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**Evaluation of Single-Sided Wall Assemblies Under Racking Load  
Sheathed with 5/16" American Gypsum Wall Board**

Bonded with:  
**Pemco 5100 Adhesive**  
Manufactured By:  
**Alpha Systems, Inc.**

Prepared For:

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

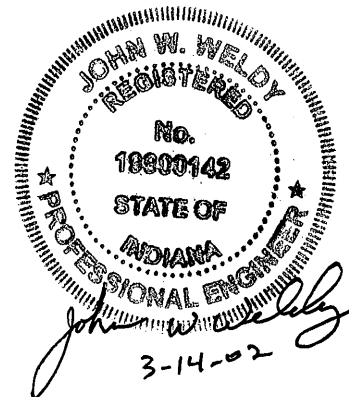
Test Report: NTA200218

Issued: March 13, 2002

Prepared By:

John Kirkwood  
Director of Testing

Reviewed By:  
John W. Weldy  
Test 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 based on 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" American Gypsum wall board attached vertically with Pemco 5100 adhesive as manufactured by Alpha Systems when used in shear walls for manufactured housing.

## 2.0 TEST SPECIMEN DESCRIPTION

### A. Materials

1. Studs: 2"x 3", Stud Grade SPF at 16" o.c.
2. Top Plate: Single 2" x 3" Stud Grade SPF.
3. Bottom Plate: Single 2" x 3" Stud Grade SPF.
4. Gypsum: 48" x 96", 5/16" American Gypsum Wall Board.
5. Adhesive: Pemco 5100.

### B. Fastening

- Top plate fastened to studs with Two (2) - 7/16" x 2-1/2" x 15 Ga. staples per stud.
- Bottom plate fastened to studs with Two (2) - 7/16" x 2-1/2" x 15 Ga. staples per stud.
- Gypsum bonded to 2"x 3" framing members with Two (2) - 1/16"-1/8" (average) beads of "P5100" adhesive.
- Gypsum bonded to 2" x 3" top and bottom plates with Two (2) - 1/16"-1/8" (average) bead of "Pemco 5100" adhesive.
- Gypsum fastened to framing with 3/16"x 3/4" x 19 Ga. staples at 6" o.c. around perimeter and 12" o.c. field fasteners.

### C. Construction Steps

- Adhesives applied to the assembled walls with a glue bottle.
- The gypsum was placed vertically on one side of the wall framing immediately after the adhesive was applied and then promptly fastened along all wall board perimeters to the framing members as described.

### D. Cure Time

After construction, each of the wall assemblies was 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 which was 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 395 pound increments, up to 2370 pounds, at a rate of approximately 790 pounds per two minutes (not less than). 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 790 pounds per two minutes. Zero load readings were taken after each load increment up to 2370 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 American Gypsum bonded to one side using adhesives described above. 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	6868 pounds	Gypsum shear.
#2	6444 pounds	Gypsum shear.
#3	6578 pounds	Gypsum shear.

Average Ultimate Load = 6630 pounds

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

( 6630 pounds ) / [ (8 feet)\*(2.5) ] = 331.5 PLF

5.0 CONCLUSION

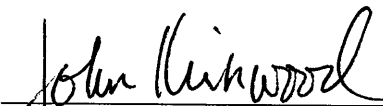
Based on the results of the tests conducted, the maximum allowable design load for a 96" tall shear wall built of 2 x 3 Stud Grade SPF studs at 16" o/c, 2 x 3, Stud Grade SPF top plates with 2 x 3 Stud Grade SPF bottom plates with American Gypsum wall board attached to one side as described in this report is:

**For 5/16" American Gypsum Wall Board  
Bonded to One Side with  
Pemco 5100 = 331.5 PLF**

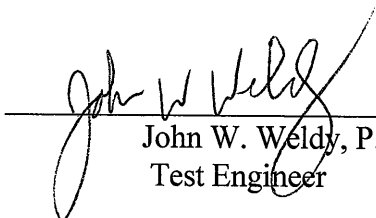
5.1 FOLLOW-UP TESTING

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

TEST REPORT BY:

  
\_\_\_\_\_  
John Kirkwood, NTA Inc.  
Director of Testing

REPORT REVIEWED BY:

  
\_\_\_\_\_  
John W. Weldy, P.E.  
Test Engineer

# NTA, Inc.

## WALL RACKING TEST

Test Procedure: ASTM E 72-80

Type of Gypsum: 5/16" American Gypsum

Adhesive Manufacturer: Alpha Systems

Type of Adhesive: P 5100

Gypsum Orientation: Vertical

Block Fastening: N/A

FASTENERS: 3/16" x3/4" x19 Gauge

Field Spacing: 12" o.c.

