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

Bonded with:
Pemco 5100 Adhesive &
Pemco 3100
Manufactured By:
Alpha Systems, Inc.

Prepared For:

Alpha Systems
5120 Beck Drive
Elkhart, IN 46516

Test Report: NTA200217
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 and Pemco 3100 adhesives 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.

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 Side “A” with Two (2) – 1/16"-1/8" (average) beads of “P5100” adhesive.
   - Gypsum bonded to framing members Side “B” with (1) 1/4" Bead of “Pemco 3100” (Center Stud side “B” (2) 1/4" beads of “Pemco 3100”).
   - Gypsum bonded to 2" x 3" top and bottom plates Side “A” with Two (2) – 1/16"-1/8" (average) beads of “Pemco 5100” adhesive.
   - Gypsum bonded to 2" x 3" top and bottom plates Side “B” with One (1) – 1/4" (average) bead of “Pemco 3100” 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. (Fastening schedule is same on both sides.)

C. Construction Steps
   - Adhesives applied to the assembled walls with a glue bottle (P5100) and a caulking gun (Pemco 3100).
   - The gypsum was placed vertically on both sides 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 both sides using adhesives described above. The ultimate loads achieved and the types of failures that occurred are described below.

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>ULTIMATE LOAD</th>
<th>FAILURE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>9544 pounds</td>
<td>Gypsum shear.</td>
</tr>
<tr>
<td>#2</td>
<td>9834 pounds</td>
<td>Gypsum shear.</td>
</tr>
<tr>
<td>#3</td>
<td>9800 pounds</td>
<td>Gypsum shear.</td>
</tr>
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</table>

Average Ultimate Load = 9726 pounds

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

( 9726 pounds ) / [(8 feet)*(2.5)] = 486.3 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 both sides as described in this report is:

For 5/16" American Gypsum Wall Board
Bonded to Both Sides with
Pemco 5100 (Side A) and
Pemco 3100 (Side B)  = 486.3 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
**WALL RACKING TEST**

- **Test Procedure:** ASTM E 72-80
- **Type of Gypsum:** 5/16" American Gypsum
- **Gypsum Orientation:** Vertical
- **Block Fastening:** N/A
- **FASTENERS:** 3/16" x 3/4" 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:** P5100 (2) 1/16"-1/8" P3100 (1) 1/4" Center (2) Beads

**SAMPLE 1**

- **Test Number:** 200217
- **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.)

<table>
<thead>
<tr>
<th>LOAD (pounds)</th>
<th>INDICATOR #1 (in.)</th>
<th>INDICATOR #2 (in.)</th>
<th>INDICATOR #3 (in.)</th>
<th>RESULTANT DEFLECTION (#1 - #2 - #3)</th>
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<tbody>
<tr>
<td></td>
<td>READING DEF.</td>
<td>READING DEF.</td>
<td>READING DEF.</td>
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<tr>
<td>0</td>
<td>0.884</td>
<td>0.358</td>
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</tr>
<tr>
<td>790</td>
<td>0.994</td>
<td>0.110</td>
<td>0.361</td>
<td>0.624</td>
</tr>
<tr>
<td>1185</td>
<td>1.051</td>
<td>0.167</td>
<td>0.364</td>
<td>0.612</td>
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<tr>
<td>1580</td>
<td>1.145</td>
<td>0.281</td>
<td>0.368</td>
<td>0.590</td>
</tr>
<tr>
<td>1975</td>
<td>1.259</td>
<td>0.375</td>
<td>0.370</td>
<td>0.581</td>
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<tr>
<td>2370</td>
<td>1.332</td>
<td>0.448</td>
<td>0.372</td>
<td>0.544</td>
</tr>
<tr>
<td>0</td>
<td>0.921</td>
<td>0.037</td>
<td>0.359</td>
<td>0.635</td>
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</table>

**LOAD AT FAILURE:** 9544 LBS.  
**DATE FABRICATED:** 3/5/2002

**MODE OF FAILURE:** Gypsum Shear both sides

**8' x 8' SAMPLE:** GYPSUM ATTACHED TO BOTH SIDES.

**TESTED BY:** Shawn Welty
**WITNESSED BY:** John Kirkwood

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S1.XLS  
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WALL RACKING TEST

Test Procedure: ASTM E 72-80
Type of Gypsum: 5/16" American Gypsum
Adhesive Manufacturer: Alpha Systems
Gypsum Orientation: Vertical
Type of Adhesive: Side A: P 5100
Block Fastening: N/A
Side B: P 3100
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: P5100 (2) 1/16"-1/8"
P3100 (1) 1/4" Center (2) Beads

SAMPLE 2
Test Number: 200217
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.)

