Project 16-186

Racking Load Tests

For

LIQUID NAILS

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ACCREDITED
TL-109

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1. Introduction

PFS Corporation, Cottage Grove, Wisconsin, was contracted by the client, PPG Architectural Coatings, Cranberry Township, Pennsylvania, to evaluate the racking load test performance of shear walls fabricated with Multipurpose Manufactured Housing Adhesive with different drywall. The testing was conducted according to Section 14 of the ASTM E72-13a standard, *"Standard Test Methods of Conducting Strength Tests of Panels for Building Construction."* The tests were conducted on 9/6/2016 through 9/19/2016 at the PFS Testing Laboratory in Cottage Grove, Wisconsin.

2. Materials and Tests

2.1 Materials

The client provided and identified the adhesive as Multipurpose Manufactured Housing Adhesive. PFS Laboratory received the Multipurpose Manufactured Housing Adhesive samples on 7/27/2016 and 9/2/2016. Drywall, lumber and fasteners were locally procured by PFS. The lumber used were nominal 2x3-in. SPF Stud grade and nominal 1x3-in. SPF grade No2 *(Photo 1)*. The fasteners used were 7/16x1-3/4-in 15 Ga Senco staples for the framing and 1/4x1-in 19 Ga Senco staples *(Photo 2)* for the sheathing. The shear wall racking test specimens were constructed by PFS as per client instructions. The construction details as listed below deviate from the construction details as listed in E72-13a and represent intended construction. Deviations from standard E-72-13a include:

- First and last studs as single studs, single top plate
- 2x3 studs and 1x3 top and bottom plates
- Staples for framing connections
- Dissipation plate use consistent with other testing for this client
- Initial preload of 200 lbf

The test specimens consisted of nominal 3-in. thick 8x8-ft frame with gypsum drywall attached on one side with the adhesive and staples as listed *(Photo 3, 4)*. Three replicates of each design were tested.

Design	***Sheathing***	***Framing***	***Fastener***	***Adhesive***
#1	3/8" ClassicRoc® from American Gypsum	Top & Bottom Plate: 1x3 SPF Vertical Studs: 2x3 SPF @ 16" OC	1/4x1-in. 19 Ga Senco staple 6" OC along the drywall edge, and 12" OC in the field.	Multipurpose Manufactured Housing Adhesive ~1/2 to 5/8" thick bead on framing
#2	3/8" ToughRock® from Georgia Pacific	Top & Bottom Plate: 1x3 SPF Vertical Studs: 2x3 SPF @ 16" OC		
#3	3/8" SheetRock® from USG	Top & Bottom Plate: 1x3 SPF Vertical Studs: 2x3 SPF @ 16" OC		
#4	3/8" GoldBond® from National Gypsum	Top & Bottom Plate: 1x3 SPF Vertical Studs: 2x3 SPF @ 16" OC		

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2.2 Specimen Preparation

The lumber, drywall and the adhesive were allowed to condition in the ambient laboratory atmosphere of approximately 70 - 75°F and 40 - 50% relative humidity. Studs were selected such that there was minimal wane and warping and arranged such that the studs would achieve maximum contact with the drywall. The frame was assembled using 7/16x1-3/4-in 15 Ga Senco staples. A 1/2" to 5/8" bead of Multipurpose Manufactured Housing Adhesive *(Photo 5)*, as prescribed by the client, was laid at the center of the framing members to ensure adequate squeeze out of the adhesive on both sides of the stud. A second bead was laid on the central stud to ensure both sheets of drywall received adequate adhesion along the central stud. The Drywall was air dusted to ensure a surface clean of dust and was applied to the frame within eight minutes of adhesive application. The Drywall was applied vertically to the framing such that the sheathing butt-joint was vertically oriented with both edges equally bearing on the central stud. The Drywall was hand pressed into the adhesive before staples were applied. The wall panels were allowed to cure for one week prior to testing in the ambient laboratory atmosphere of approximately 70 - 75°F and 40 - 50% relative humidity.

2.3 Test Procedure

The specimens were tested vertically using a racking load structural test fixture *(Photo 6)*. The test specimen was attached to the racking test frame with 1/2-in. bolt with 1-1/2-in. washers. The first bolt was located close the rear stud, with the next bolt at 9-in. apart, followed by three bolts at 24-in. spacing, and a last bolt close to the front end. Four displacement transducers were used to monitor the net rotation of the panel - Transducer #1 mounted at the rear vertical stud measured uplift, Transducer #2 mounted at the front toe measured the base slip, Transducer #3 mounted at the top front measured the horizontal displacement of the top plate, and Transducer #4 mounted at the front vertical stud measured the crush at the front toe. Net horizontal racking deflection of the panel at any load is the reading of the Transducer #3 less the sum of the readings of the other three transducers. A nominal 4x4 square steel tube section was firmly bolted across the full length of the specimen header. A 1/2-in. OSB dissipation board was mounted to the bottom plate, to allow the rotation of the sheathing. The test loads were applied to a flat surface at the end of the 4x4 member with a hydraulic ram. A hold-down roller-fixture was implemented. A transducer mounted to the hydraulic ram monitored the loading speed.

An initial preload of 200 lbf was applied and released, and loads were then applied and released in three stages to 800, 1600, and 2400 lbf, between which residual deflection was recorded to establish set characteristics. After determination of set characteristics, the panels were loaded continuously until maximum load was achieved. Loads were applied throughout the test at a constant rate of 400 lbf per minute.

3. Results

The typical mode of failure was gradual rotation of the drywall resulting in tearing of the drywall backing paper and release of the adhesive from the studs along the top or bottom plates as well as shear of the drywall at the lower load side corner (Photo 7-10). The failure mode also included shear of the drywall at the upper corner opposite the load as well as a broken stud. A summary of results is shown below. For detailed results see Charts 1-4 and Tables 1-12.

