NAHB RESEARCH CENTER

400 Prince George's Boulevard • Upper Marlboro, MD 20774-8731 • (301) 249-4000 • FAX 249-0305

November 18, 1996

Mr. Mason Knowles
The Society of the Plastics Industry, Inc.
Spray Polyurethane Foam Division
1275 K Street, N.W., Suite 400
Washington, DC 20005-6154

Dear Mr. Knowles:

The enclosed data sheets list the results of the racking tests on the two conventional (R-19) and two spray polyurethane foam-filled wall panels. The tests were conducted in accordance with ASTM E-72 *Standard Methods of Conducting Strength Tests of Panels for Building Construction*, Section 14. Each wall panel was constructed with 20-gauge structural light-gauge steel framing as follows:

- Test #1: 7/16" OSB (front side) and 1/2" drywall (back side) with R-19 batts in wall cavities.
- Test #2: 1/2" drywall (both sides) with R-19 batts in wall cavities.
- Test #3: 7/16" OSB (front side) and 1/2" drywall (back side) with spray polyurethane foam (SPF) in wall cavities.
- Test #4: 1/2" drywall (both sides) with SPF in wall cavities.

Each panel measured 8' x 8' with studs spaced 24" on-center. OSB sheathing was fastened with No. 8 x 1-1/4" rock board screws spaced 6" on-center at edges and 12" on-center in the field. Drywall sheathing was fastened with No. 6 x 1-1/4" drywall screws spaced 12" on-center at edges and in the field. All drywall joints were spackled and taped, and all drywall screws were covered with one coat of drywall compound.

SPF density was measured by weighing six specimens and immersing them in a known volume of water. Each specimen was cut from a container that was filled with SPF during the same spraying session as the wall panels. Three specimens were cut from the exterior portion of the block, and three additional specimens were cut from the interior portion of the block. Weight, displaced water volume, and density of each specimen is listed in Table 1 on the following page. Test results are summarized in Table 2.

Table 1
Measured Density of SPF

Specimen #	Weight (grams)	Displacement (ml)	Density (pcf)
Exterior #1	1.000	23	2.71
Exterior #2	1.377	43	2.00
Exterior #3	0.827	22	2.35
Interior #1	1.126	42	1.67
Interior #2	1.538	45	2.13
Interior #3	1.330	31	2.68
Average	**1.200**	**34**	**2.26**

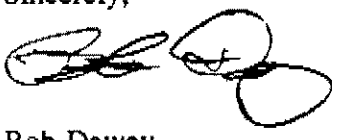
Table 2
Racking Test Results

Specimen	Max. Racking Load (lbs.)	Max. Racking Deflection (in.)	Max. Racking Set (in.)
OSB with R-19	4,800	1.045	0.516
OSB with SPF	6,000	0.767	0.142
Drywall with R-19	2,400	0.856	0.413
Drywall with SPF	5,380	0.945	0.407

Both of the specimens with SPF-filled cavities sustained higher racking loads than the conventional test specimens filled with R-19 batts. In addition, racking deflections and sets for the SPF specimens were consistently lower than racking deflections and sets for the conventional specimens at a given load. It should be noted that failure of the SPF-filled OSB specimen was due to buckling of the steel frame as opposed to failure of the sheathing.

If you have any questions or comments regarding these results, please do not hesitate to call me at (301) 249-4000, x-618.

