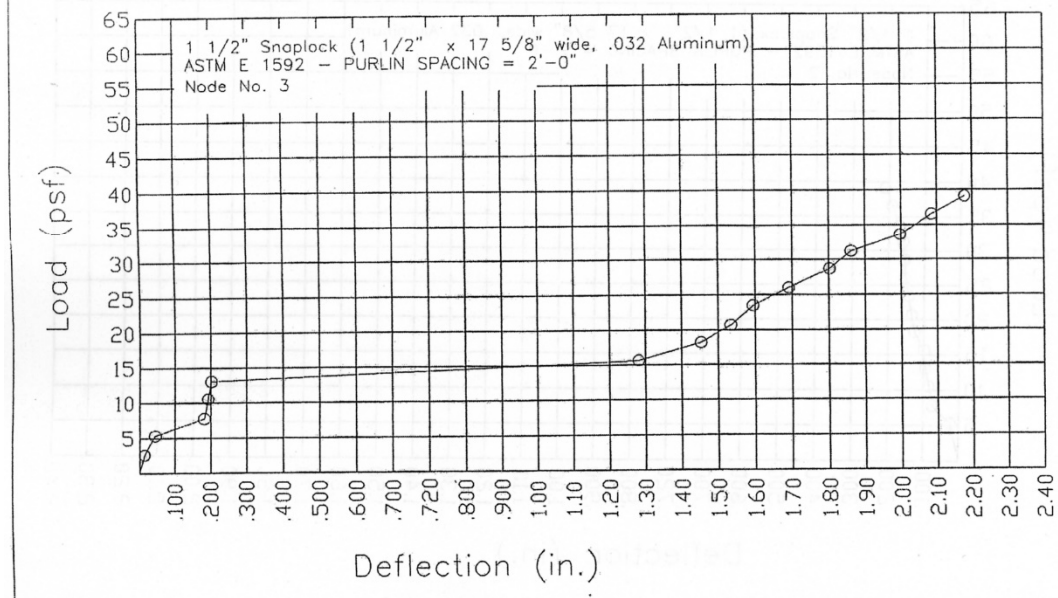
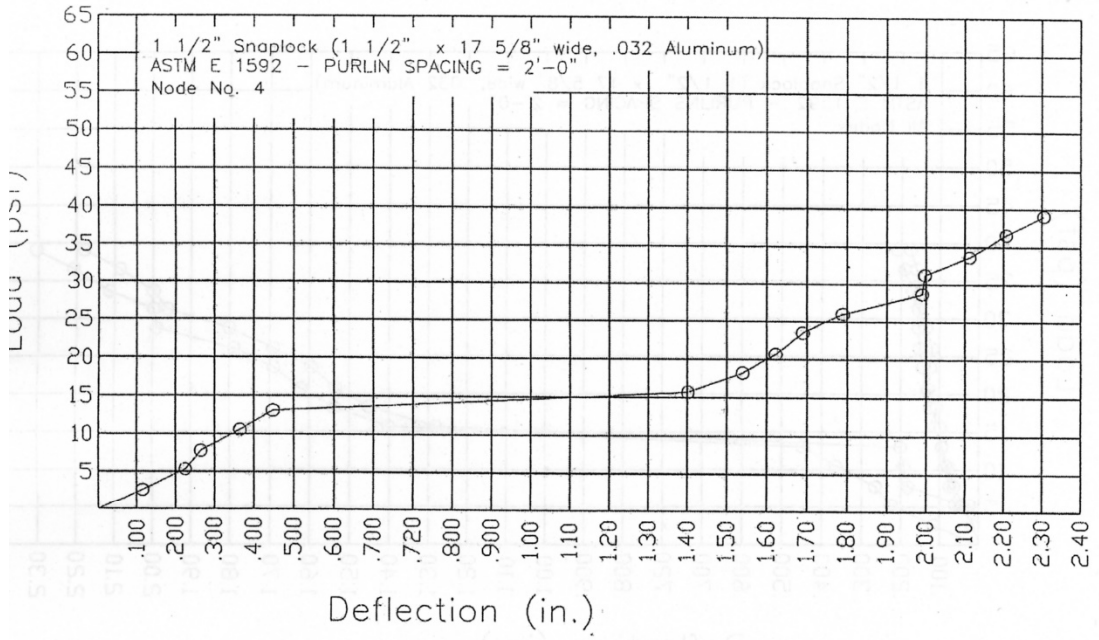
Deflection (in.)