		Design #1 - 3/8" ClassicRoc® from American Gypsum				
		Max Load at stage (lbf)	Net Deflection (in.)	Set After Load (in.)	Failure Mode	
Test No 1	Stage 1	797	0.058	0.003	Failure along bottom plate, adhesive release from studs	
	Stage 2	1597	0.123	0.025		
	Stage 3	2398	0.199	0.089		
	Failure	3035	0.258			
Test No 2	Stage 1	800	0.037	-0.003	Failure along bottom plate, 90 % adhesive release from studs, 10% paper tear	
	Stage 2	1600	0.093	0.002		
	Stage 3	2400	0.150	0.001		
	Failure	3185	0.290			
Test No 3	Stage 1	797	0.041	0.001	Failure along bottom plate, drywall shear bottom load side corner, 75% adhesive release from studs, 25% paper tear	
	Stage 2	1600	0.088	0.002		
	Stage 3	2398	0.135	0.003		
	Failure	3020	0.237			
		Average Failure Load (lbf)		3080	Average Failure Load (lbf/ft)	385

		Design #2- 3/8" ToughRock® from Georgia Pacific				
		Max Load at stage (lbf)	Net Deflection (in.)	Set After Load (in.)	Failure Mode	
Test No 1	Stage 1	800	0.033	0.003	Failure along top plate, 50 % paper tear, 50 % adhesive release from studs	
	Stage 2	1596	0.076	0.006		
	Stage 3	2400	0.144	0.021		
	Failure	3120	0.259			
Test No 2	Stage 1	800	0.044	0.003	Failure along top plate, adesive release from studs	
	Stage 2	1599	0.098	0.016		
	Stage 3	2391	0.168	0.036		
	Failure	2985	0.263			
Test No 3	Stage 1	797	0.030	0.001	Failure along bottom plate, 50% paper tear, 50% adhesive release from studs	
	Stage 2	1600	0.066	0.005		
	Stage 3	2400	0.104	-0.004		
	Failure	3085	0.147			
		Average Failure Load (lbf)		3063	Average Failure Load (lbf/ft)	383

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		Design #3- 3/8" SheetRock® from USG				
		Max Load at stage (lbf)	Deflection (in.)	Set After Load (in.)	Failure Mode	
Test No 1	Stage 1	796	0.035	0.000	Failure along bottom plate, drywall shear lower load side corner, 75% paper tear, 25% Adhesive release from studs	
	Stage 2	1600	0.077	0.000		
	Stage 3	2400	0.128	0.007		
	Failure	**2897**	**0.146**			
Test No 2	Stage 1	799	0.049	0.004	Failure along bottom plate, drywall shear lower load side corner, 90% paper tear, 10% adhesive release from studs	
	Stage 2	1600	0.104	0.009		
	Stage 3	2399	0.145	0.016		
	Failure	**3087**	**0.219**			
Test No 3	Stage 1	796	0.046	0.002	Failure along top plate, drywall shear upper corner opposite load, 65% paper tear, 35% adhesive release from stud.	
	Stage 2	1599	0.108	0.021		
	Stage 3	2398	0.168	0.026		
	Failure	**3002**	**0.267**			
		Average Failure Load (lbf)		**2995**	**Average Failure Load (lbf/ft)**	**374**

		Design #4- 3/8" GoldBond® from National Gypsum				
		Max Load at stage (lbf)	Deflection (in.)	Set After Load (in.)	Failure Mode	
Test No 1	Stage 1	800	0.034	-0.008	Failure along bottom plate, drywall shear lower load side corner, majority paper tear	
	Stage 2	1592	0.081	-0.007		
	Stage 3	2400	0.134	-0.002		
	Failure	**3250**	**0.213**			
Test No 2	Stage 1	799	0.042	0.000	Failure along bottom plate, drywall shear lower load side corner, majority paper tear	
	Stage 2	1595	0.092	0.001		
	Stage 3	2398	0.154	-0.001		
	Failure	**2928**	**0.200**			
Test No 3	Stage 1	800	0.037	0.000	Failure along top plate, drywall shear upper corner opposite load, fracture of second to last stud opposite load, 70% paper tear, 30% adhesive release from studs	
	Stage 2	1597	0.084	0.002		
	Stage 3	2400	0.170	0.012		
	Failure	**2630**	**0.267**			
		Average Failure Load (lbf)		**2936**	**Average Failure Load (lbf/ft)**	**367**

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10/14/2016

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10/14/2016

Attachments:
Attachment 1 - Detailed Test Results

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Photo 1: Typical 2x3 SPF Stud (left) and 1x3 SPF Plate (right)

Photo 2: Left- Fastener Used to Attach Framing, Right-Fastener Used to Attach Drywall

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Photo 3: Typical Frame

Photo 4: Typical Wall Specimen

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Photo 5: Typical Adhesive Bead Size