Sincerely,



Bob Dewey
Mechanical Engineer

Test #1
OSB with Insulation
Date: 11/4/96

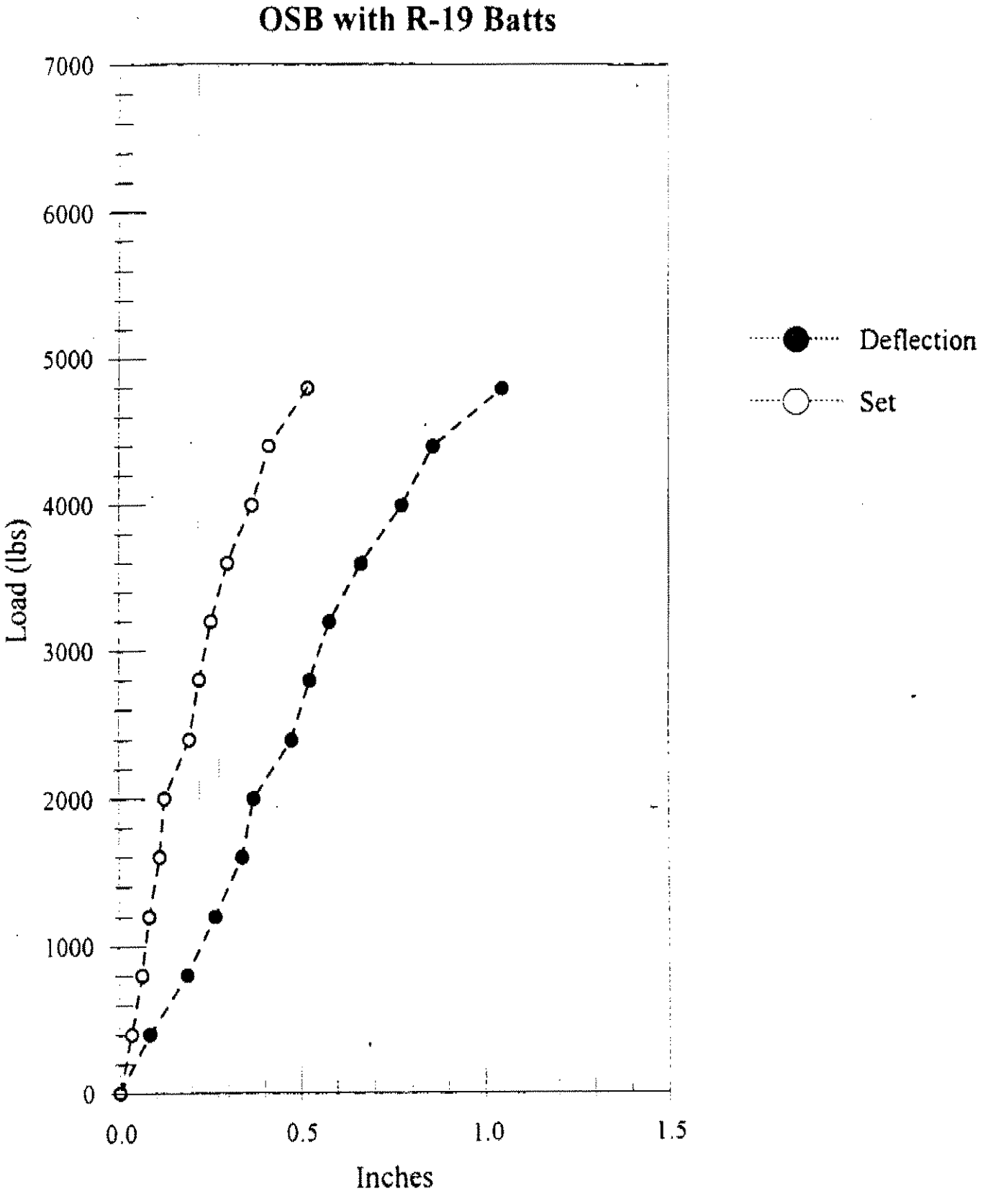
	Test Data						Calculations	
	Deflection under Load (in.)			Set after Load Removal (in.)			Racking Dfls. (in.)	
Load (lbs)	#1	#2	#3	#1	#2	#3	Load	Set
0	0.000	0.000	0.000	0.000	0.000	0.000		
400	0.166	0.015	0.080	0.064	0.007	0.028	**0.083**	**0.033**
800	0.367	0.031	0.174	0.116	0.014	0.048	**0.188**	**0.062**
1200	0.556	0.073	0.255	0.181	0.045	0.064	**0.265**	**0.082**
1600	0.705	0.132	0.280	0.272	0.099	0.075	**0.337**	**0.111**
2000	0.840	0.183	0.340	0.333	0.132	0.092	**0.368**	**0.124**
2400	1.157	0.251	0.504	0.497	0.168	0.160	**0.473**	**0.194**
2800	1.266	0.280	0.540	0.554	0.183	0.178	**0.523**	**0.221**
3200	1.393	0.312	0.588	0.621	0.194	0.208	**0.577**	**0.252**
3600	1.563	0.351	0.643	0.699	0.208	0.232	**0.663**	**0.296**
4000	1.728	0.389	0.670	0.814	0.235	0.261	**0.772**	**0.362**
4400	1.897	0.436	0.715	0.926	0.266	0.302	**0.858**	**0.408**
4800	2.527	0.785	0.830	1.406	0.584	0.368	**1.045**	**0.516**

Assumptions for Calculations:

x1 = x2 = 3 inches from ends
x3 = 2 inches from end

Observations from Test:

Load (lbs.)	**Comments**
3200	Drywall screws starting to pop.
3550	Drywall popping continuing.
4000	Bottom track starting to bend away from rail adjacent to deflection gage #3.
4800	Maximum load achieved. Additional ram movement caused load to fall off.