Top Plate Spacing: 6" o.c.

Bottom Plate Spacing: 6" o.c.

Vertical Edge Spacing: 6" o.c.

Adhesive Bead Size: Studs (2) 1/16"-1/8" Beads

Plates (1) 1/16" - 1/8" Bead

**SAMPLE 1**

Test Number: 200218

Test Date: 3/12/2002

Temperature: 70 F

Relative Humidity: 19%

**AVERAGE MOISTURE CONTENT**

Plates: 10.00% ( 2x3, Stud Grade SPF )

Studs: 10.00% ( 2x3, Stud Grade SPF at 16" o.c. )

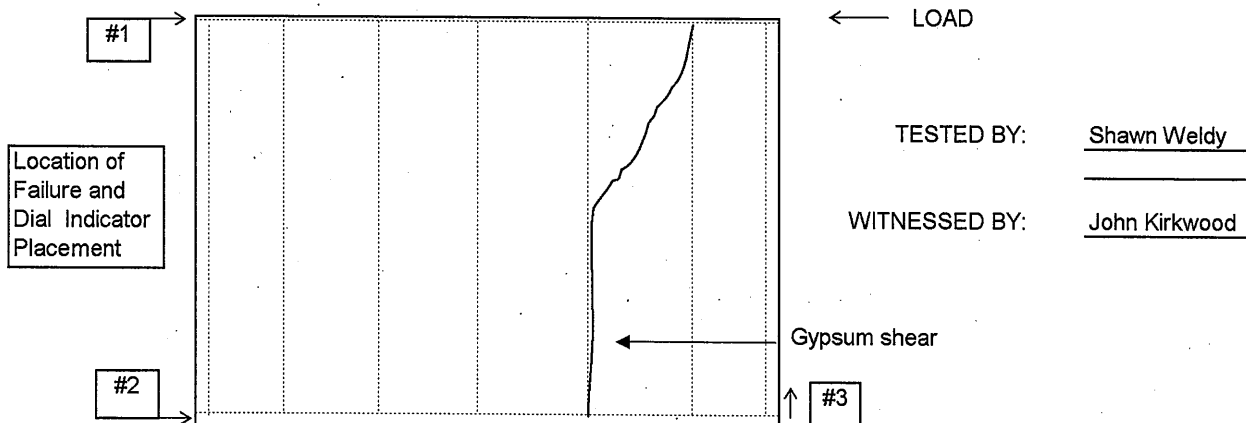
LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)		RESULTANT DEFLECTION ( #1 - #2 - #3 )
	READING	DEF.	READING	DEF.	READING	DEF.	
0	0.687		0.602		0.563		
395	0.750	0.063	0.604	0.002	0.553	0.010	0.051
0	0.699	0.012	0.602	0.000	0.560	0.003	0.009
790	0.887	0.200	0.608	0.006	0.529	0.034	0.160
0	0.727	0.040	0.603	0.001	0.558	0.005	0.034
1185	0.956	0.269	0.610	0.008	0.517	0.046	0.215
0	0.733	0.046	0.603	0.001	0.557	0.006	0.039
1580	1.035	0.348	0.613	0.011	0.501	0.062	0.275
0	0.740	0.053	0.603	0.001	0.557	0.006	0.046
1975	1.141	0.454	0.619	0.017	0.478	0.085	0.352
0	0.748	0.061	0.603	0.001	0.556	0.007	0.053
2370	1.211	0.524	0.622	0.020	0.463	0.100	0.404
0	0.752	0.065	0.604	0.002	0.555	0.008	0.055

LOAD AT FAILURE: 6868 LBS.