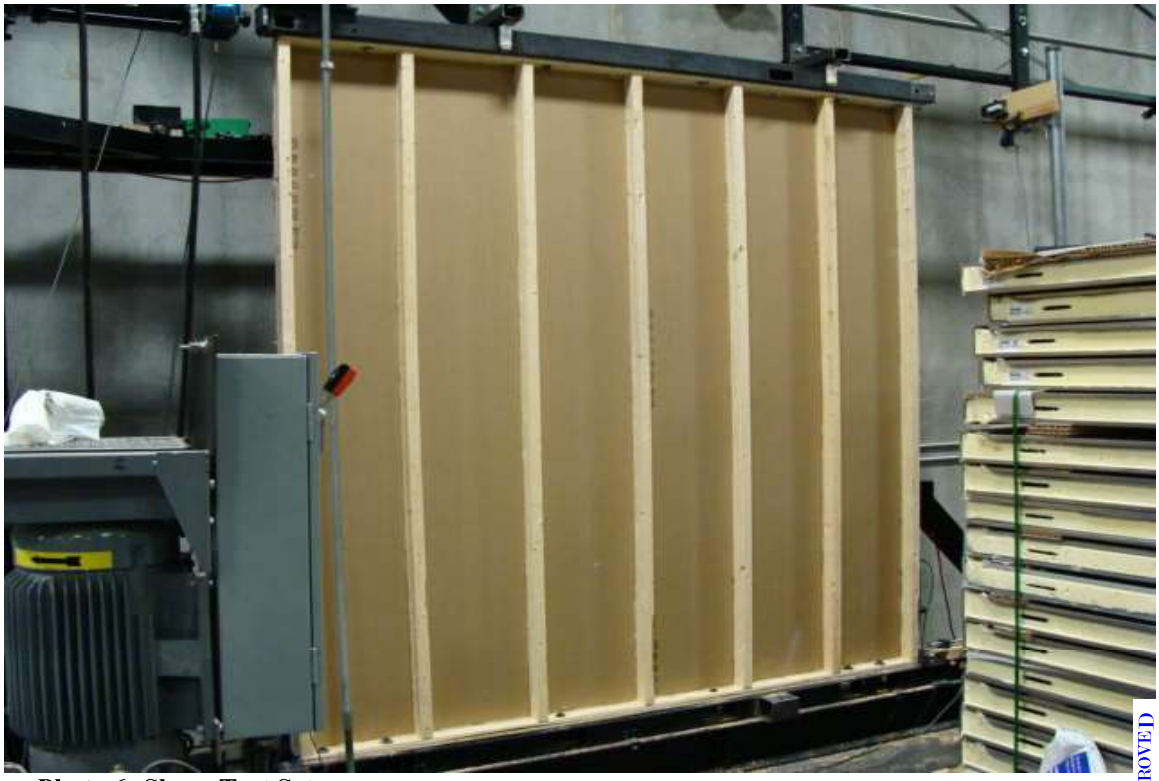

Photo 6: Shear Test Setup

Photo 7: Typical Failure- Top Plate

Photo 8: Typical Failure- Bottom Plate

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Photo 9: Typical Failure- Drywall Shear

Photo 10: Broken Stud

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Table #1

	Design #1 - American Test #1					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	200	0.016	0.005	0.001	0.002	0.008
Set	0	0.000	0.000	0.000	0.000	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.017	0.006	0.001	0.002	0.008
	400	0.044	0.014	0.004	0.003	0.023
	600	0.080	0.025	0.007	0.005	0.044
	797	0.116	0.041	0.009	0.007	0.058
Set	0	0.003	0.001	0.001	-0.002	0.003
	1000	0.146	0.053	0.012	0.008	0.074
	1200	0.191	0.070	0.015	0.015	0.091
	1400	0.236	0.085	0.019	0.027	0.105
	1590	0.316	0.128	0.026	0.040	0.123
Set	10	0.050	0.017	0.007	0.002	0.025
	1800	0.357	0.146	0.028	0.027	0.156
	2000	0.393	0.157	0.032	0.031	0.174
	2200	0.424	0.170	0.035	0.035	0.185
	2398	0.458	0.182	0.039	0.039	0.199
Set	0	0.087	0.033	0.011	-0.046	0.089
	2600	0.500	0.196	0.043	0.043	0.219
	2800	0.543	0.213	0.046	0.050	0.234
	3000	0.590	0.229	0.051	0.057	0.252
	3035	0.607	0.234	0.055	0.060	0.258
Failure Load (lbf):		3035	Failure Load (lbf/ft):			379
Load at 1/8" Deflection (lbf):		1376	Load at 1/8" Deflection (lbf/ft):			172

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Table #2

	Design #1 - American Test #2					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	199	0.012	0.003	0.002	0.002	0.005
Set	0	0.000	0.000	0.000	0.000	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.012	0.003	0.002	0.002	0.006
	400	0.026	0.006	0.004	0.004	0.012
	600	0.055	0.012	0.006	0.007	0.030
	800	0.081	0.021	0.009	0.014	0.037
Set	0	0.005	0.001	0.002	0.006	-0.003
	1000	0.117	0.031	0.013	0.019	0.055
	1200	0.147	0.041	0.017	0.023	0.066
	1400	0.182	0.052	0.021	0.028	0.081
	1600	0.215	0.065	0.027	0.031	0.093
Set	0	0.038	0.005	0.013	0.017	0.002
	1800	0.254	0.079	0.033	0.033	0.109
	2000	0.289	0.090	0.036	0.036	0.127
	2200	0.322	0.105	0.041	0.039	0.138
	2400	0.354	0.118	0.044	0.042	0.150
Set	0	0.067	0.019	0.021	0.026	0.001
	2600	0.398	0.133	0.049	0.046	0.170
	2800	0.432	0.145	0.052	0.049	0.186
	3000	0.487	0.159	0.058	0.054	0.217
	3185	0.604	0.177	0.075	0.062	0.290
	Failure Load (lbf):		3185	Failure Load (lbf/ft):		398
	Load at 1/8" Deflection (lbf):		1980	Load at 1/8" Deflection (lbf/ft):		248

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Table #3

	Design #1 - American Test #3					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	200	0.018	0.003	0.002	0.005	0.008
Set	0	0.007	0.000	0.001	0.006	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.011	0.003	0.001	0.002	0.005
	400	0.038	0.007	0.003	0.010	0.018
	600	0.067	0.014	0.007	0.017	0.031
	797	0.099	0.024	0.011	0.024	0.041
Set	0	0.018	0.002	0.004	0.011	0.001
	1000	0.136	0.035	0.016	0.030	0.056
	1200	0.164	0.046	0.020	0.037	0.062
	1400	0.203	0.062	0.025	0.043	0.074
	1600	0.257	0.091	0.030	0.049	0.088
Set	0	0.047	0.009	0.012	0.024	0.002
	1800	0.296	0.110	0.035	0.053	0.098
	2000	0.334	0.123	0.039	0.058	0.113
	2200	0.361	0.135	0.043	0.062	0.121
	2398	0.400	0.150	0.048	0.067	0.135
Set	0	0.071	0.017	0.018	0.034	0.003
	2600	0.441	0.163	0.053	0.072	0.152
	2800	0.479	0.174	0.059	0.077	0.169
	3000	0.543	0.189	0.070	0.082	0.202
	3020	0.596	0.194	0.078	0.086	0.237
Failure Load (lbf):		3020	Failure Load (lbf/ft):			378
Load at 1/8" Deflection (lbf):		2254	Load at 1/8" Deflection (lbf/ft):			282

