

## Evaluation of Single-Sided Wall Assemblies Under Racking Load Sheathed with 5/16" U. S. Gypsum Wall Board

Attached with:  
**"P 5100" Adhesive**

Manufactured By:  
**Alpha Systems**

Prepared For:

**Alpha Systems  
5120 Beck Drive  
Elhart, IN 46516**

Test Report: NTA990014

Issued: March 25, 1999

Prepared By:

John Kirkwood  
NTA, Inc.

Approved by:  
Kevin M. Finn, P. E.  
Managing Engineer



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## 1.0 INTRODUCTION

NTA, Inc. conducted racking load tests on wall assemblies at the NTA test facility in Nappanee, Indiana. The wall assemblies were tested in conformance to ASTM E 72-80; Standard Methods of Conducting Strength Tests of Panels for Building Construction, Section 14, Racking Load -- Evaluation of Sheathing Materials on a Standard Wood Frame.

The Purpose of this evaluation is to determine what the allowable design shear load is for wall assemblies constructed as described in this report, using 5/16" U. S. Gypsum wall board attached with "P 5100" adhesive as manufactured by Alpha Systems when used in shear walls for manufactured housing.

## 2.0 TEST SPECIMEN DESCRIPTION

### A. Materials

1. Studs: 2x3, Stud Grade SPF at 16" o.c.
2. Top Plate: Single 1x3, Un-Grade SPF.
3. Bottom Plate: Single 1x3, Un-Graded SPF.
4. Sheathing: 48" x 96", 5/16" U. S. Gypsum wall board.
5. Adhesive: "P 5100", Alpha Systems.

### B. Fastening

- Top plate fastened to studs with Two (2) - 7/16" x 1-3/4" x 15 Ga. staples per stud.
- Bottom plate fastened to studs with Two (2) - 7/16" x 1-3/4" x 15 Ga. staples per stud.
- Sheathing attached to 2x3 studs with Two (2) - 1/16" - 1/8" (average) beads of "P 5100" adhesive.
- Sheathing attached to center 2x3 stud at seam with Two (2) - 1/16" - 1/8" (average) bead of "P 5100" adhesive.
- Sheathing attached to 1x3 top plate with One (1) - 1/16" - 1/8" (average) bead of "P 5100" adhesive.
- Sheathing attached to 1x3 bottom plate with One (1) - 1/16" - 1/8" (average) bead of "P 5100" adhesive.
- Sheathing fastened to framing with 3/16" x 3/4" x 19 Ga. staples at 6" o.c. around perimeter of sheathing, and none in the field for the interior studs.

### C. Construction Steps

- "P 5100" applied to the assembled wall with a caulking gun.
- The sheathing was placed on one side of the wall framing immediately after the adhesive was applied and then promptly fastened along all panel edges and framing members as described.

### D. Cure Time

After construction, each of the wall assemblies were cured a minimum of seven (7) days before testing.

### 3.0 TEST SETUP AND PROCEDURE

The wall top plate was fastened to a steel load bar using four(4) - #10 wood screws into each stud bay adjacent to a panel edge for load application. The bottom plate was securely fastened to a structural tee with four (4) - #10 wood screws into each stud bay. The structural tee was then attached to the I-beam in order to secure the sample to the test rack.

Load was applied horizontally to the load bar attached to the top plate of the wall. Dial indicators were placed on the top plate (Indicator #1), and on the bottom plate (Indicator #2) opposite the loaded end of the wall. An additional dial indicator was placed on the load end of the wall at the base of the rack at the first stud location (Indicator #3). See Figure #2 for details.

Load was applied in 400 pound increments, up to 2400 pounds, at a rate of approximately 400 pounds per minute. When each load increment was reached, deflection readings were taken while maintaining the load. The load was then reduced back to zero at an approximate rate of 400 pounds per minute. Zero load readings were taken after each load increment up to 2400 pounds. Finally, load was applied at the same approximate rate until failure occurred.

To determine the horizontal deflection of the panel, subtract the deflection readings from Indicators #2 and #3 from Indicator #1. Indicator #3, which is attached to the stud, will measure any rotation of the panel. Indicator #2 measures any slippage of the panel in the test rack. Indicator #1 measures the total of displacement of Indicators #2 and #3, as well as the deformation of the panel.

