

**NEGATIVE WIND PRESSURE TEST ON EXTERIOR SIDING  
FOR MANUFACTURED HOUSING APPLICATIONS:  
DOUBLE, 2X4, STUD GRADE STUDS ON 16-IN. CENTERS  
WITH 3/8, 24/0 RATED, OSB SHEATHING  
FOR 90-IN. TALL EXTERIOR WALLS  
WITH NOVIK PERFECTO SHAKE KHAKI (0.080-IN.) SIDING FOR  
WIND ZONE III, CORNER**

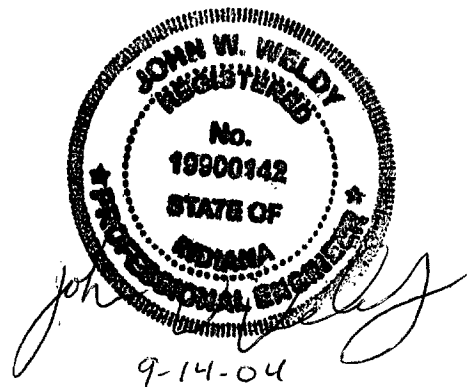
Prepared for:  
**Novik, Inc.**  
**160 Des Grands Lacs,**  
**St-Augustin-de-Desmaures, Québec**  
**Canada, G3A 2K1**

Phone: (418) 878-6161  
Fax: (418) 878-6164  
Web: www.novik.com

Test Report: TL081704-43  
Issued: September 13, 2004

Prepared By:  
Dale Arter  
Director of Testing

Reviewed By:  
John Weldy P.E.  
Test Engineer



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## 1. INTRODUCTION

NTA, Inc. conducted negative uniform wind pressure load tests on Perfecto Shake Khaki exterior siding for Novik, Inc. of St-Augustin-de-Desmaures, Québec, Canada. The purpose of this evaluation is to assess the suitability of Novik exterior siding, subjected to simulated negative wind pressure in accordance with Section 3280.305 of the *Federal Manufactured Home Construction and Safety Standards* (FMHCSS), for use in manufactured home construction. General test parameters and pass/fail criteria, in accordance with the FMHCSS, are summarized in Table 1, below. All tests were conducted at the NTA Test Laboratory located in Nappanee, Indiana.

**Table 1: Test Parameters**

Parameter	Value
FMHCSS Wind Zone	III
Corner/Non-Corner	Corner
Design Pressure	58 psf
Deflection Limit	L/180
Clear Height, h	90-in.
Specimen Width, w	48-in.

## 2. TEST PROGRAM

### 2.1. DESCRIPTION OF TEST SPECIMENS

Three similar test assemblies were constructed from the sample siding material provided by the client. Spacing of the fasteners consisted even spacing of 16-in on center. All the siding was fastened in accordance with the manufactures installation instructions. Fasteners were also installed with at least 1/16 of space between the fastener and the siding also described in the manufacturer's instructions manual

All commonly available construction materials were obtained by NTA. A summary of the construction materials is provided in Table 2, with a summary of the attachment methods provided in Table 3. A construction diagram is provided in the Appendix (Figure 1). A sample diagram of the siding is provided in the Appendix (Figure2). During construction an oversized polyethylene sheet (6 mil) was placed between the wall framing and the exterior sheathing. This sheeting will apply the uniform pressure for testing.

**Table 2: Materials**

Location	Material
Studs	Single, 2x4 SPF Stud Grade, 16-in. oc.
Top Plate	Single, 1x4 SPF Un-Graded
Bottom Plate	Single, 1x4 SPF Un-Graded
Exterior Sheathing	3/8-in. OSB , 24/0 Rated, By Weyerhaeuser Structurwood.
Exterior Siding	Novik, Perfect Shake Khaki (0.080) Siding

**Table 3: Fastening Schedule**

<b>Connection</b>	<b>Fastener</b>	<b>Quantity or Spacing</b>
Top Plate-to-Studs	15 Ga. x 7/16-in. x 1-3/4-in. Staple	3
Bottom Plate-to-Studs	15 Ga. x 7/16-in. x 1-3/4-in. Staple	3
Exterior Sheathing	16 Ga. x 7/16-in. x 1-1/2-in. Staple	6/6
Exterior Siding	0.122 x 1-1/2-in. Galvanized Roofing Nail	16-in. oc

## 2.2. TEST PROCEDURE

The test procedure is based on ASTM E72<sup>2</sup>, Section 11; however, the loading stages were modified to correspond with those required in the ultimate load test procedures found in Section 3280.401(b) of the Federal Manufactured Home Construction and Safety Standards. Accordingly, the test setup consists of a vacuum chamber with an open side slightly larger than the test assembly, as shown in Figure 3. A vacuum pump and manometer connection provide a means to apply and monitor the applied pressure. The samples are placed with the exterior sheathing facing inward, thereby placing a negative force on the exterior sheathing. The polyethylene sheeting is pleated to accommodate the specimen deflection and then sealed to the chamber.