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Chart #1: Design #1

ClassicRoc Gypsum from American Gypsum

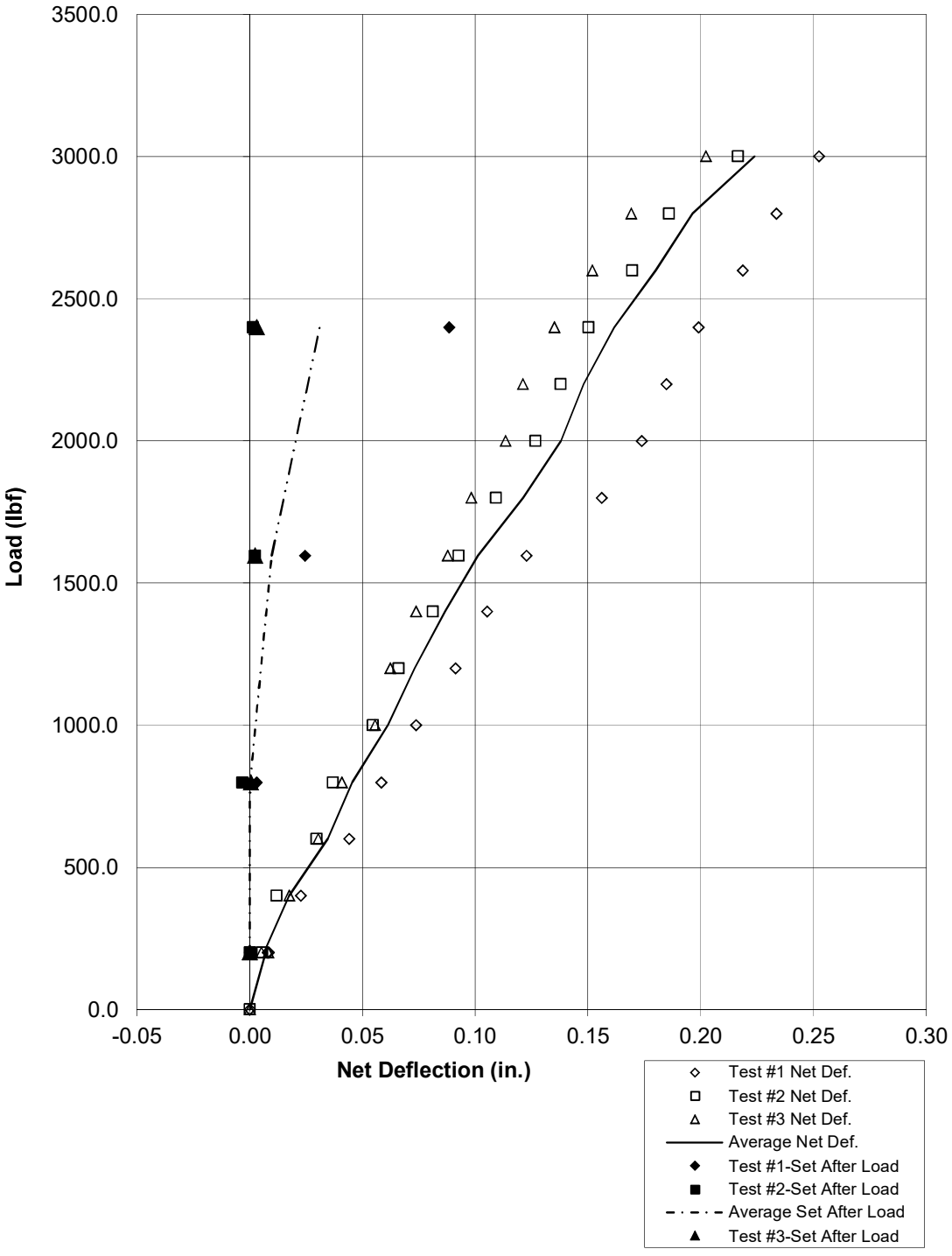

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Table #4

	Design #2 - Georgia Pacific Test #1					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	200	0.018	0.004	0.002	0.009	0.003
Set	0	0.000	0.000	0.000	0.000	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.017	0.004	0.002	0.009	0.003
	400	0.048	0.012	0.004	0.020	0.013
	600	0.106	0.034	0.008	0.039	0.026
	800	0.150	0.053	0.011	0.053	0.033
Set	0	0.013	0.002	0.002	0.007	0.003
	1000	0.189	0.070	0.015	0.064	0.040
	1200	0.231	0.087	0.019	0.073	0.053
	1400	0.268	0.101	0.022	0.080	0.065
	1596	0.302	0.115	0.025	0.087	0.076
Set	0	0.033	0.007	0.006	0.015	0.006
	1800	0.354	0.133	0.031	0.094	0.096
	2000	0.397	0.146	0.036	0.101	0.114
	2200	0.432	0.157	0.041	0.108	0.125
	2400	0.472	0.169	0.044	0.114	0.144
Set	0	0.070	0.011	0.015	0.023	0.021
	2600	0.537	0.195	0.050	0.126	0.166
	2800	0.590	0.209	0.054	0.135	0.191
	3000	0.641	0.223	0.059	0.145	0.215
	3120	0.706	0.232	0.062	0.153	0.259
Failure Load (lbf):		3120	Failure Load (lbf/ft):			390
Load at 1/8" Deflection (lbf):		2201	Load at 1/8" Deflection (lbf/ft):			275