### 4.0 TEST RESULTS

A total of three (3) test samples were tested. Each sample had sheathing attached to one side using "P 5100" adhesive. The ultimate loads achieved and the types of failures that occurred are described below.

<u>SAMPLE</u>	<u>ULTIMATE LOAD</u>	<u>FAILURE MODE</u>
#1	4661 pounds	Gypsum shear.
#2	5233 pounds	Gypsum shear.
#3	4672 pounds	Gypsum shear.

Average Ultimate Load = 4855 pounds

Allowable Design Load = (Average Ultimate Load) / [ (Wall Length)\*(Safety Factor) ]

( 4855 pounds ) / [ (8 feet)\*(2.5) ] = 242.76 PLF

5.0 CONCLUSION

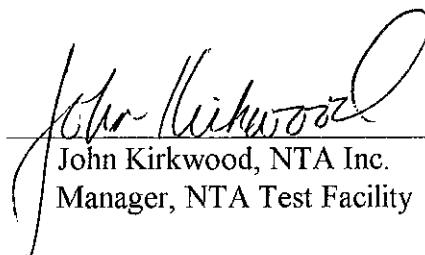
Based on the results of the tests conducted, the maximum allowable design load for a 96" tall shear wall built of 2x3 Stud Grade SPF studs at 16" o/c, 1x3, un-graded SPF top plates with 1x3 un-graded SPF bottom plates with sheathing attached to one side as described in this report is:

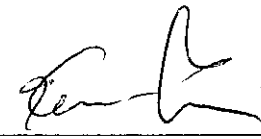
**For 5/16" U. S. Gypsum Wall Board  
Attached to One Side with  
Alpha Systems  
"P 5100" Adhesive = 242.76 PLF**

This design value is only applicable for Manufactured Housing built under the Manufactured Home Construction and Safety Standards and is not intended for use with other model building codes.

5.1 FOLLOW-UP TESTING

Follow-up testing will be in accordance with the NTA, Inc. follow-up testing procedures.

TEST REPORT BY:   
John Kirkwood, NTA Inc.  
Manager, NTA Test Facility

REPORT REVIEWED BY:   
Kevin M. Finn, P.E.  
Managing Engineer

## WALL RACKING TEST

Test Procedure: ASTM E 72-80

Type of Gypsum: 5/16" U.S. Gypsum  
 Gypsum Lot Number: \_\_\_\_\_

Adhesive Manufacturer: Alpha Systems  
 Type of Adhesive: P 5100

FASTENERS: 3/16" x 3/4" x 19 Ga. Senco Staple  
 Field Spacing: None  
 Top Plate Spacing: 6" o.c.  
 Bottom Plate Spacing: 6" o.c.  
 Vertical Edge Spacing: 6" o.c.  
 Adhesive Bead Size: (2) 1/16" - 1/8"  
 Average Beads Per Stud \_\_\_\_\_

**SAMPLE 1**

Test Number: 990014  
 Test Date: 4/1/99  
 Temperature: 68 F  
 Relative Humidity: 50%