Instrumentation consists of a water manometer and dial indicators. The water manometer has a resolution of 0.1 inches of water for pressures up to  $\pm 72.0$  inches of water. Dial indicators, with a resolution of 0.001-in., are positioned along selected studs to take deflection readings at midspan and at the supports. For specimens with studs spaced at 16-in. centers, the center two studs are gauged, using a total of six dial gauges. For studs spaced at 24-in. centers, only the middle stud is gauged, using a total of three gauges.

For testing, each specimen is loaded monotonically at approximate  $\frac{1}{4}$  live load pressure increments. Upon reaching each loading stage, applied load is maintained for not less than 10 minutes prior to reading the dial indicators. Once the dial indicators have been read, the pressure is increased to the next loading stage. This procedure is followed through pressure corresponding to 1.25 times live load. After which, the dial gauges are removed and the pressure is increased to 2.5 times live load. Once this pressure had been maintained for not less than 10 minutes, the pressure is further increased to ultimate. At ultimate, the peak pressure and mode of failure are noted. Ultimate is taken as the point where the specimen exhibits rupture, fracture, or excessive yielding. Any failure or observations at any point during the test are duly noted.

The applied pressure, in inches of water, is converted to pounds per square foot (psf) using the following conversion: 1 inch of water column = 5.2 psf.

### 3. TEST RESULTS

A total of three specimens were tested using the procedure outlined herein. The ultimate loads and service load deflections for each specimen are presented in Table 4, below. This table also provides the average assembly strength and compares it to the required pass/fail criteria.

**Table 4: Test Results**

<b>Specimen</b>	<b>Ultimate Pressure (psf)</b>	<b>Service Load Deflection (in.)</b>	<b>Failure Mode at Ultimate</b>
1344	256	0.256	Left Stud failure at Bottom Plate
1345	225	0.234	Left Stud failure at Top Plate
1346	224	0.266	Sheathing Fastener Failure
Average Ultimate	235	0.252	--
Evaluation Criteria	145	0.500	--
<b>Overall Result</b>	<i>Pass</i>	<i>Pass</i>	--

<sup>a</sup> As required by the FMHCSS<sup>1</sup>, which requires a factor of safety of 2.5 against failure and L/180 deflection limit under service level loads.

5. CONCLUSION

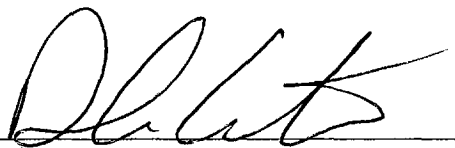
Three similar assemblies were tested and assessed in accordance with the ultimate load test procedures of the FMHCSS. The conditions of test and overall findings are summarized in Table 5, below.

It must be noted that NTA, Inc. did not oversee or verify the sampling procedure used by the client when selecting the sample material. The data provided herein were obtained and assessed in accordance with FMHCSS test procedures and criteria and should not be used for other types of construction. For use in manufactured housing, these findings and results are subject to DAPIA review and approval.

**Table 5: Conclusion**

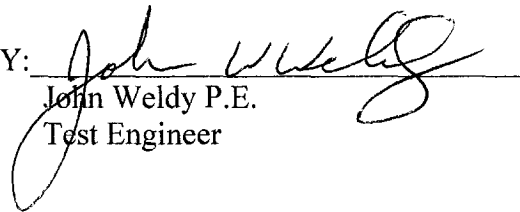
<b>Specimen</b>	<b>Test Conditions</b>	<b>Overall Result</b>
Novik, Perfecto Shake Khaki (0.080-in.) Siding Fastened and constructed as detailed herein	Wind Zone III Corner	<i>Pass</i>

TEST PERFORMED BY:



Dale Arter  
Director of Testing

REPORT REVIEWED BY:

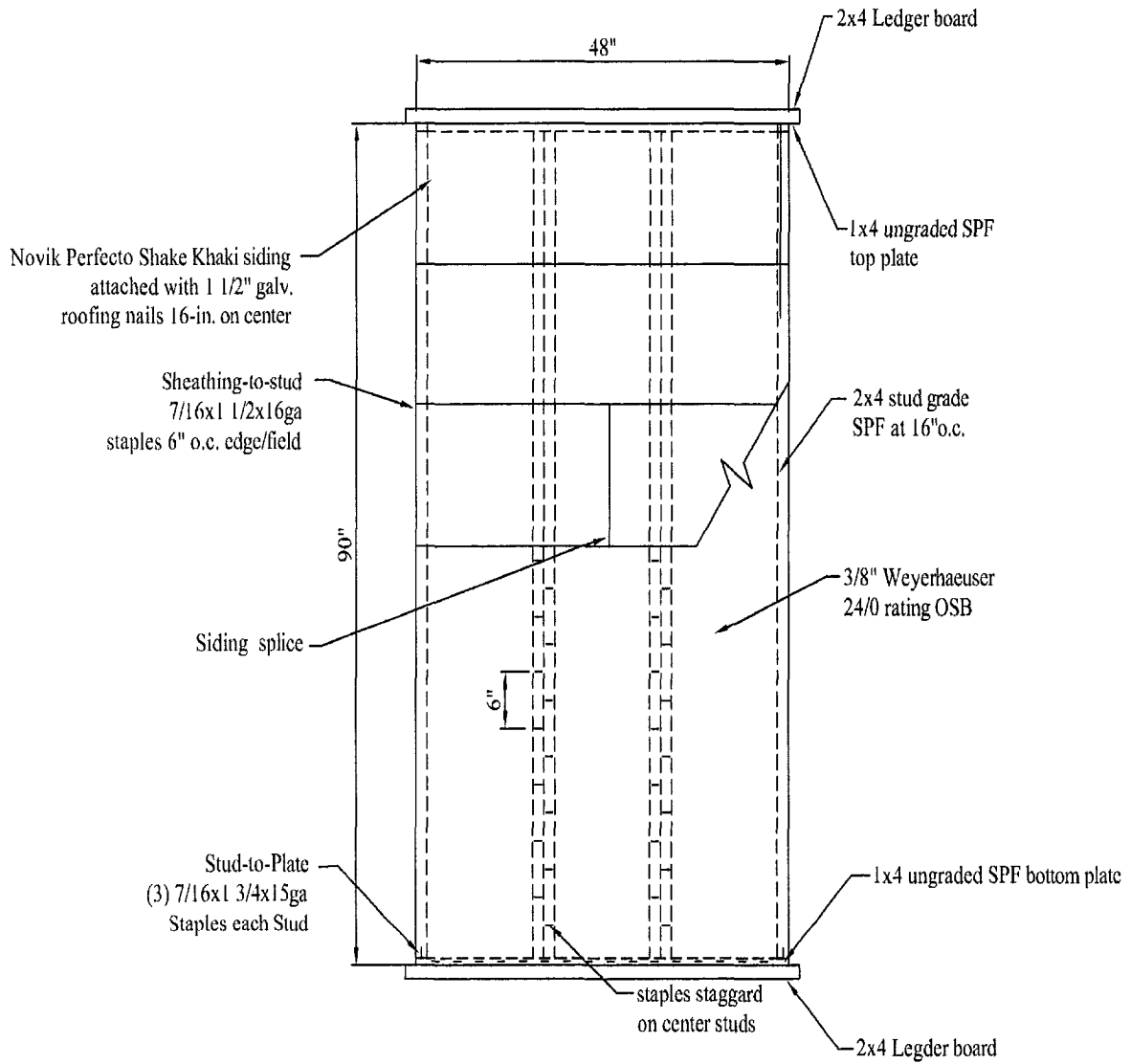


John Weldy P.E.  
Test Engineer

## REFERENCES

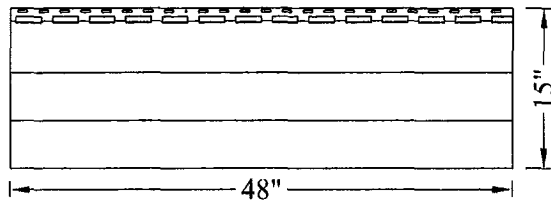
1. Department of Housing and Urban Development (HUD). *Manufactured Home Construction and Safety Standards & Interpretive Bulletins to the Standards April 1, 1995. 24 Code of Federal Regulations Part 3280*. Office of Assistant Secretary for Housing, Federal Housing Commissioner, Department of Housing and Urban Development.
2. American Society for Testing and Materials (ASTM). *Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*. ASTM E 72-02. ASTM, Philadelphia, PA, 2002. 11 pp.