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Table #5

	Design #2 - Georgia Pacific Test #2					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	197	0.013	0.004	0.001	0.006	0.002
Set	0	0.003	0.001	0.000	0.002	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.010	0.004	0.001	0.004	0.002
	400	0.046	0.012	0.003	0.012	0.020
	600	0.080	0.026	0.006	0.020	0.029
	800	0.130	0.047	0.009	0.029	0.044
Set	0	0.019	0.003	0.003	0.010	0.003
	1000	0.168	0.065	0.013	0.037	0.053
	1200	0.217	0.084	0.017	0.045	0.071
	1400	0.257	0.101	0.021	0.051	0.084
	1599	0.311	0.129	0.025	0.060	0.098
Set	0	0.058	0.013	0.008	0.021	0.016
	1800	0.362	0.147	0.029	0.068	0.117
	2000	0.395	0.160	0.032	0.073	0.130
	2200	0.440	0.176	0.036	0.081	0.148
	2391	0.481	0.189	0.039	0.085	0.168
Set	0	0.108	0.028	0.014	0.031	0.036
	2600	0.534	0.210	0.042	0.092	0.189
	2800	0.598	0.232	0.046	0.101	0.219
	2985	0.665	0.245	0.050	0.108	0.263
	Failure Load (lbf):		2985	Failure Load (lbf/ft):		373
	Load at 1/8" Deflection (lbf):		1919	Load at 1/8" Deflection (lbf/ft):		240

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Table #6

	Design #2 - Georgia Pacific Test #3					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	195	0.011	0.004	0.001	0.004	0.002
Set	0	0.004	0.001	0.000	0.003	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.006	0.003	0.001	0.003	-0.001
	400	0.036	0.012	0.004	0.009	0.011
	600	0.071	0.028	0.007	0.017	0.019
	797	0.105	0.041	0.010	0.023	0.030
Set	0	0.018	0.007	0.003	0.007	0.001
	1000	0.137	0.056	0.014	0.030	0.036
	1200	0.177	0.073	0.019	0.038	0.047
	1400	0.215	0.089	0.023	0.046	0.058
	1600	0.255	0.105	0.029	0.056	0.066
Set	0	0.052	0.016	0.011	0.020	0.005
	1800	0.296	0.119	0.036	0.064	0.077
	2000	0.335	0.132	0.040	0.072	0.091
	2200	0.370	0.146	0.045	0.081	0.099
	2400	0.412	0.157	0.055	0.096	0.104
Set	0	0.102	0.031	0.028	0.048	-0.004
	2600	0.450	0.171	0.062	0.107	0.110
	2800	0.488	0.183	0.066	0.116	0.123
	3000	0.533	0.197	0.072	0.125	0.140
	3085	0.555	0.203	0.075	0.130	0.147
Failure Load (lbf):			3085	Failure Load (lbf/ft):		386
Load at 1/8" Deflection (lbf):			2824	Load at 1/8" Deflection (lbf/ft):		353

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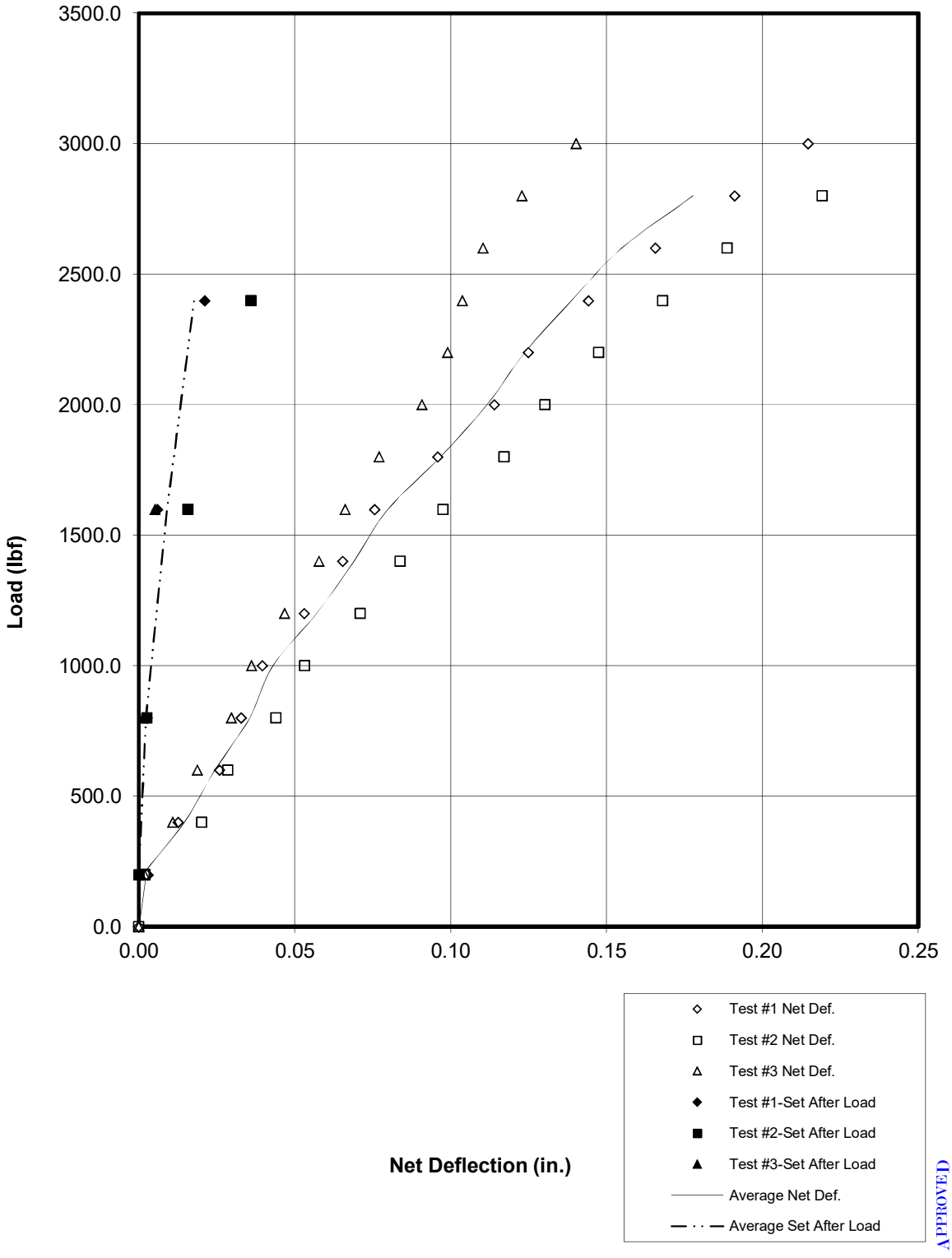
Chart #2: Design #2