**AVERAGE MOISTURE CONTENT**

Plates: 10.00% 1 x 3 SPF Ungraded

Studs: 10.00% 2 x 3 SPF Stud Grade

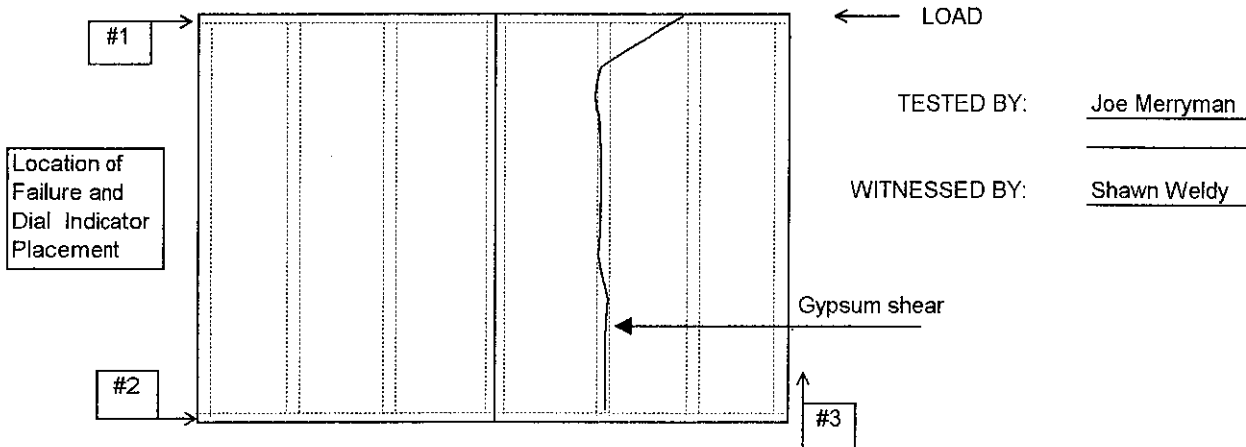
LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)		RESULTANT DEFLECTION (#1 - #2 - #3)
	READING	DEF.	READING	DEF.	READING	DEF.	
0	0.082		0.331		0.424		
400	0.400	0.318	0.334	0.003	0.404	0.020	0.295
0	0.088	0.006	0.332	0.001	0.424	0.000	0.005
800	0.554	0.472	0.340	0.009	0.375	0.049	0.414
0	0.095	0.013	0.333	0.002	0.420	0.004	0.007
1200	0.728	0.646	0.343	0.012	0.347	0.077	0.557
0	0.104	0.022	0.335	0.004	0.418	0.006	0.012
1600	0.872	0.790	0.347	0.016	0.327	0.097	0.677
0	0.108	0.026	0.335	0.004	0.417	0.007	0.015
2000	0.963	0.881	0.348	0.017	0.319	0.105	0.759
0	0.116	0.034	0.335	0.004	0.416	0.008	0.022
2400	1.056	0.974	0.352	0.021	0.301	0.123	0.830
0	0.124	0.042	0.336	0.005	0.415	0.009	0.028

LOAD AT FAILURE: 4661

DATE FABRICATED: 3/25/99

MODE OF FAILURE: Gypsum shear.

8' x 8' SAMPLE: GYPSUM ATTACHED TO ONE SIDE.



## WALL RACKING TEST

Test Procedure: ASTM E 72-80

Type of Gypsum: 5/16" U.S. Gypsum  
 Gypsum Lot Number: \_\_\_\_\_

Adhesive Manufacturer: Alpha Systems  
 Type of Adhesive: P 5100

FASTENERS: 3/16" x 3/4" x 19 Ga. Senco Staple  
 Field Spacing: None  
 Top Plate Spacing: 6" o.c.  
 Bottom Plate Spacing: 6" o.c.  
 Vertical Edge Spacing: 6" o.c.  
 Adhesive Bead Size: (2) 1/16" - 1/8"  
 Average Beads Per Stud \_\_\_\_\_

**SAMPLE 2**

Test Number: 990014  
 Test Date: 4/1/99  
 Temperature: 68 F  
 Relative Humidity: 50%