OSB with R-19 Batts
7000
6000
5000
4000
3000
2000
1000
0
Load (lbs)
0.0
0.5
1.0
1.5
Inches
Deflection
Set

Test #2
Drywall with Insulation
Date: 11/6/96

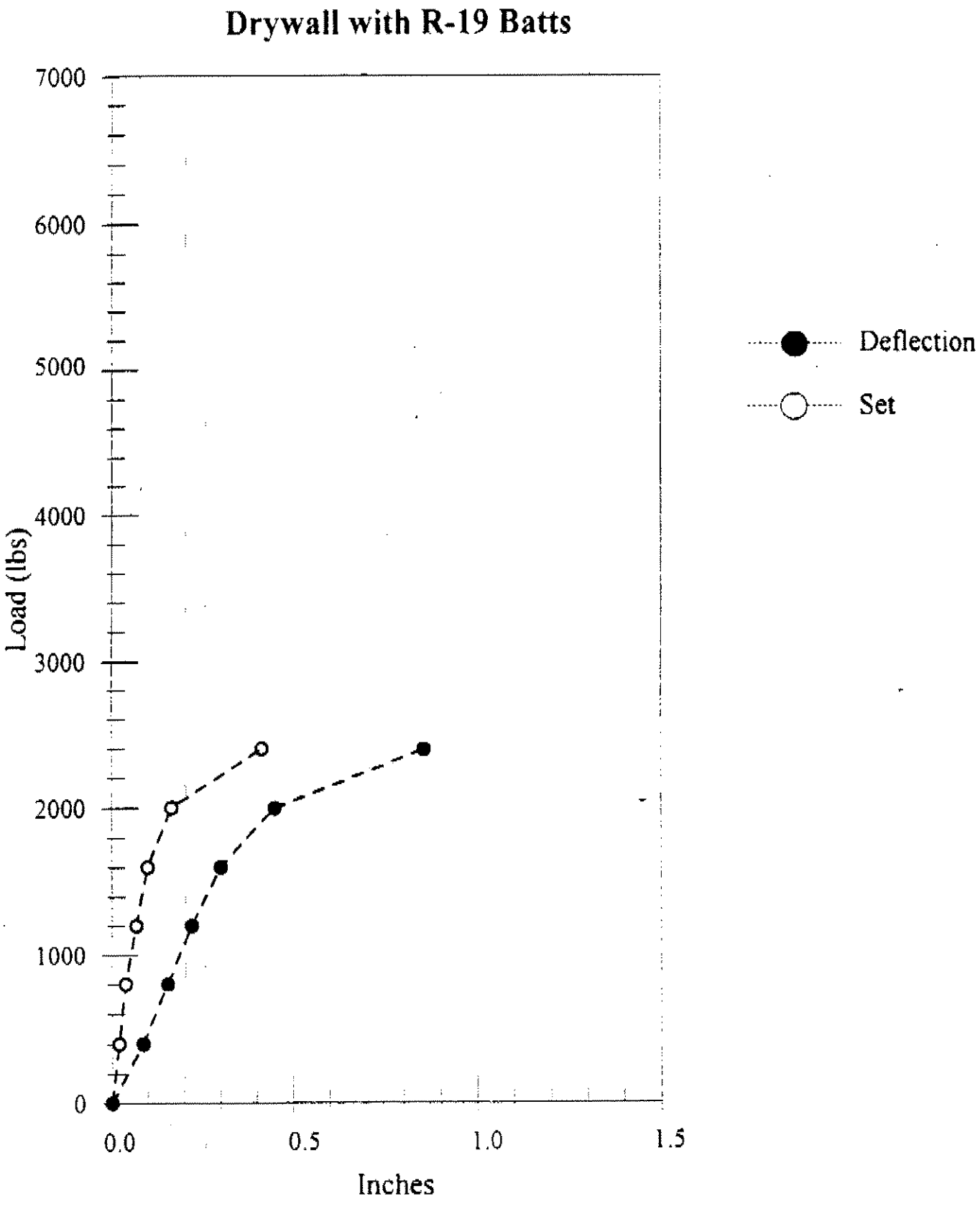
	Test Data						Calculations	
	Deflection under Load (in.)			Set after Load Removal (in.)			Racking Dfls. (in.)	
Load (lbs)	#1	#2	#3	#1	#2	#3	Load	Set
0	0.000	0.000	0.000	0.000	0.000	0.000		
400	0.179	0.016	0.089	0.034	0.004	0.013	**0.087**	**0.019**
800	0.340	0.035	0.174	0.078	0.010	0.035	**0.155**	**0.038**
1200	0.487	0.056	0.245	0.127	0.014	0.055	**0.220**	**0.067**
1600	0.640	0.080	0.305	0.185	0.027	0.071	**0.299**	**0.099**
2000	0.902	0.132	0.380	0.305	0.065	0.094	**0.449**	**0.164**
2400	1.454	0.216	0.474	0.639	0.126	0.137	**0.856**	**0.413**