DATE FABRICATED: 3/5/2002

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" American Gypsum

Adhesive Manufacturer: Alpha Systems  
 Type of Adhesive: P 5100

Gypsum Orientation: Vertical  
 Block Fastening: N/A

**SAMPLE 2**

Test Number: 200218  
 Test Date: 3/12/2002  
 Temperature: 70 F  
 Relative Humidity: 19%

FASTENERS: 3/16" x3/4" x19 Gauge  
 Field Spacing: 12" o.c.  
 Top Plate Spacing: 6" o.c.  
 Bottom Plate Spacing: 6" o.c.  
 Vertical Edge Spacing: 6" o.c.  
 Adhesive Bead Size: Studs (2) 1/16"-1/8" Beads  
Plates (1) 1/16" - 1/8" Bead

**AVERAGE MOISTURE CONTENT**

Plates: 10.00% ( 2x3, Stud Grade SPF )

Studs: 10.00% ( 2x3, Stud Grade SPF at 16" o.c. )

LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)	
	READING	DEF.	READING	DEF.	READING	DEF.
0	0.719		0.265		0.508	
395	0.785	0.066	0.268	0.003	0.501	0.007
0	0.732	0.013	0.265	0.000	0.507	0.001
790	0.883	0.164	0.271	0.006	0.488	0.020
0	0.748	0.029	0.266	0.001	0.504	0.004
1185	0.948	0.229	0.274	0.009	0.469	0.039
0	0.772	0.053	0.268	0.003	0.499	0.009
1580	1.044	0.325	0.276	0.011	0.449	0.059
0	0.780	0.061	0.268	0.003	0.497	0.011
1975	1.140	0.421	0.281	0.016	0.426	0.082
0	0.788	0.069	0.268	0.003	0.495	0.013
2370	1.254	0.535	0.303	0.038	0.396	0.112
0	0.801	0.082	0.269	0.004	0.491	0.017

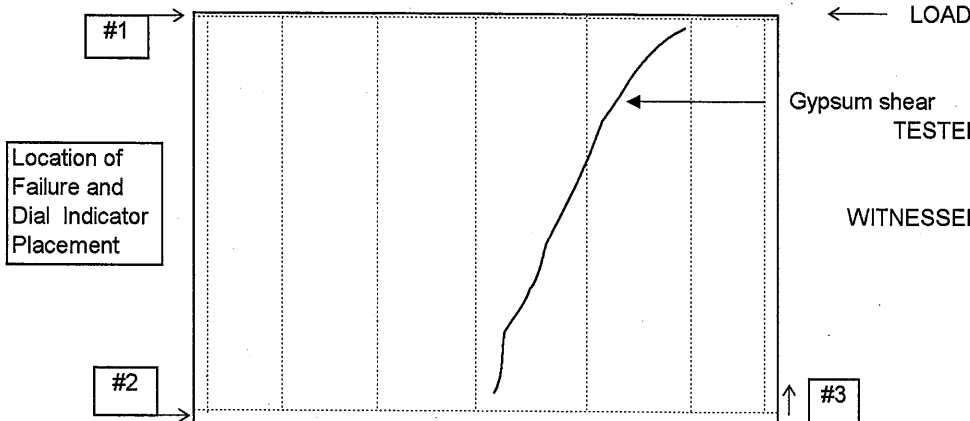
RESULTANT DEFLECTION ( #1 - #2 - #3 )
0.056
0.012
0.138
0.024
0.181
0.041
0.255
0.047
0.323
0.053
0.385
0.061

LOAD AT FAILURE: 6444 LBS.

DATE FABRICATED: 3/5/2002

MODE OF FAILURE: Gypsum Shear

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



TESTED BY: Shawn Weldy  
 WITNESSED BY: John Kirkwood

# NTA, Inc.

## WALL RACKING TEST

Test Procedure: ASTM E 72-80

Type of Gypsum: 5/16" American Gypsum

Adhesive Manufacturer: Alpha Systems  
 Type of Adhesive: P 5100

Gypsum Orientation: Vertical  
 Block Fastening: N/A  
 FASTENERS: 3/16" x3/4" x19 Gauge  
 Field Spacing: 12" o.c.  
 Top Plate Spacing: 6" o.c.  
 Bottom Plate Spacing: 6" o.c.  
 Vertical Edge Spacing: 6" o.c.  
 Adhesive Bead Size: Studs (2) 1/16"-1/8" Beads  
Plates (1) 1/16" - 1/8" Bead

**SAMPLE 3**

Test Number: 200218  
 Test Date: 3/12/2002  
 Temperature: 70 F  
 Relative Humidity: 19%