**AVERAGE MOISTURE CONTENT**

Plates: 10.50% 1 x 3 SPF Ungraded

Studs: 10.00% 2 x 3 SPF Stud Grade

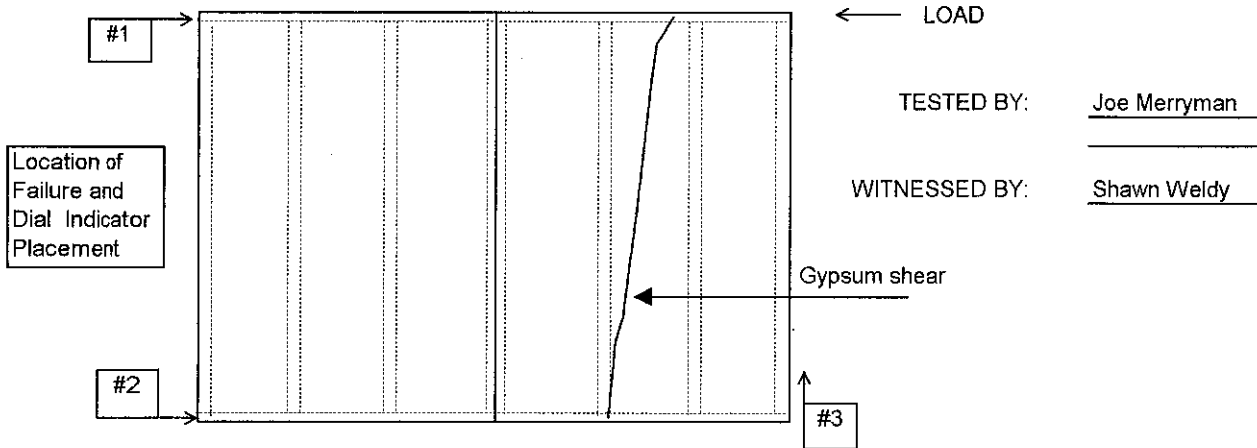
LOAD (pounds)	INDICATOR #1 (In.)		INDICATOR #2 (In.)		INDICATOR #3 (In.)		RESULTANT DEFLECTION (#1 - #2 - #3)
	READING	DEF.	READING	DEF.	READING	DEF.	
0	0.072		0.186		0.356		
400	0.379	0.307	0.190	0.004	0.345	0.011	0.292
0	0.079	0.007	0.186	0.000	0.356	0.000	0.007
800	0.521	0.449	0.195	0.009	0.330	0.026	0.414
0	0.088	0.016	0.188	0.002	0.361	0.005	0.009
1200	0.740	0.668	0.200	0.014	0.312	0.044	0.610
0	0.111	0.039	0.186	0.000	0.370	0.014	0.025
1600	0.858	0.786	0.201	0.015	0.300	0.056	0.715
0	0.116	0.044	0.185	0.001	0.369	0.013	0.030
2000	0.950	0.878	0.203	0.017	0.288	0.068	0.793
0	0.122	0.050	0.185	0.001	0.370	0.014	0.035
2400	1.025	0.953	0.204	0.018	0.277	0.079	0.856
0	0.122	0.050	0.186	0.000	0.370	0.014	0.036

LOAD AT FAILURE: 5233

DATE FABRICATED: 3/25/99

MODE OF FAILURE: Gypsum shear.

8' x 8' SAMPLE: GYPSUM ATTACHED TO ONE SIDE.



## WALL RACKING TEST

Test Procedure: ASTM E 72-80

Type of Gypsum: 5/16" U.S. Gypsum  
 Gypsum Lot Number: \_\_\_\_\_

Adhesive Manufacturer: Alpha Systems  
 Type of Adhesive: P 5100

FASTENERS: 3/16" x 3/4" x 19 Ga. Senco Staples  
 Field Spacing: None  
 Top Plate Spacing: 6" o.c.  
 Bottom Plate Spacing: 6" o.c.  
 Vertical Edge Spacing: 6" o.c.  
 Adhesive Bead Size: (2) 1/16" - 1/8"  
 Average Beads Per Stud \_\_\_\_\_

**SAMPLE 3**

Test Number: 990014  
 Test Date: 4/1/99  
 Temperature: 68 F  
 Relative Humidity: 50%