Tough Rock Gypsum from Georgia Pacific



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C1HBG-PT-20.72

Table #7

	Design #3 - USG Test #1					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	200	0.020	0.004	0.004	0.006	0.006
Set	0	0.006	0.001	0.002	0.004	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.016	0.004	0.002	0.002	0.008
	400	0.046	0.011	0.006	0.009	0.020
	600	0.074	0.020	0.011	0.016	0.028
	796	0.104	0.031	0.015	0.023	0.035
Set	0	0.020	0.002	0.006	0.012	0.000
	1000	0.142	0.045	0.021	0.030	0.046
	1200	0.223	0.091	0.034	0.044	0.055
	1400	0.270	0.111	0.040	0.056	0.063
	1600	0.324	0.132	0.049	0.066	0.077
Set	0	0.074	0.013	0.027	0.034	0.000
	1800	0.370	0.150	0.059	0.070	0.091
	2000	0.423	0.176	0.066	0.078	0.104
	2200	0.469	0.194	0.075	0.087	0.113
	2400	0.517	0.210	0.083	0.096	0.128
Set	0	0.118	0.019	0.046	0.046	0.007
	2600	0.543	0.226	0.089	0.104	0.124
	2800	0.579	0.238	0.096	0.110	0.135
	2897	0.609	0.246	0.101	0.115	0.146
Failure Load (lbf):		2897	Failure Load (lbf/ft):			362
Load at 1/8" Deflection (lbf):		2363	Load at 1/8" Deflection (lbf/ft):			295

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AUG 30 2024
Federal Manufactured Home Construction And Safety Standards

Table #8

	Design #3 - USG Test #2					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	198	0.019	0.003	0.002	0.004	0.010
Set	0	0.000	0.000	0.000	0.000	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.018	0.003	0.002	0.003	0.009
	400	0.047	0.008	0.006	0.010	0.025
	600	0.084	0.015	0.015	0.016	0.038
	799	0.126	0.029	0.027	0.020	0.049
Set	0	0.031	0.002	0.017	0.008	0.004
	1000	0.171	0.043	0.035	0.026	0.068
	1200	0.217	0.061	0.042	0.034	0.080
	1400	0.273	0.092	0.048	0.041	0.091
	1600	0.321	0.117	0.053	0.047	0.104
Set	0	0.069	0.011	0.031	0.018	0.009
	1800	0.369	0.140	0.059	0.057	0.113
	2000	0.411	0.158	0.063	0.063	0.126
	2200	0.454	0.184	0.068	0.072	0.130
	2399	0.515	0.214	0.073	0.083	0.145
Set	0	0.110	0.024	0.038	0.033	0.016
	2600	0.557	0.235	0.079	0.092	0.151
	2800	0.609	0.253	0.084	0.104	0.168
	3000	0.609	0.246	0.101	0.115	0.146
	3087	0.755	0.283	0.120	0.133	0.219
Failure Load (lbf):		3087	Failure Load (lbf/ft):			386
Load at 1/8" Deflection (lbf):		1985	Load at 1/8" Deflection (lbf/ft):			248

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AUG 30 2024
Federal Manufactured Home Construction And Safety Standards

Table #9

	Design #3 - USG Test #3					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	196	0.020	0.004	0.001	0.008	0.007
Set	0	0.002	0.000	0.000	0.001	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.021	0.004	0.001	0.006	0.010
	400	0.056	0.012	0.004	0.017	0.023
	600	0.115	0.038	0.009	0.029	0.038
	796	0.158	0.061	0.013	0.039	0.046
Set	0	0.024	0.004	0.005	0.014	0.002
	1000	0.219	0.088	0.019	0.050	0.063
	1200	0.271	0.113	0.025	0.058	0.075
	1400	0.320	0.135	0.031	0.065	0.089
	1599	0.380	0.160	0.037	0.075	0.108
Set	0	0.081	0.012	0.017	0.031	0.021
	1800	0.426	0.178	0.041	0.081	0.126
	2000	0.474	0.195	0.046	0.090	0.143
	2200	0.511	0.208	0.052	0.096	0.155
	2398	0.543	0.219	0.057	0.099	0.168
Set	0	0.110	0.017	0.021	0.046	0.026
	2600	0.591	0.232	0.064	0.108	0.187
	2800	0.655	0.246	0.069	0.119	0.220
	3000	0.609	0.246	0.101	0.115	0.146
	3002	0.721	0.256	0.074	0.124	0.267
	Failure Load (lbf):		3002	Failure Load (lbf/ft):		375
	Load at 1/8" Deflection (lbf):		1778	Load at 1/8" Deflection (lbf/ft):		222

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Federal Manufactured Home Construction And Safety Standards