**AVERAGE MOISTURE CONTENT**

Plates: 10.00% ( 2x3, Stud Grade SPF )

Studs: 10.00% ( 2x3, Stud Grade SPF at 16" o.c. )

LOAD (pounds)	INDICATOR #1 (in.)		INDICATOR #2 (in.)		INDICATOR #3 (in.)	
	READING	DEF.	READING	DEF.	READING	DEF.
0	0.713		0.440		0.376	
395	0.738	0.025	0.442	0.002	0.373	0.003
0	0.718	0.005	0.441	0.001	0.376	0.000
790	0.819	0.106	0.446	0.006	0.359	0.017
0	0.729	0.016	0.441	0.001	0.374	0.002
1185	0.919	0.206	0.447	0.007	0.340	0.036
0	0.737	0.024	0.442	0.002	0.373	0.003
1580	0.997	0.284	0.452	0.012	0.323	0.053
0	0.743	0.030	0.442	0.002	0.372	0.004
1975	1.112	0.399	0.454	0.014	0.293	0.083
0	0.749	0.036	0.442	0.002	0.371	0.005
2370	1.179	0.466	0.455	0.015	0.280	0.096
0	0.758	0.045	0.442	0.002	0.370	0.006

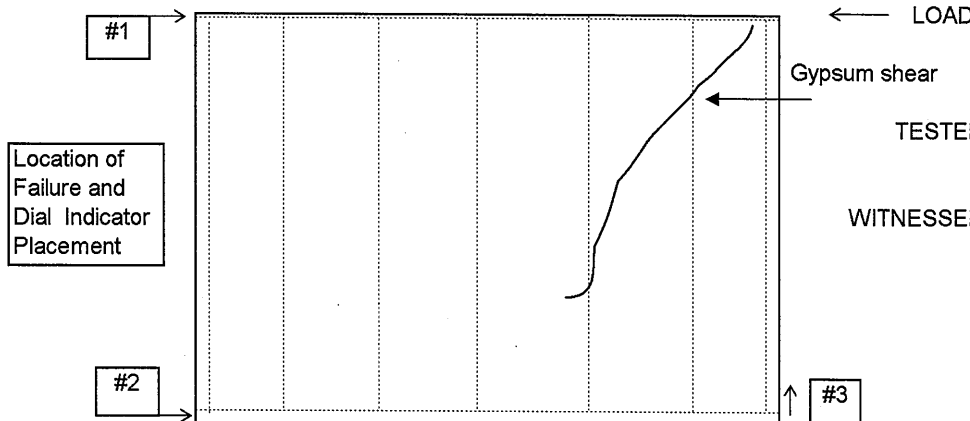
RESULTANT DEFLECTION (#1 - #2 - #3)
0.020
0.004
0.083
0.013
0.163
0.019
0.219
0.024
0.302
0.029
0.355
0.037

LOAD AT FAILURE: 6578 LBS.