Assumptions for Calculations:

x1 = x2 = 3 inches from ends
x3 = 2 inches from end

Observations from Test:

Load (lbs.)	Comments
1700	Drywall screws starting to pop.
2000	Drywall popping increasing.
2400	Maximum load achieved. Deflections and sets were measured. While attempting to load to 2800 lbs., a maximum load of 2300 lbs. was achieved before drywall pulled through the screws at corners.


Drywall with R-19 Batts
7000
6000
5000
4000
3000
2000
1000
0
Load (lbs)
0.0
0.5
1.0
1.5
Inches
Deflection
Set

Test #3
OSB with SPUF
Date: 11/12/96

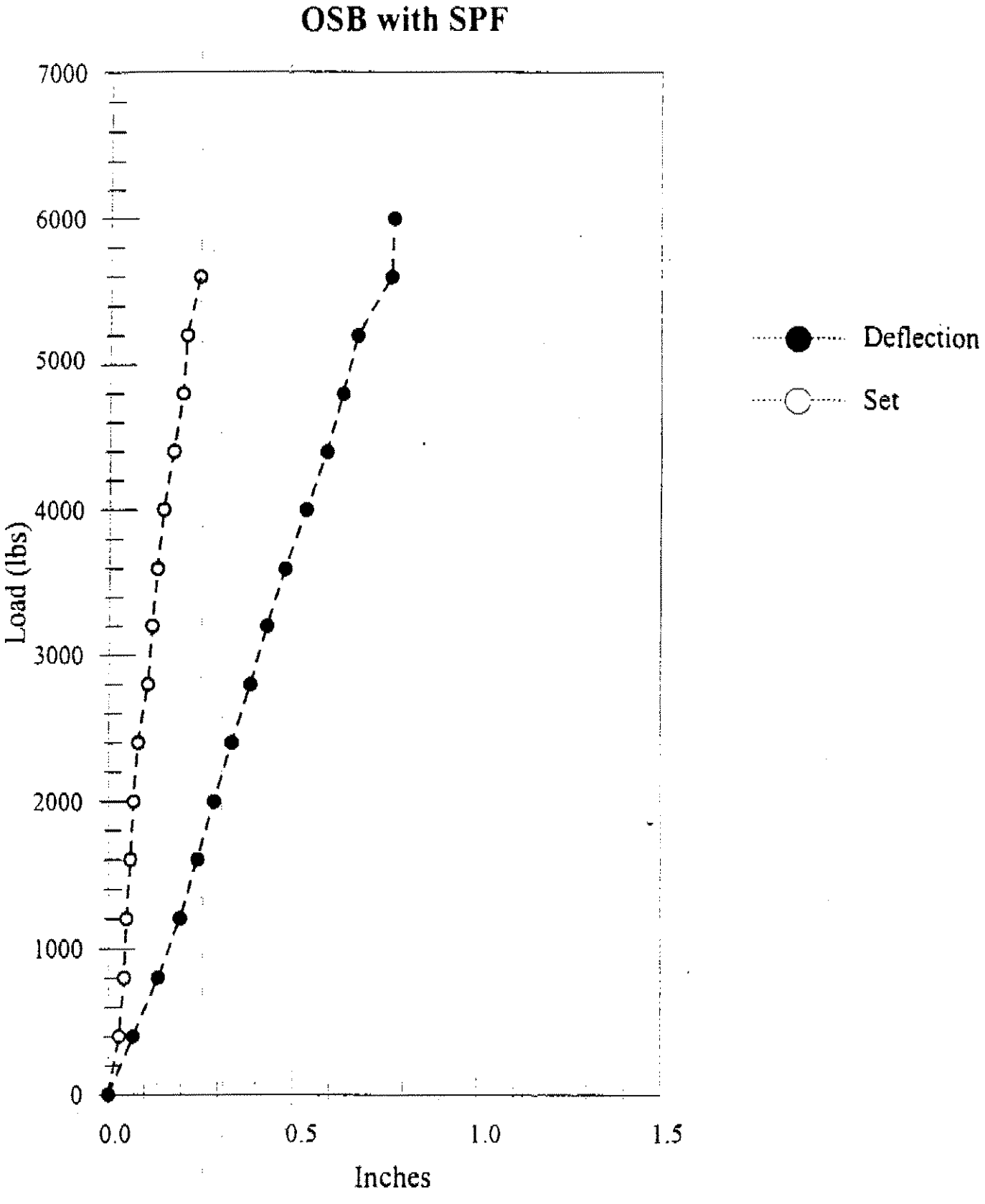
	Test Data						Calculations	
	Deflection under Load (in.)			Set after Load Removal (in.)			Racking Dfls. (in.)	
Load (lbs)	#1	#2	#3	#1	#2	#3	Load	Set
0	0.000	0.000	0.000	0.000	0.000	0.000		