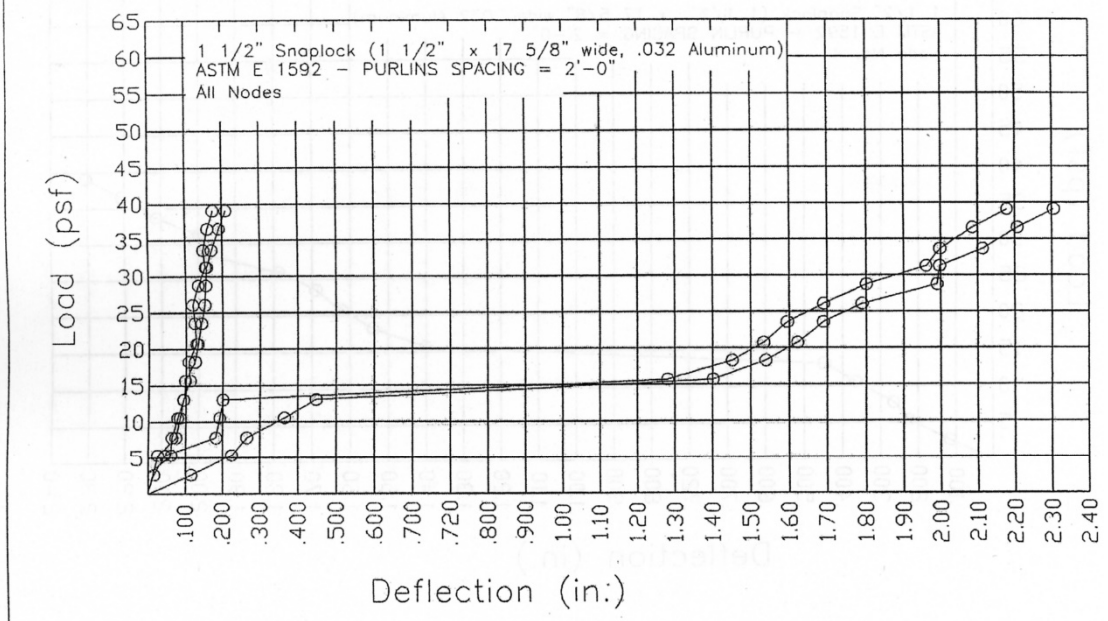
Pressure in. H20	Pressure psf	Deflection (in.)			
		1	2	3	4
0.000	0.000	2.394	2.355	2.448	2.358
0.500	2.600	-0.002	0.024	0.018	0.117
0.000	0.000	0.013	0.026	0.015	0.019
1.000	5.200	0.062	0.073	0.043	0.224
0.000	0.000	0.034	0.041	0.018	0.016
1.500	7.800	0.063	0.084	0.182	0.266
0.000	0.000	0.041	0.048	0.027	0.032
2.000	10.400	0.079	0.093	0.192	0.365
0.000	0.000	0.046	0.050	0.035	0.052
2.500	13.000	0.096	0.099	0.200	0.449
0.000	0.000	0.029	0.049	0.024	0.032
3.000	15.600	0.111	0.124	1.279	1.401
0.000	0.000	0.036	0.038	0.028	0.027
3.500	18.200	0.109	0.131	1 ,452	1,541
0.000	0.000	0.045	0.044	0.035	0,024
4,000	20.800	0.129	0.141	1.536	1 .621
0.000	0.000	0.027	0.045	0,032	0.041
4.500	23.400	0.125	0.153	1.597	1.690
0.000	0,000	0.005	0.025	0,199	0.355
5.000	26.000	0.119	0.156	1.891	1.790
0.000	0.000	0.030	0.027	0.206	0.372
5.500	28.600	0.134	0.158	1.802	1.913
0.000	0.000	0.030	0.023	0,210	0.374
6.000	31.200	0.153	0.163	1 .860	1.975
0.000	0.0Q0	0.020	0,018	0.21 1	0,384
6.500	33.800	0.150	0.170	1.996	2.113
0.000	0.000	0.000	0,013	0.209	0,375
7.000	36.400	0.160	0,192	2.087	2.207
0.000	0.000	0,017	0,005	0,200	0,371
7.500	39.000	0,173	0.201	2.179	2.302
0.000	0.000	-0.022	-0.036	n.me:	n.^BB


1 1/2" Snaplock (1 1/2" x 17 5/8" wide, .032 Aluminum)
ASTM E 1592 - PURLIN SPACING = 2'-0"
Node No. 1
Load (psf)
65
60
55
50
45
40
35
30
25
20
15
10
5
.100
.200
.300
.400
.500
.600
.700
.720
.800
.900
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 17 5/8" wide, .032 Aluminum)
ASTM E 1592 - PURLIN SPACING = 2'-0"
Node No. 2
Load (psf)
65
60
55
50
45
40
35
30
25
20
15
10
5
.100
.200
.300
.400
.500
.600
.700
.720
.800
.900
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 17 5/8" wide, .032 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'-0"
Node No. 3
Load (psf)
65
60
55
50
45
40
35
30
25
20
15
10
5
.100
.200
.300
.400
.500
.600
.700
.720
.800
.900
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 17 5/8" wide, .032 Aluminum)
ASTM E 1592 – PURLIN SPACING = 2'–0"
Node No. 4
65
60
55
50
45
40
35
30
25
20
15
10
5
.100
.200
.300
.400
.500
.600
.700
.720
.800
.900
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
Deflection (in.)


1 1/2" Snaplock (1 1/2" x 17 5/8" wide, .032 Aluminum)
ASTM E 1592 - PURLINS SPACING = 2'-0"
All Nodes
Load (psf)
65
60
55
50
45
40
35
30
25
20
15
10
5
.100
.200
.300
.400
.500
.600
.700
.720
.800
.900
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
Deflection (in:)