DATE FABRICATED: 3/5/2002

MODE OF FAILURE: Gypsum shear right side

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

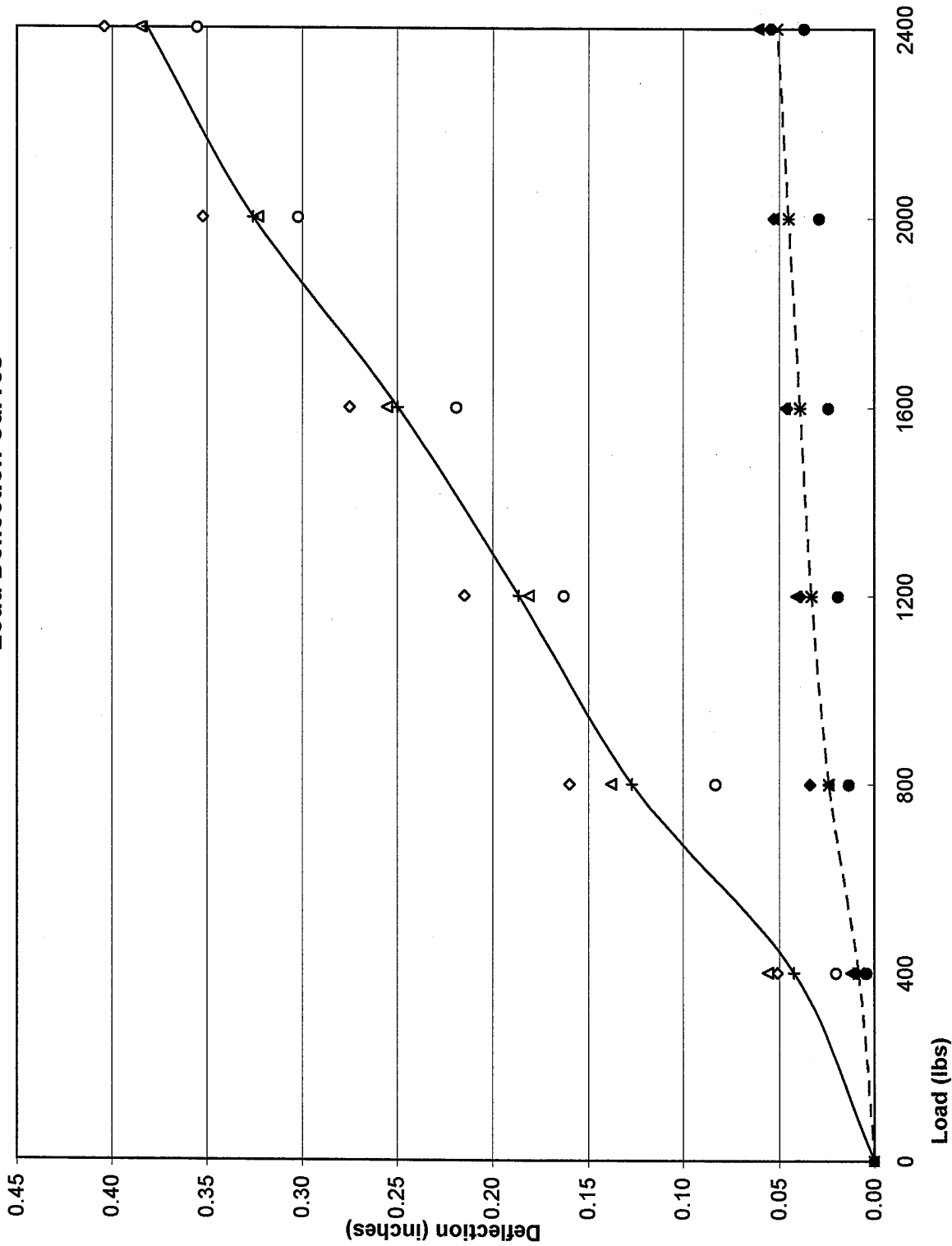


TESTED BY: Shawn Weldy

WITNESSED BY: John Kirkwood



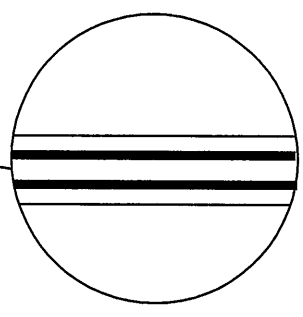
# Load Deflection Curves



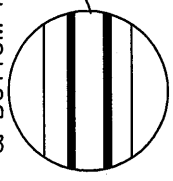
◆ Test No. 1 Load  
 ◆ Test No.1 Residual  
 ▲ Test No. 2 Load  
 ▲ Test No. 2 Residual  
 ○ Test No. 3 Load  
 ● Test No. 3 Residual  
 — Average Load  
 - \* - Average Residual

(2) 7/16" x 2-1/2" x 15 ga. STAPLES AT EACH STUD END TOP PLATE.