**AVERAGE MOISTURE CONTENT**

Plates: 10.50% 1 x 3 SPF Ungraded

Studs: 11.00% 2 x 3 SPF Stud grade

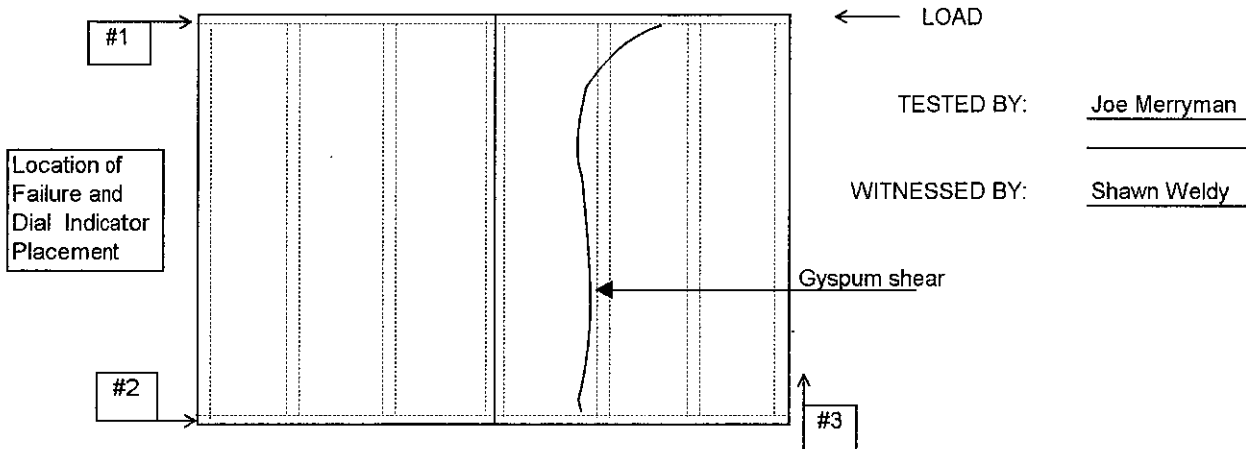
LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)		RESULTANT DEFLECTION (#1 - #2 - #3)
	READING	DEF.	READING	DEF.	READING	DEF.	
0	0.083		0.259		0.361		
400	0.386	0.303	0.261	0.002	0.355	0.006	0.295
0	0.087	0.004	0.258	0.001	0.359	0.002	0.001
800	0.536	0.453	0.264	0.005	0.338	0.023	0.425
0	0.093	0.010	0.259	0.000	0.357	0.004	0.006