# APPENDIX

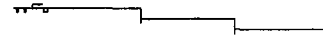


**Figure 1: Specimen Construction**

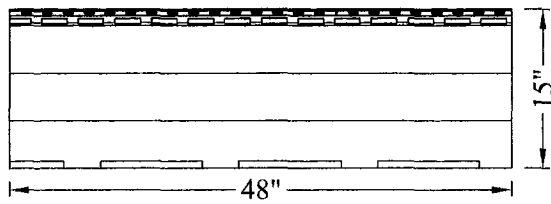
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Perfecto Shake Khaki Siding  
Top View



Perfecto Shake Khaki Siding  
End View



Perfecto Shake Khaki Siding  
Bottom View

Figure 2: Siding Specimen

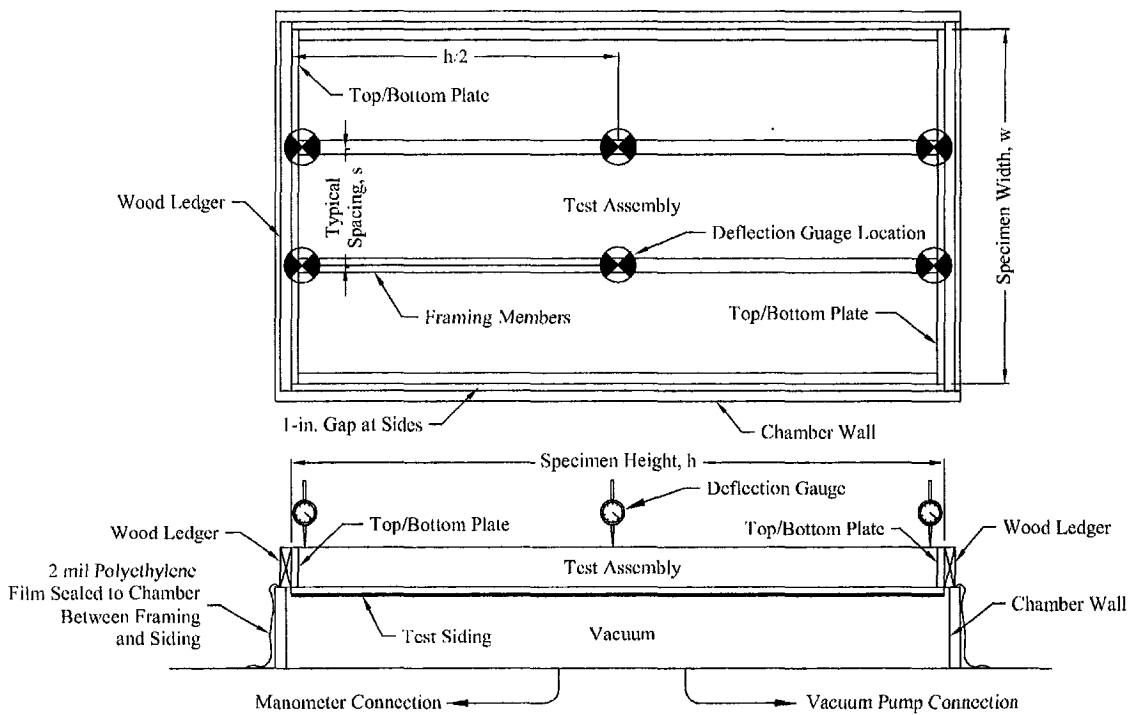


Figure 3: Test Setup

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NTA, Inc.

## Negative Wind Test for Wall Assemblies to be used in Manufactured Homes: Specimen 1

Client: Novik  
Job Number: TL081704-43  
Test Method: *FMHCSS, Section 3280.401(b), Ultimate Load Test Procedure*

Performed By: Gregg Tompos  
Witnessed By: Dale Arter

<b>General:</b>	<b>Apparatus:</b>	<b>Asset No.</b>	<b>Ambient Conditions:</b>
Received: 8/17/2004	Length Measure: 00306		Ambient Temp.: 73.1 deg. F
Fabrication Date: 9/1/2004	Vacuum Table: 00023		Ambient R.H.: 52%
Test Date: 9/2/2004	Manometer: 00337		Senor Asset No.: 00200
Test Location: NTA, Test Facility Nappance, IN	Moisture Meter: 00173		