400	0.144	0.013	0.073	0.061	0.005	0.031	0.068	0.029
800	0.294	0.027	0.151	0.097	0.012	0.049	0.137	0.043
1200	0.422	0.040	0.216	0.118	0.016	0.061	0.196	0.049
1600	0.531	0.054	0.270	0.142	0.019	0.073	0.244	0.060
2000	0.645	0.083	0.318	0.178	0.038	0.083	0.288	0.068
2400	0.765	0.114	0.368	0.220	0.059	0.093	0.334	0.081
2800	0.874	0.137	0.412	0.270	0.070	0.110	0.383	0.106
3200	0.988	0.167	0.458	0.314	0.087	0.128	0.427	0.117
3600	1.093	0.193	0.494	0.355	0.102	0.143	0.476	0.130
4000	1.223	0.228	0.540	0.401	0.125	0.151	0.532	0.146
4400	1.354	0.262	0.589	0.477	0.149	0.181	0.588	0.173
4800	1.481	0.307	0.634	0.552	0.181	0.203	0.631	0.197
5200	1.608	0.362	0.674	0.62	0.227	0.217	0.669	0.207
5600	2.172	0.745	0.777	1.056	0.584	0.268	0.761	0.241
6000	2.358	0.858	0.850	1.182	0.780	0.293	0.767	0.142