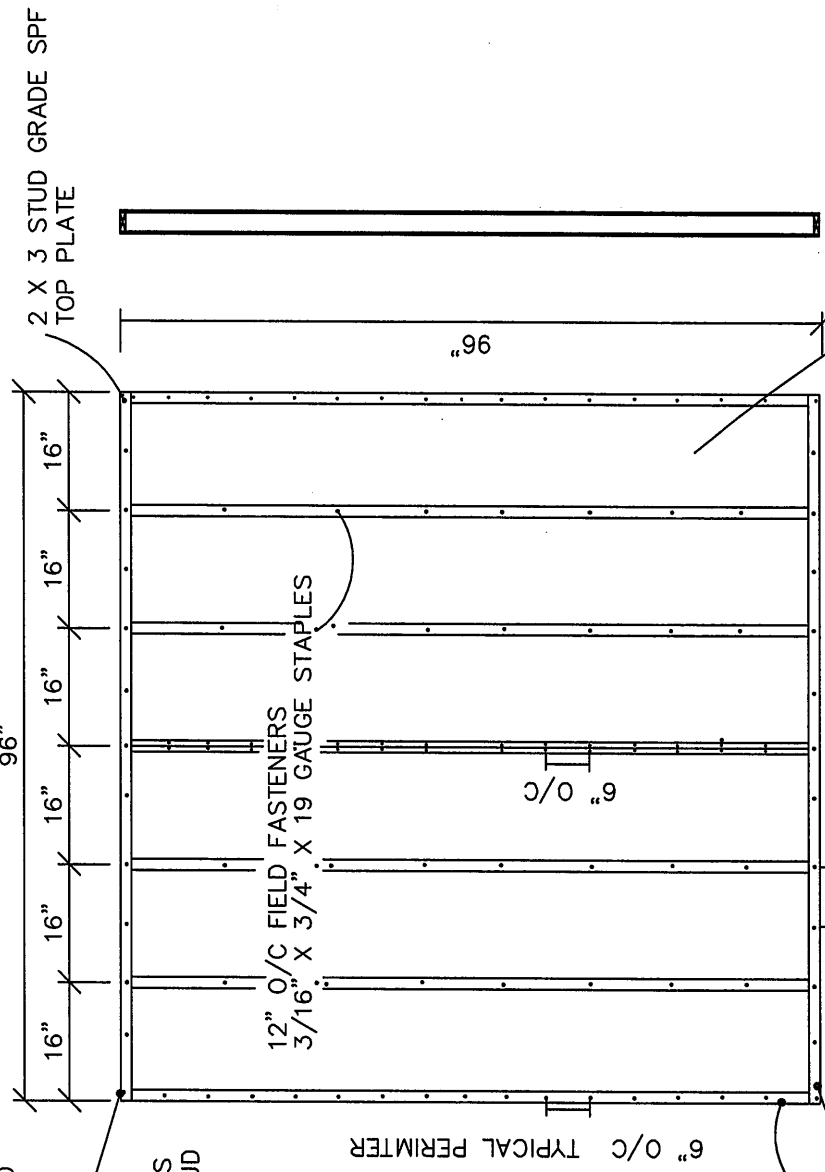
SIDE "A"  
PEMCO 5100  
(2) 1/16"-1/8" AVERAGE BEADS PER STUD



(1) 1/16-1/8" BEAD TOP & BOTTOM PLATE



2x3 STUD GRADE SPF STUDS 16" O/C



SINGLE SIDED DESIGN SHEAR = 331.5 PLF

2 X 3 STUD GRADE SPF BOTTOM PLATE  
(2) 7/16" x 2-1/2" x 15GA. STAPLES AT EACH END BOTTOM PLATE

(2) 5/16 X 48" X 96"  
5/16" AMERICAN GYPSUM CORPORATION WALL BOARD FASTENED VERTICALLY TO ONE SIDE WITH 3/16" X 3/4" X 19 GAUGE STAPLES  
6" O/C PERIMETER  
12" O/C IN THE FIELD