Chart #3: Design #3
SheetRock Gypsum from USG

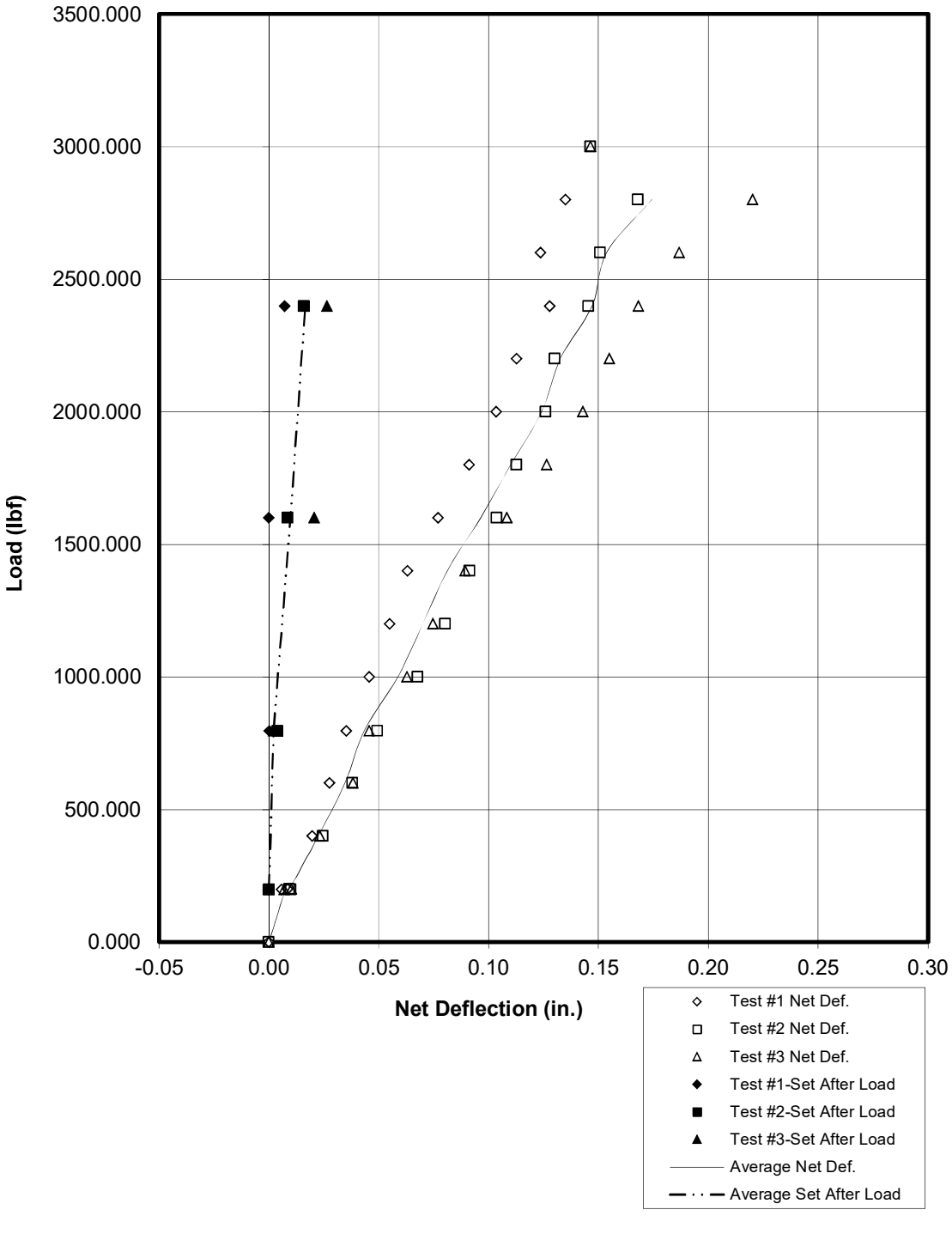

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Table # 10

	Design #4 - National Test #1					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	200	0.023	0.005	0.004	0.010	0.004
Set	0	0.000	0.000	0.000	0.000	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.021	0.005	0.003	0.009	0.004
	400	0.066	0.017	0.013	0.024	0.012
	600	0.097	0.026	0.018	0.033	0.021
	800	0.132	0.035	0.022	0.040	0.034
Set	0	0.018	0.004	0.008	0.015	-0.008
	1000	0.163	0.046	0.027	0.047	0.043
	1200	0.203	0.058	0.032	0.057	0.056
	1400	0.236	0.070	0.037	0.066	0.064
	1592	0.278	0.082	0.041	0.074	0.081
Set	0	0.057	0.014	0.021	0.030	-0.007
	1800	0.314	0.093	0.045	0.078	0.098
	2000	0.343	0.102	0.049	0.081	0.112
	2200	0.393	0.126	0.056	0.085	0.126
	2400	0.419	0.138	0.059	0.089	0.134
Set	0	0.105	0.039	0.030	0.039	-0.002
	2600	0.459	0.152	0.063	0.091	0.153
	2800	0.494	0.162	0.067	0.095	0.169
	3000	0.524	0.172	0.072	0.099	0.182
	3200	0.584	0.187	0.083	0.108	0.206
	3250	0.605	0.191	0.087	0.113	0.213
Failure Load (lbf):		3250	Failure Load (lbf/ft):			406
Load at 1/8" Deflection (lbf):		2187	Load at 1/8" Deflection (lbf/ft):			273

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AUG 30 2024
Federal Manufactured Home Construction And Safety Standards

Table # 11

	Design #4 - National Test #2					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	197	0.018	0.005	0.003	0.005	0.006
Set	0	0.003	0.000	0.000	0.003	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.017	0.005	0.003	0.007	0.003
	400	0.053	0.013	0.006	0.013	0.021
	600	0.092	0.030	0.011	0.022	0.030
	799	0.145	0.056	0.017	0.030	0.042
Set	0	0.021	0.007	0.005	0.009	0.000
	1000	0.186	0.070	0.023	0.036	0.056
	1200	0.226	0.083	0.033	0.042	0.068
	1400	0.275	0.100	0.044	0.050	0.081
	1595	0.314	0.113	0.053	0.056	0.092
Set	0	0.067	0.017	0.026	0.023	0.001
	1800	0.359	0.129	0.062	0.063	0.106
	2000	0.409	0.145	0.071	0.070	0.123
	2200	0.446	0.159	0.078	0.077	0.133
	2398	0.500	0.177	0.084	0.085	0.154
Set	0	0.121	0.038	0.042	0.041	-0.001
	2600	0.555	0.194	0.092	0.093	0.175
	2800	0.589	0.204	0.097	0.100	0.188
	2928	0.619	0.213	0.100	0.106	0.200
Failure Load (lbf):		2928	Failure Load (lbf/ft):			366
Load at 1/8" Deflection (lbf):		2038	Load at 1/8" Deflection (lbf/ft):			255