<b>Specimen Description:</b>	<b>Loading Conditions:</b>
Specimen No.: 01344	HUD Wind Zone: Zone 3 (Corner)
Clear Span: 90-in.	Design Pressure: 58 psf
Width: 48-in.	Deflection Limit (L/180): 0.5-in.
Framing: (2) 2x4 stud SPF 16 o/c-in. oc	
Ext. Sheathing: Weverhaeuser 0.375 OSB	
16 ga x 7/16 x 1 1/2-in. staple 6/6-in. oc edge/field	
Ext. Siding: Novik Perfecto Shake Khaki Vinyl(0.0793-in. flange thick.)	
(4) 4 d x 1.5-in. Roofing nails 16 o/c-in. oc	
Int. Sheathing: none	
Wood MC: 0% - 0%	

### Specimen 1 Ultimate Load Test Deflection Data

Load Stages	Applied Pressure (psf)	Left Stud Deflection (in.)			Right Stud Deflection (in.)		
		Top Support	Mid Span	Bottom Support	Top Support	Mid Span	Bottom Support
		00246	00254	00245	00081	00253	00077
0 (REF)	0.0	0.000	0.000	0.000	0.000	0.000	0.000
1/4LL	15.6	0.071	0.124	0.063	0.068	0.132	0.066
1/2LL	29.1	0.119	0.214	0.094	0.119	0.238	0.101
3/4LL	43.7	0.161	0.296	0.113	0.163	0.335	0.122
LL	58.2	0.190	0.398	0.132	0.192	0.443	0.143
5/4LL	72.8	0.216	0.489	0.150	0.216	0.542	0.161
5/2LL	144.6	--	--	--	--	--	--

**Net LL Deflection: 0.256-in. at 58 psf**  
**Ultimate Uniform Load: 256 psf**  
**Failure Mode: Left stud disengaged from bottom plate**

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Reviewed & Approved By: Dale Arter

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NTA, Inc.

## Negative Wind Test for Wall Assemblies to be used in Manufactured Homes: Specimen 2

Client: Novik  
Job Number: TL081704-43  
Test Method: *FMHCSS, Section 3280.401(b), Ultimate Load Test Procedure*

Performed By: Gregg Tompos  
Witnessed By: Dale Arter

<b>General:</b>	<b>Apparatus:</b>	<b>Asset No.</b>	<b>Ambient Conditions:</b>
Received: 8/17/2004	Length Measure:	00306	Ambient Temp.: 72.4 deg. F
Fabrication Date: 9/1/2004	Vacuum Table:	00023	Ambient R.H.: 52%
Test Date: 9/2/2004	Manometer:	00023	Senor Asset No.: 00200
Test Location: NTA, Test Facility Nappanee, IN	Moisture Meter:	00173	

<b>Specimen Description:</b>	<b>Loading Conditions:</b>
Specimen No.: 01345	HUD Wind Zone: Zone 3 (Corner)
Clear Span: 90-in.	Design Pressure: 58 psf
Width: 48-in.	Deflection Limit (L/180): 0.5-in.
Framing: (2) 2x4 stud SPF 16 o/c-in. oc	
Ext. Sheathing: Weverhaeuser 0.375 OSB 16 ga x 7/16 x 1 1/2-in. staple 6/6-in. oc edge/field	
Ext. Siding: Novik Perfecto Shake Khaki Vinyl(0.0793-in. flange thick.) (4) 4 d x 1.5-in. Roofing nails 16 o/c-in. oc	
Int. Sheathing: none	
Wood MC: 0% - 0%	

### Specimen 2 Ultimate Load Test Deflection Data

Load Stages	Applied Pressure (psf)	Left Stud Deflection (in.)			Right Stud Deflection (in.)		
		Top Support	Mid Span	Bottom Support	Top Support	Mid Span	Bottom Support
0 (REF)	0.0	0.000	0.000	0.000	0.000	0.000	0.000
1/4LL	14.6	0.057	0.088	0.029	0.056	0.095	0.034
1/2LL	29.1	0.095	0.184	0.054	0.093	0.187	0.058
3/4LL	43.7	0.116	0.251	0.074	0.117	0.270	0.080
LL	58.2	0.136	0.341	0.101	0.139	0.368	0.106
5/4LL	72.8	0.155	0.425	0.125	0.158	0.456	0.131
5/2LL	144.6	--	--	--	--	--	--

**Net LL Deflection: 0.234-in. at 58 psf**  
**Ultimate Uniform Load: 225 psf**  
**Failure Mode: Left 2x4 stud broke at top plate**

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NTA, Inc.