1200	0.698	0.615	0.270	0.011	0.318	0.043	0.561
0	0.096	0.013	0.260	0.001	0.360	0.001	0.011
1600	0.843	0.760	0.273	0.014	0.302	0.059	0.687
0	0.104	0.021	0.261	0.002	0.361	0.000	0.019
2000	0.943	0.860	0.275	0.016	0.292	0.069	0.775
0	0.112	0.029	0.262	0.003	0.362	0.001	0.025
2400	1.017	0.934	0.276	0.017	0.281	0.080	0.837
0	0.118	0.035	0.263	0.004	0.362	0.001	0.030

LOAD AT FAILURE: 4672

DATE FABRICATED: 3/25/99

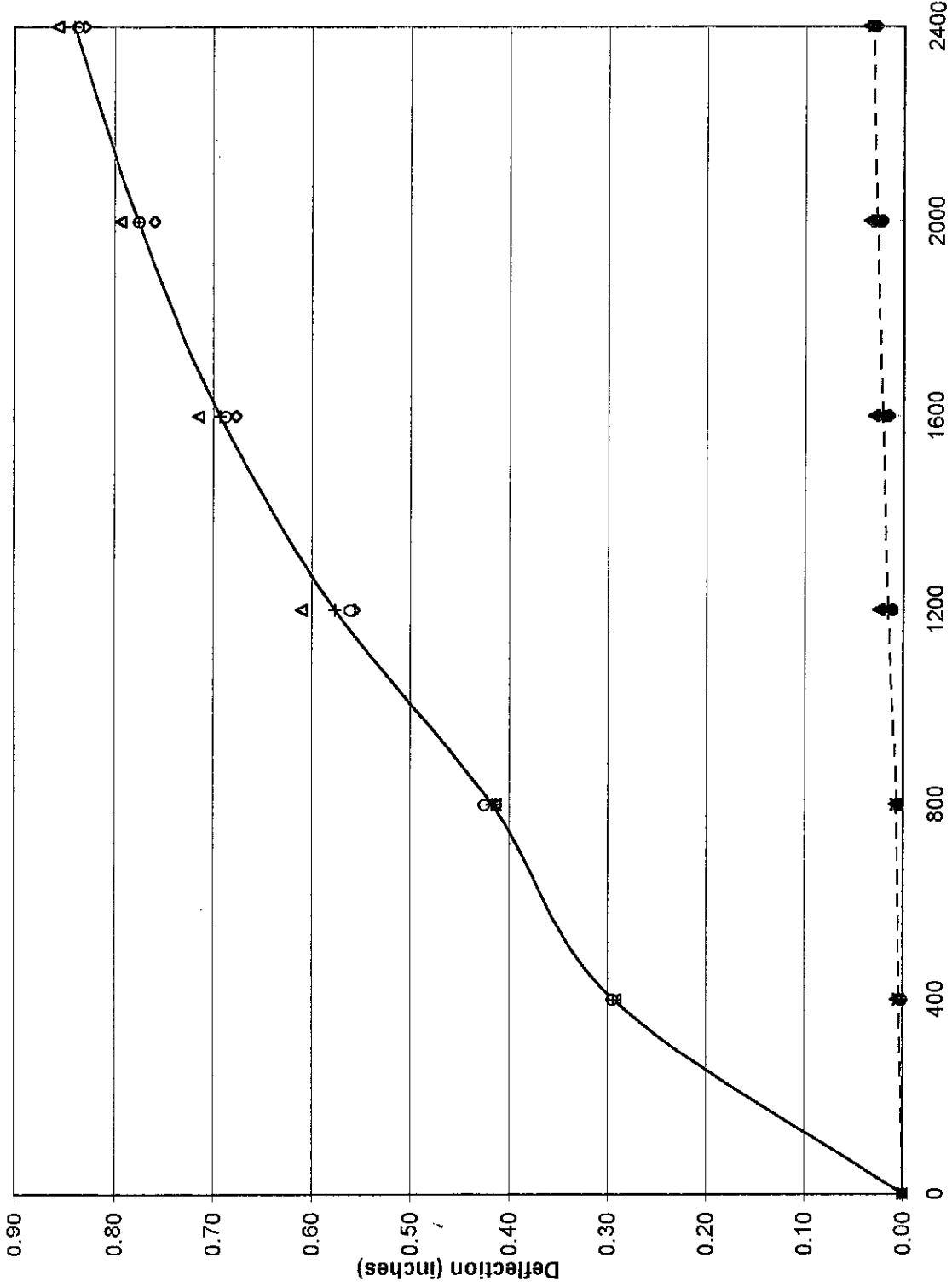
MODE OF FAILURE: Gypsum shear.