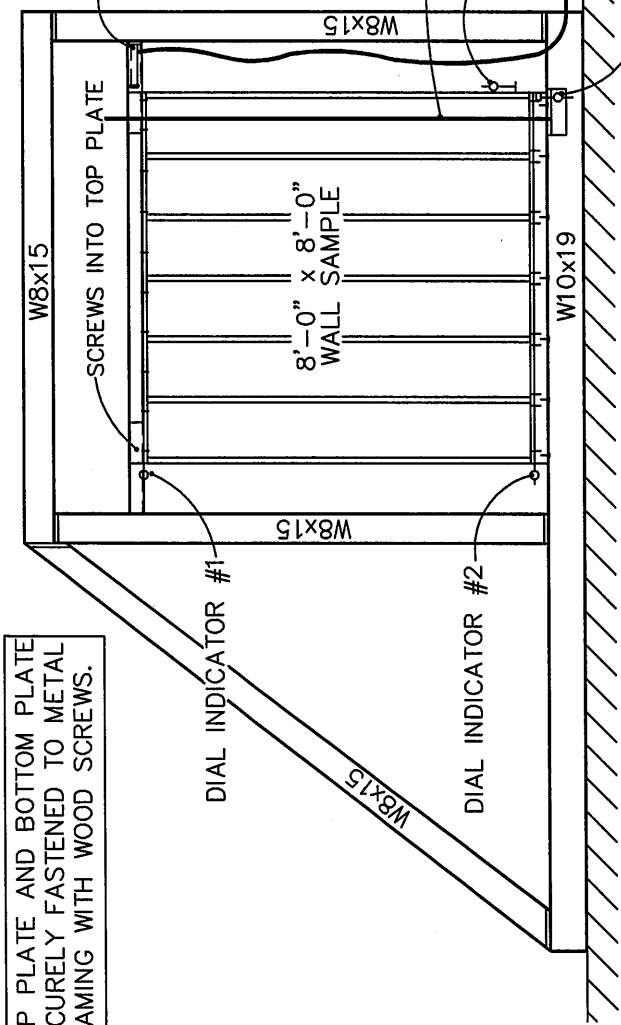
NOTE:  
SEE THE ATTACHED TEST REPORT FOR EXACT CONSTRUCTION PROCEDURE.

ADHESIVE = PEMCO 5100

PAGE 10 OF 11

REVISIONS:	SCALE: N.T.S.	APPROVED BY:
200218	DATE: 03/04/02	PROJECT NO: NTA200216
	DRAWN BY: JCK	DRAWING NO:
NTA, INC.		
305 N. OAKLAND AVENUE, NAPPANEE, IN. 46550		
MODEL:	TITLE: WALL PANEL	

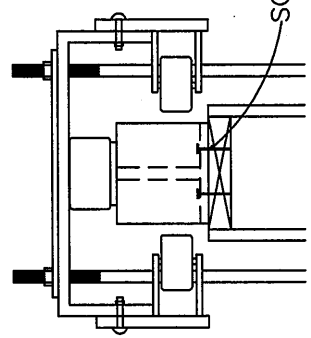
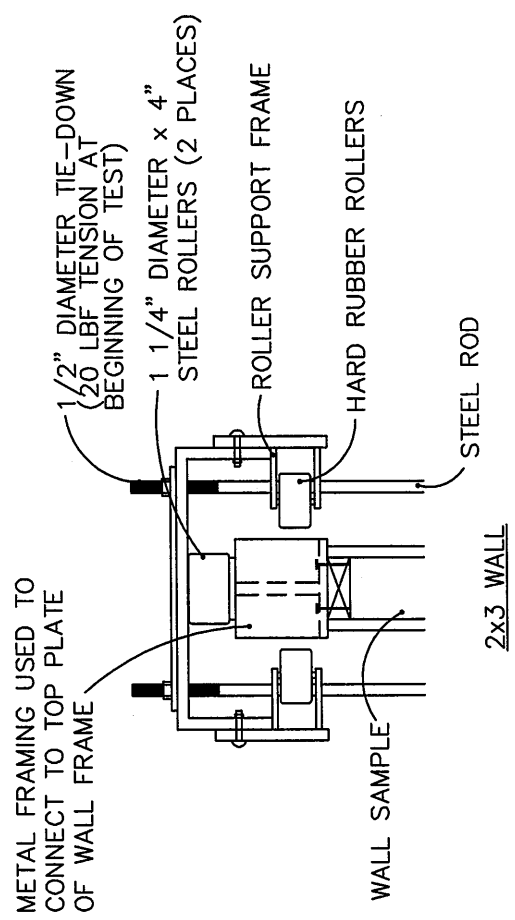
TOP OF RACK LATERALLY BRACED TO BLOCK WALL



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

I-BEAM FASTENED TO FLOOR

METAL FRAMING USED TO CONNECT TO TOP PLATE OF WALL FRAME



2x3 WALL

2x4 WALL

REVISIONS:	SCALE: N.T.S.	APPROVED BY:
	DATE: 03/04/02	PROJECT NO: NTA200218
NTA200218	TITLE: RACKING TEST FIXTURE	DRAWN BY: JCK
NTA, INC. 305 N.OAKLAND AVE., NAPPANEE, IN. 46550		