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AUG 30 2024
Federal Manufactured Home Construction And Safety Standards

Table # 12

	Design #4 - National Test #3					
	Load	Deflection Readings (in.)				Net Deflection
	(lbf)	Front Top	Rear Toe	Front Toe	Toe Crush	(in.)
Initial	0	0.000	0.000	0.000	0.000	0.000
Preload	200	0.019	0.003	0.003	0.006	0.007
Set	0	0.000	0.000	0.000	0.000	0.000
Start	0	0.000	0.000	0.000	0.000	0.000
	200	0.015	0.003	0.002	0.005	0.004
	400	0.045	0.008	0.007	0.014	0.016
	600	0.079	0.015	0.013	0.022	0.030
	800	0.119	0.032	0.019	0.031	0.037
Set	0	0.028	0.005	0.007	0.016	0.000
	1000	0.161	0.050	0.025	0.039	0.048
	1200	0.202	0.065	0.030	0.046	0.061
	1400	0.238	0.080	0.034	0.052	0.072
	1597	0.293	0.107	0.040	0.061	0.084
Set	0	0.057	0.010	0.016	0.029	0.002
	1800	0.357	0.141	0.048	0.070	0.098
	2000	0.406	0.162	0.052	0.077	0.116
	2200	0.472	0.187	0.058	0.083	0.143
	2400	0.552	0.221	0.068	0.094	0.170
Set	0	0.120	0.032	0.030	0.045	0.012
	2600	0.669	0.246	0.078	0.103	0.243
	2630	0.699	0.249	0.079	0.105	0.267
	Failure Load (lbf):		2630	Failure Load (lbf/ft):		329
	Load at 1/8" Deflection (lbf):		2068	Load at 1/8" Deflection (lbf/ft):		259

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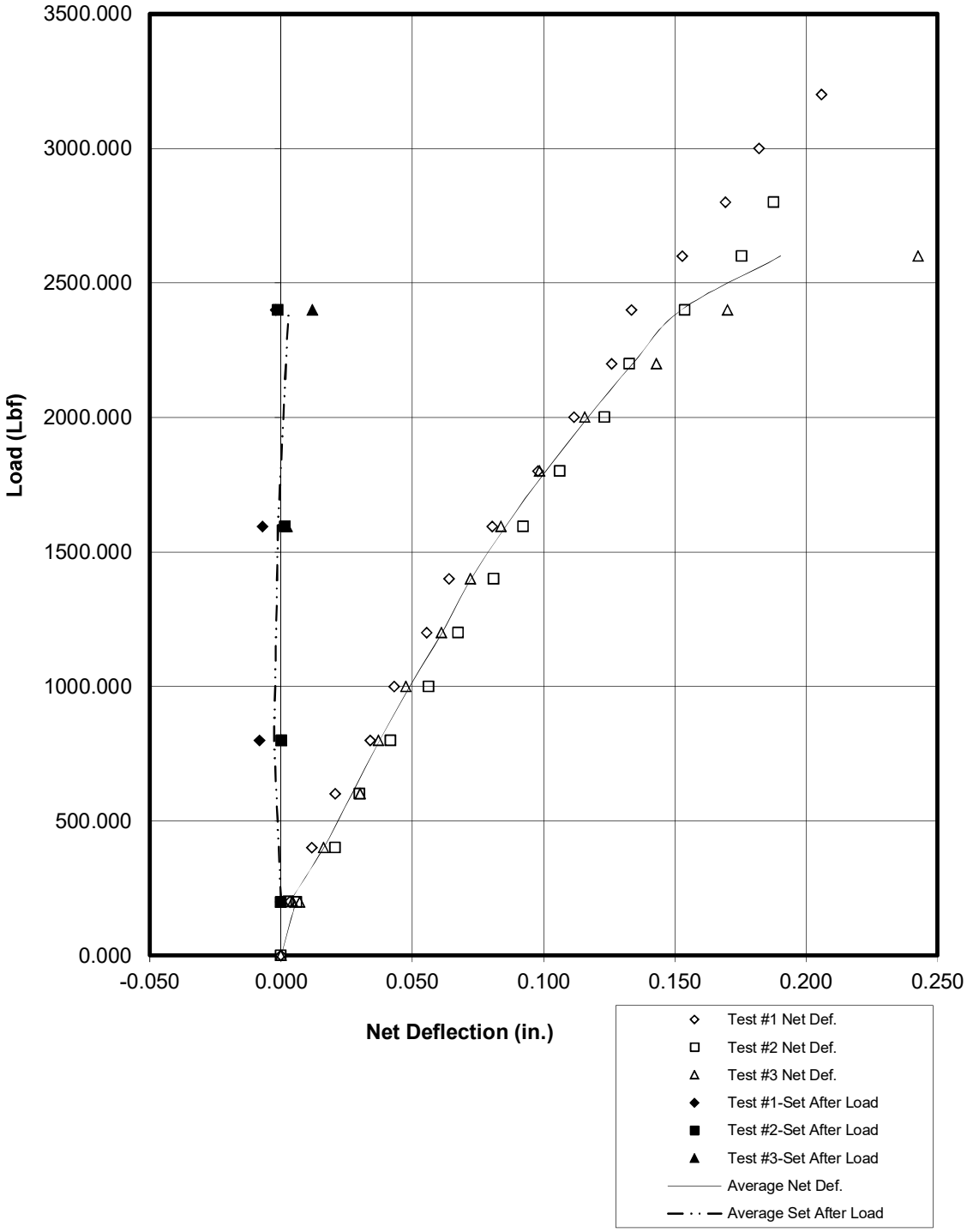
AUG 30 2024
Federal Manufactured Home Construction And Safety Standards

CHART #4: Design #4

GoldBond Gypsum from National Gypsum



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AUG 30 2024
Federal Manufactured Home Construction And Safety Standards

C1HBG-PT-20.80