Assumptions for Calculations:

x1 = x2 = 3 inches from ends
x3 = 2 inches from end

Observations from Test:

Load (lbs.)	Comments
1900	Drywall screws starting to pop.
2350	Drywall popping continuing.
2800	Drywall cracking at corners.
6000	Maximum load achieved. Additional loading was not possible due to bending of the bottom track adjacent to deflection gage #3 (causing excessive rotation).


OSB with SPF
7000
6000
5000
4000
3000
2000
1000
0
Load (lbs)
0.0
0.5
1.0
1.5
Inches
Deflection
Set

Test #4
Drywall with SPUF
Date: 11/13/96

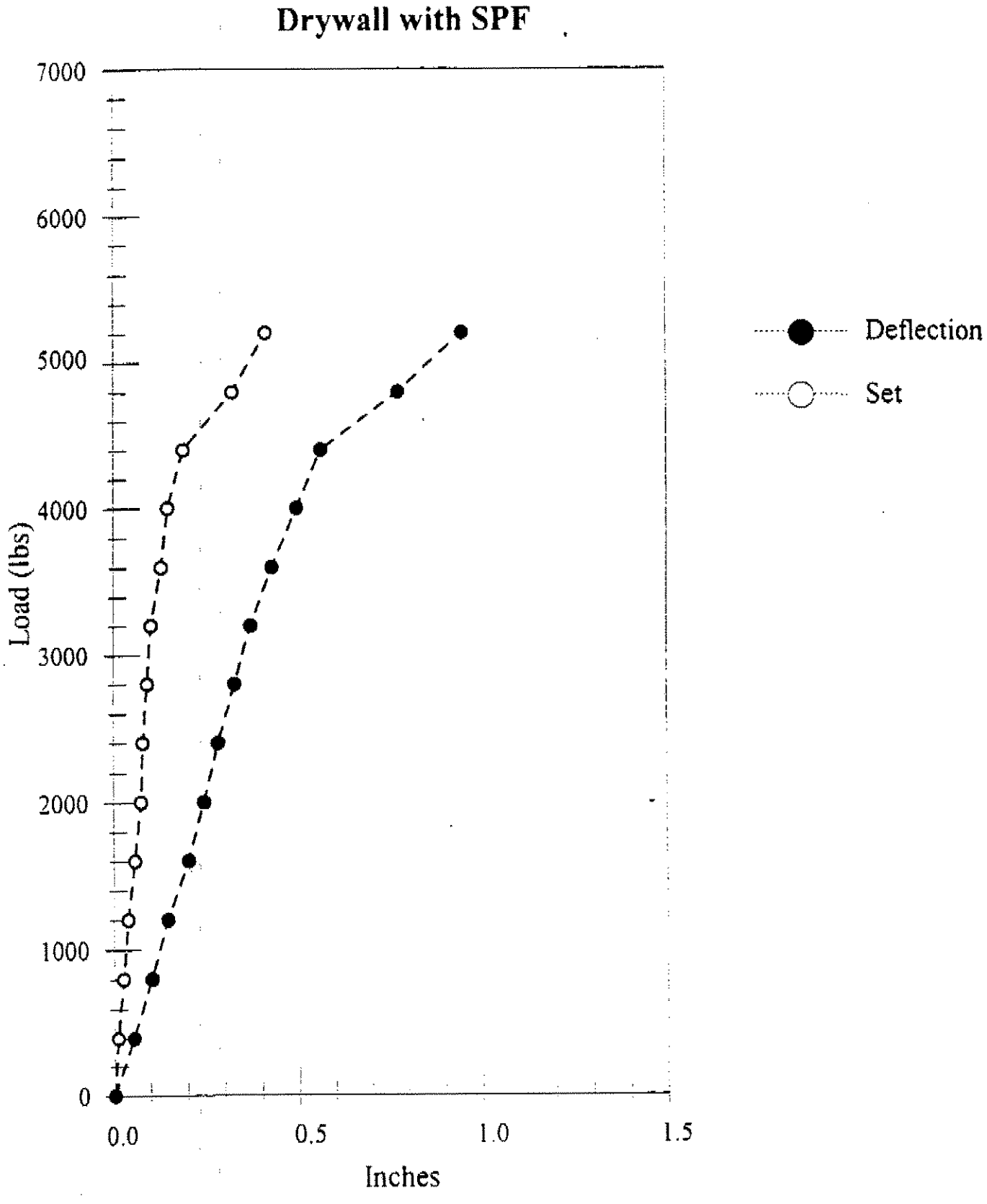
	Test Data						Calculations	
	Deflection under Load (in.)			Set after Load Removal (in.)			Racking Dfls. (in.)	
Load (lbs)	#1	#2	#3	#1	#2	#3	Load	Set
0	0.000	0.000	0.000	0.000	0.000	0.000		
400	0.107	0.010	0.050	0.024	0.002	0.014	**0.054**	**0.010**
800	0.230	0.029	0.113	0.054	0.006	0.026	**0.104**	**0.026**
1200	0.343	0.048	0.170	0.086	0.015	0.037	**0.148**	**0.039**
1600	0.490	0.085	0.233	0.141	0.042	0.049	**0.204**	**0.058**
2000	0.618	0.122	0.290	0.194	0.066	0.063	**0.245**	**0.075**
2400	0.725	0.156	0.332	0.230	0.092	0.068	**0.282**	**0.081**
2800	0.848	0.191	0.384	0.272	0.113	0.078	**0.325**	**0.093**
3200	0.968	0.227	0.431	0.318	0.140	0.089	**0.368**	**0.103**
3600	1.100	0.269	0.472	0.372	0.166	0.093	**0.424**	**0.129**
4000	1.246	0.315	0.512	0.409	0.183	0.097	**0.492**	**0.146**
4400	1.420	0.372	0.573	0.502	0.223	0.112	**0.557**	**0.188**
4800	1.671	0.495	0.492	0.667	0.320	0.053	**0.772**	**0.318**
5200	1.968	0.618	0.505	0.878	0.419	0.084	**0.945**	**0.407**