8' x 8' SAMPLE: GYPSUM ATTACHED TO ONE SIDE.





# Load Deflection Curves

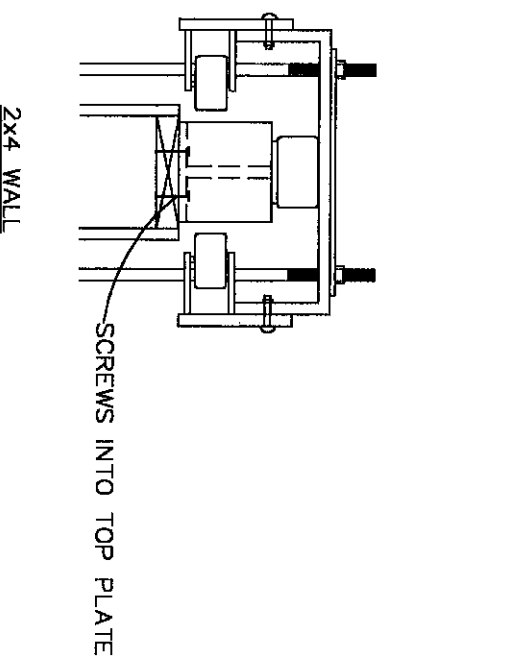
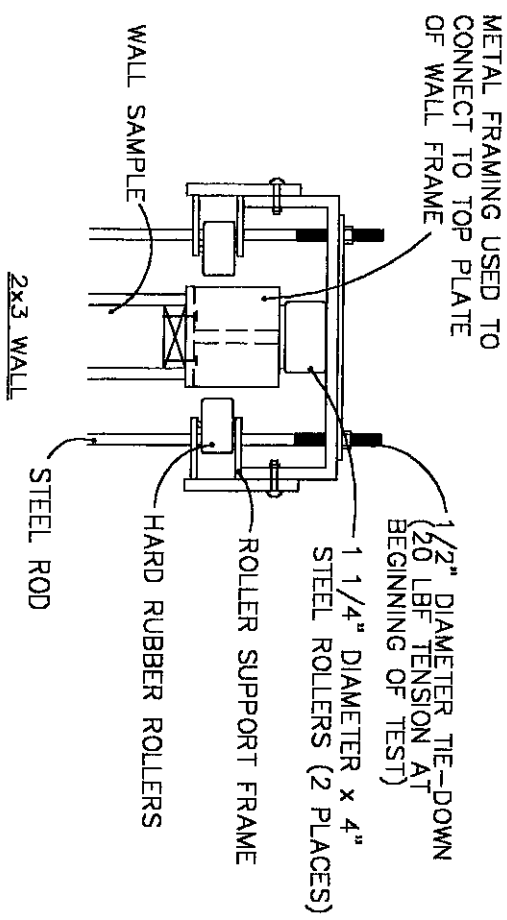
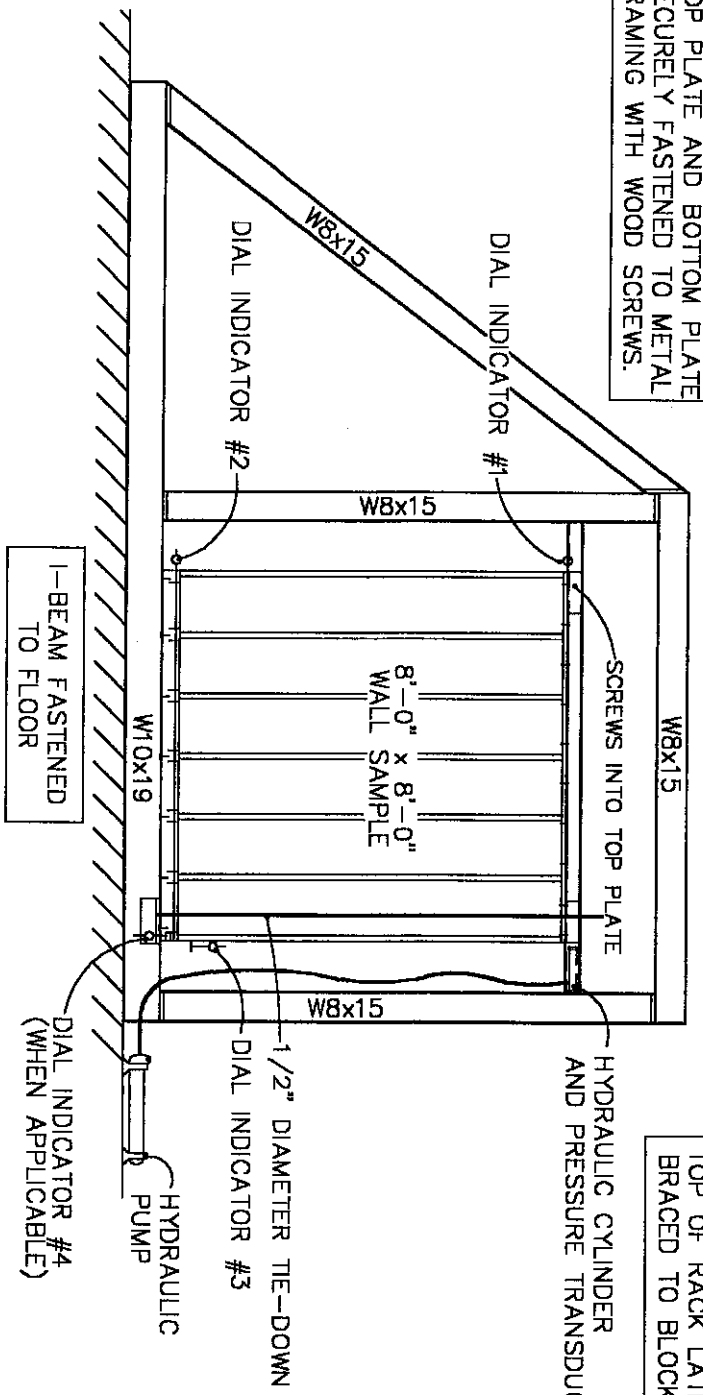


- ◆ Test No. 1 Load
- ◆ Test No. 1 Residual
- ▲ Test No. 2 Load
- ▲ Test No. 2 Residual
- Test No. 3 Load
- Test No. 3 Residual
- Average Load
- - - Average Residual

Load (lbs)  
 Alpha Systems  
 "P 5100" Adhesive  
 5/16" U. S. Gypsum Wall Board  
 (Single-Sided)

TOP PLATE AND BOTTOM PLATE  
SECURELY FASTENED TO METAL  
FRAMING WITH WOOD SCREWS.