<table>
<thead>
<tr>
<th>LOAD (pounds)</th>
<th>INDICATOR #1 (in.)</th>
<th>INDICATOR #2 (in.)</th>
<th>INDICATOR #3 (in.)</th>
<th>RESULTANT DEFLECTION ( #1 - #2 - #3 )</th>
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<tr>
<td>0</td>
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<tr>
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<td>0.110</td>
<td>0.404</td>
<td>0.006</td>
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<td>0.014</td>
<td>0.399</td>
<td>0.001</td>
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<td>1185</td>
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<td>0.404</td>
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<tr>
<td>0</td>
<td>0.622</td>
<td>0.021</td>
<td>0.399</td>
<td>0.001</td>
</tr>
<tr>
<td>1580</td>
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<td>0.409</td>
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<tr>
<td>0</td>
<td>0.625</td>
<td>0.024</td>
<td>0.399</td>
<td>0.001</td>
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<tr>
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<tr>
<td>0</td>
<td>0.632</td>
<td>0.031</td>
<td>0.399</td>
<td>0.001</td>
</tr>
<tr>
<td>2370</td>
<td>1.020</td>
<td>0.419</td>
<td>0.418</td>
<td>0.020</td>
</tr>
<tr>
<td>0</td>
<td>0.638</td>
<td>0.037</td>
<td>0.399</td>
<td>0.001</td>
</tr>
</tbody>
</table>

LOAD AT FAILURE: 9834 LBS.  
DATE FABRICATED: 3/5/2002

MODE OF FAILURE: Gypsum Shear both sides.

8' x 8' SAMPLE: GYPSUM ATTACHED TO BOTH SIDES.

LOAD
TESTED BY: Shawn Wedly
WITNESSED BY: John Kirkwood
WALL RACKING TEST

Test Procedure: ASTM E 72-80
Adhesive Manufacturer: Alpha Systems
Type of Adhesive: Side A: P 5100
Type of Adhesive: Side B: P 3100

SAMPLE 3
Test Number: 200217
Test Date: 3/12/2002
Temperature: 70 F
Relative Humidity: 19%

TYPE OF GYPSUM: 5/16" American Gypsum
Gypsum Orientation: Vertical
Block Fastening: N/A
FASTENERS: 3/16" x 3/4" x 19 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: P5100 (2) 1/16"-1/8"
P3100 (1) 1/4" Center (2) Beads

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 )
--- | --- | --- | --- | ---
0 | 0.839 | 0.199 | 0.608 | 0.035
395 | 0.883 | 0.044 | 0.201 | 0.002 | 0.601 | 0.007
0 | 0.845 | 0.006 | 0.199 | 0.000 | 0.607 | 0.001
790 | 0.950 | 0.111 | 0.202 | 0.003 | 0.588 | 0.020
0 | 0.851 | 0.012 | 0.199 | 0.000 | 0.606 | 0.002
1185 | 0.994 | 0.155 | 0.204 | 0.005 | 0.579 | 0.029
0 | 0.855 | 0.016 | 0.199 | 0.000 | 0.606 | 0.002
1580 | 1.089 | 0.250 | 0.207 | 0.008 | 0.557 | 0.051
0 | 0.882 | 0.023 | 0.199 | 0.000 | 0.604 | 0.004
1975 | 1.162 | 0.323 | 0.209 | 0.010 | 0.537 | 0.071
0 | 0.873 | 0.034 | 0.199 | 0.000 | 0.601 | 0.007
2370 | 1.227 | 0.388 | 0.211 | 0.012 | 0.520 | 0.088
0 | 0.881 | 0.042 | 0.199 | 0.000 | 0.600 | 0.008

LOAD AT FAILURE: 9800 LBS.
DATE FABRICATED: 3/5/2002

MODE OF FAILURE: Bottom plate paper failure.

8' x 8' SAMPLE: GYPSUM ATTACHED TO BOTH SIDES.

LOCATION OF FAILURE AND DIAL INDICATOR PLACEMENT:

TESTED BY: Shawn Weid
WITNESSED BY: John Kirkwood

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(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

12" O/C FIELD FASTENERS
3/16" X 3/4" X 19 GAUGE STAPLES

2 X 3 STUD GRADE SPF
TOP PLATE

SIDE "B"
Pemco 3100
(1)-1/4" BEAD PER STUD & TOP AND BOTTOM PLATES

2x3 STUD GRADE SPF STUDS
16" O/C

6" O/C TYPICAL PERIMETER

DOUBLE SIDED DESIGN SHEAR = 486.3 PLF

6" O/C TYPICAL PERIMETER

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

(2) 1/16-1/8" BEADS TOP & BOTTOM PLATE

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

ADHESIVE = PEMCO 5100
SIDES "A" & "B"
Pemco 3100

CENTER STUD 1/4" (2) BEADS

5/16" AMERICAN GYPSUM CORPORATION
WALL BOARD FASTENED VERTICALLY TO BOTH SIDES WITH
3/16" X 3/4" X 19 GAUGE STAPLES
6" O/C PERIMETER
12" O/C IN THE FIELD

NTA, INC.
305 N. OAKLAND AVENUE, NAPPANEE, IN. 46550

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