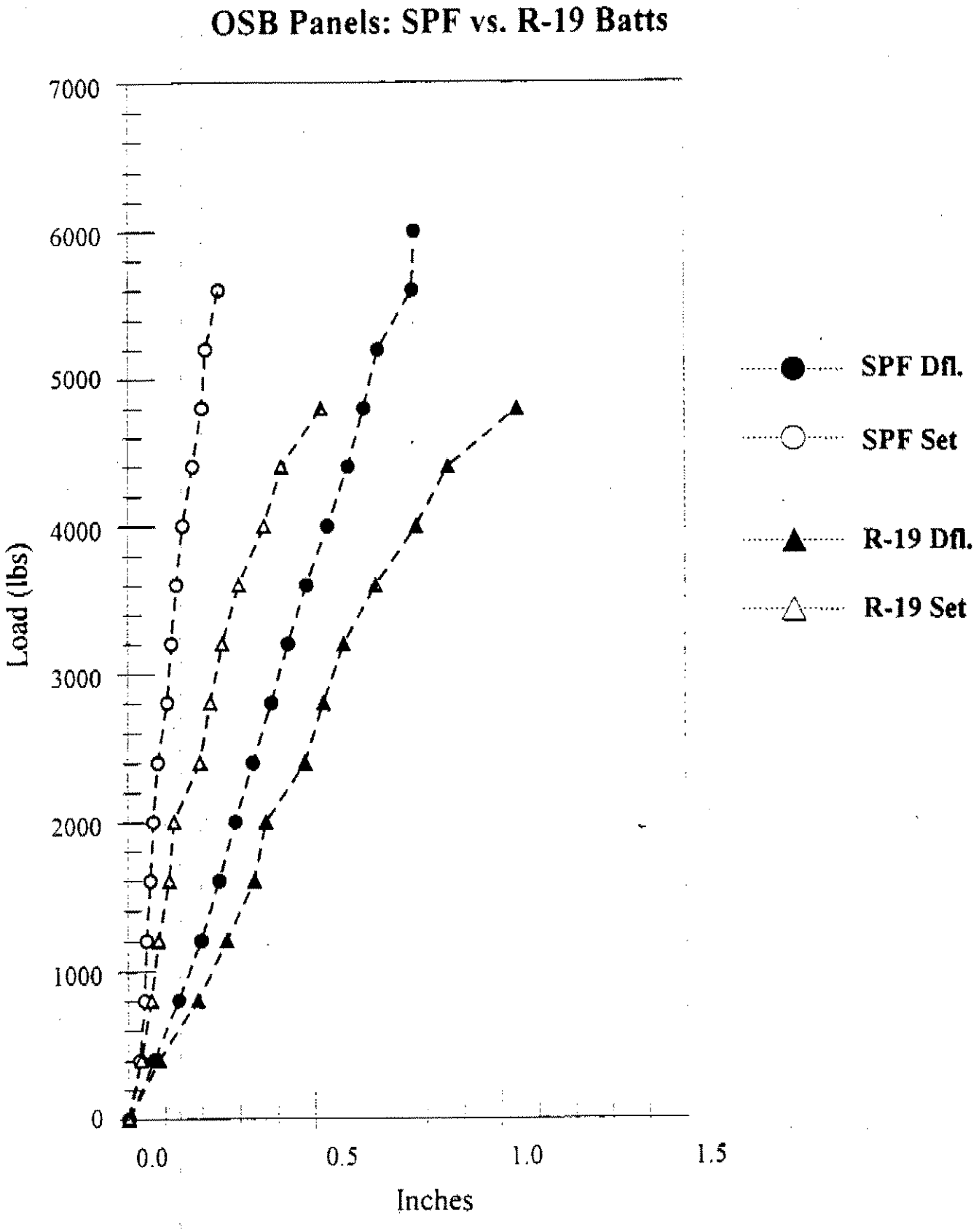
Assumptions for Calculations:

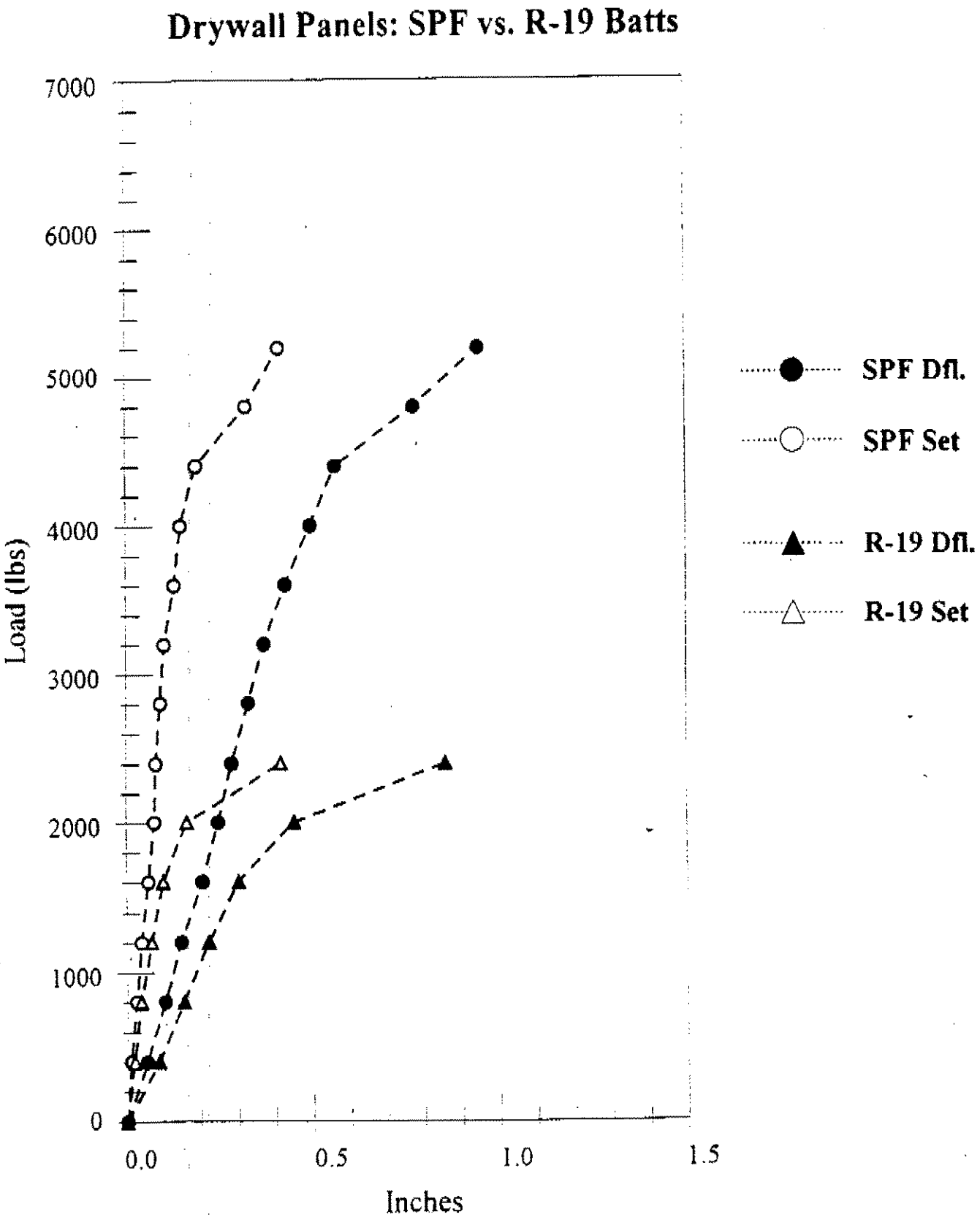
x1 = x2 = 3 inches from ends
x3 = 2 inches from end

Observations from Test:

Load (lbs.)	Comments
2400	Drywall cracking at corners.
4400	Bottom track starting to bend away from rail adjacent to deflection gage #3.
5380	Maximum load achieved. Bottom track adjacent to deflection gage #3 pulled away from fastening rail. Excessive bending of the track caused the load to fall and the drywall to peel away from the framing at the bending location.


Drywall with SPF
7000
6000
5000
4000
3000
2000
1000
0
Load (lbs)
0.0
0.5
1.0
1.5
Inches
Deflection
Set


OSB Panels: SPF vs. R-19 Batts
Load (lbs)
7000
6000
5000
4000
3000
2000
1000
0
0.0
0.5
1.0
1.5
Inches
SPF Dfl.
SPF Set
R-19 Dfl.
R-19 Set


Drywall Panels: SPF vs. R-19 Batts
Load (lbs)
7000
6000
5000
4000
3000
2000
1000
0
0.0
0.5
1.0
1.5
Inches
SPF Dfl.
SPF Set
R-19 Dfl.
R-19 Set