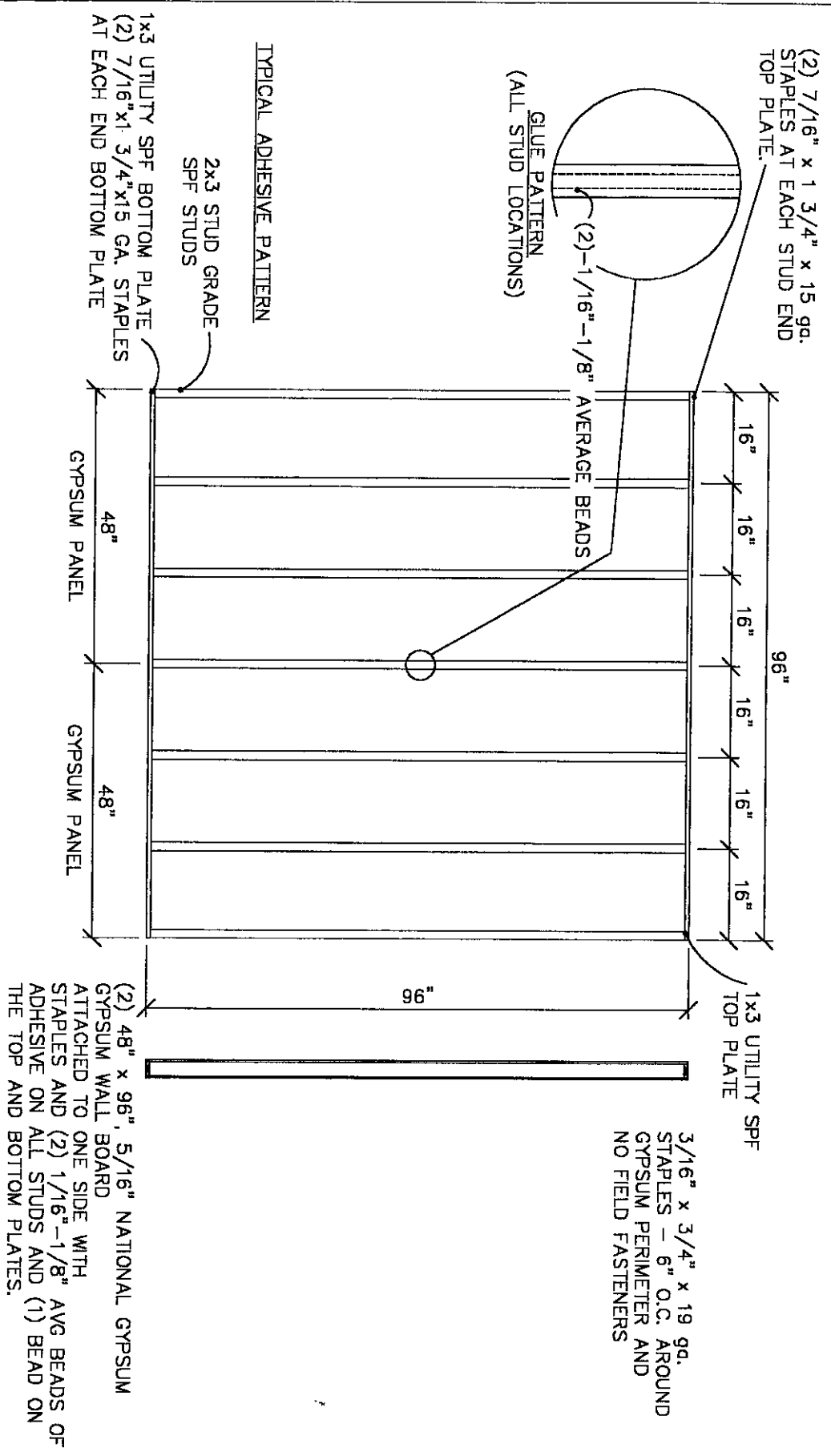
TOP OF RACK LATERALLY  
BRACED TO BLOCK WALL



REVISIONS: SCALE: N.T.S. APPROVED BY:

990014 MODEL: 305 NORTH OAKLAND AVE., NAPPANEE, IN. 46550 TITLE: RACKING TEST FIXTURE

DATE: PROJECT NO: NTA990014 DRAWN BY: JCK DRAWING NO: FIGURE #2



NOTE:  
SEE THE ATTACHED TEST REPORT  
FOR EXACT CONSTRUCTION PROCEDURE.

ADHESIVE=P 5100 ADHESIVE AS MANUFACTURED BY ALPHA SYSTEMS  
DESIGN SHEAR = 242.76 PLF

REVISIONS:

990014	MODEL:	NTA, INC.	SCALE:	N.T.S.	APPROVED BY:
	TITLE:	305 NORTH DAKLAND AVENUE, NAPPANEE, IN. 46550	DATE:	04/14/99	PROJECT NO:
		WALL PANEL	DRAWN BY:	JCK	DRAWING NO:
					FIGURE #1