## Negative Wind Test for Wall Assemblies to be used in Manufactured Homes: Specimen 3

Client: Novik  
Job Number: TL081704-43  
Test Method: *FMHCSS, Section 3280.401(b), Ultimate Load Test Procedure*

Performed By: Gregg Tompos  
Witnessed By: Dale Arter

<b>General:</b>	<b>Apparatus:</b>	<b>Asset No.</b>	<b>Ambient Conditions:</b>
Received: 8/17/2004	Length Measure: 00306		Ambient Temp.: 70.6 deg. F
Fabrication Date: 9/1/2004	Vacuum Table: 00023		Ambient R.H.: 51%
Test Date: 9/2/2004	Manometer: 00023		Senor Asset No.: 00200
Test Location: NTA, Test Facility Nappance. IN	Moisture Meter: 00173		

<b>Specimen Description:</b>	<b>Loading Conditions:</b>
Specimen No.: 01346	HUD Wind Zone: Zone 3 (Corner)
Clear Span: 90-in.	Design Pressure: 58 psf
Width: 48-in.	Deflection Limit (L/180): 0.5-in.
Framing: (2) 2x4 stud SPF 16 o/c-in. oc	
Ext. Sheathing: Weverhaeuser 0.375 OSB 16 ga x 7/16 x 1 1/2-in. staple 6/6-in. oc edge/field	
Ext. Siding: Novik Perfecto Shake Khaki Vinyl(0.0793-in. flange thick.) (4) 4 d x 1.5-in. Roofing nails 16 o/c-in. oc	
Int. Sheathing: none	
Wood MC: 0% - 0%	

### Specimen 3 Ultimate Load Test Deflection Data

Load Stages	Applied Pressure (psf)	Left Stud Deflection (in.)			Right Stud Deflection (in.)		
		Top Support	Mid Span	Bottom Support	Top Support	Mid Span	Bottom Support
0 (REF)	0.0	0.000	0.000	0.000	0.000	0.000	0.000
1/4LL	14.6	0.048	0.087	0.024	0.050	0.090	0.018
1/2LL	29.1	0.077	0.174	0.048	0.076	0.188	0.037
3/4LL	43.7	0.106	0.263	0.071	0.101	0.292	0.057
LL	58.2	0.131	0.349	0.095	0.125	0.398	0.078
5/4LL	72.8	0.158	0.443	0.121	0.150	0.496	0.101
5/2LL	144.6	--	--	--	--	--	--

**Net LL Deflection: 0.266-in. at 58 psf**  
**Ultimate Uniform Load: 224 psf**  
**Failure Mode: OSB fasteners failed pulled out of left stud**

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NTA, Inc.

## Negative Wind Test for Wall Assemblies to be used in Manufactured Homes: Results Summary

Client: Novik  
Job Number: TL081704-43  
Test Method: *FMHCSS, Section 3280.401(b), Ultimate Load Test Procedure*

Performed By: Gregg Tompos  
Witnessed By: Dale Arter

<p><b>Specimen Description:</b> Clear Span: 90-in. Width: 48-in.</p> <p>Framing: (2) 2x4 stud SPF 16 o/c-in. oc Ext. Sheathing: <i>Weverhaeuser 0.375 OSB 16 ga x 7/16 x 1 1/2-in. staple 6/6-in. oc edge/field</i> Ext. Siding: <i>Novik Perfecto Shake Khaki Vinyl(0.0793-in. flange thick.) (4) 4 d x 1.5-in. Roofing nails 16 o/c-in. oc</i> Int. Sheathing: <i>none</i></p> <p>Wood MC: 0% - 0%</p>	<p><b>Loading Conditions:</b> HUD Wind Zone: Zone 3 (Corner) Design Pressure: 58 psf Deflection Limit (L/180): 0.5-in.</p>
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### Overall Test Results

Specimen	Specimen No.	Ultimate Pressure (psf)	Service Deflection (in.)
1	01344	256	0.256
2	01345	225	0.234
3	01346	224	0.266

**Average Ultimate Pressure: 235 psf, Pass (58 psf x 2.5 = 145 psf min.)**  
**Average Midspan Deflection\*: 0.252-in., Pass (L/180 = 0.5-in.)**

\* Midspan deflection less the average of the support deflections.

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