


ICC NTA TEST REPORT

ASTM E72 Evaluation of Sheathing Materials - Wall Racking Test

**RENDERED TO: Innovated Structures, Inc.
14048 Terrace RD NE
Ham Lake, MN 55304**

**PRODUCT: 7/16" APA Rated
OSB Panels (Vertical)
Fastened with Nails
to 2x6 WarmStud Framing**



Report No.: ISIA021723-33(R0)
Test Date(s): 8/1/2023 - 8/2/2023, 9/18/2023
Report Date: 09/25/2023
Pages: 14

1. OBJECTIVE

To determine the shear strength and stiffness of a wall panel and its connections by applying a racking force to the specimen while recording the horizontal and vertical displacements.

2. TESTING ORGANIZATION

ICC NTA, LLC
58640 State Road 15
Goshen, IN 46528

See A2LA Certificate Number 6395.01 for ISO 17025 Accreditation.

3. TESTING PERSONNEL

Operations Manager - Justin Mann
Project Manager - Jacob Bontrager
Technician - Chris Stutzman

4. REFERENCE STANDARDS

ASTM E72 - 22 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction; Section 14 Racking Load - Evaluation of Sheathing Materials on a Standard Wood Frame.

5. TEST EQUIPMENT

- A. Data Acquisition System - (Asset No. 523)
- B. One (1) 15K Capacity Load Cell (PEI No. 874)
- C. Four (4) Linear Transducers (Asset Nos. 928, 1224, 1225, & 1226)
- D. One (1) Lynair Hydraulic Cylinders, Model No. LH-D401, Bore 3-1/4" and 12" stroke

6. TEST SPECIMENS

- A. Framing
 - 1. Studs - 2x4 SPF Lumber MSR 1650Fb 1.5E and 2" WarmStud Foam
 - 2. Top Plates - 2x6 SPF Lumber - No. 2 Grade
 - 3. Bottom Plate - 2x6 SPF Lumber - No. 2 Grade

Note: The test sample provided for the 9/18/2023 test used 2x4 SPF No 2 Grade studs. The test samples provided for the 8/1/2023 tests used MSR 1650Fb 1.5E studs.

- B. Fasteners
 - 1. Top Plate to Studs - .131" x 3-1/2" long 16D common nails
 - 2. Double Top Plate - .131" x 3-1/2" long 16D common nails
 - 3. Bottom Plate to Studs - .131" x 3-1/2" long 16D common nails
 - 4. 7/16" OSB Panels to Framing - .131" x 3-1/2" long 16D common nails

- C. Sheathing

7/16" OSB Sheathing - The APA rated oriented strand board panels were 4' x 8' with an average measured thickness of .470". The edges were square. Typical board markings on the back side of the panels included: "West Fraser APA 7/16" Category, JUN 16 2023 19:36".

A representative of ICC NTA visited Innovated Structures, Inc.'s facility located in Newton, AI on 6/19/2023 and 9/05/2023 and selected the materials for the testing reported herein. All test specimens were supplied by Innovated Structures, Inc.

7. TEST SPECIMEN CONSTRUCTION

All test samples were constructed by the client prior to being delivered to ICC NTA for testing.

1. A 96" x 96" frame was assembled with the studs placed 16" o.c.
2. The 7/16" OSB panels were applied to the previously constructed framework (96" x 96").
3. The panels were fastened to the framework using .131" x 3-1/2" long 16D common nails. The fasteners were placed 3" o.c. around the perimeter and 6" o.c. along the center of the field studs. The perimeter fasteners did not have a particular edge inset from the edge of the sheathing. A measured range of 3/8" - 1-1/4" was recorded from all three (3) walls.

See attached drawings for wall layout details.

8. SPECIMEN CONDITIONING

The specimens were conditioned as described in ASTM E72, Section 14.

9. TEST SETUP

- A. As permitted in Section 14.3.1 of ASTM E72, a steel base and loading beam were used. The loading beam was secured to the top plate of the sample with #8 x 3" long screws. A 1/2" thick steel plate with counter-sunk holes was secured to the bottom plate with #8 x 3" long screws. The bottom plate of the test sample was secured to the base fixture with 1/2" bolts at four (4) locations, thru the threaded holes in the 1/2" thick steel plate. Two (2) 1" diameter steel rollers were set on the steel loading beam at the load end and an upper cross beam of the fixture was lowered onto the rollers. The load end of the wall was restrained from vertical displacement using two (2) 1/2" diameter steel rods which were tightened by hand plus 1/4 turn at the start of the test.
- B. A hydraulic cylinder was used to apply horizontal force to the loading beam, and measured with a compression load cell. Four (4) linear transducers were positioned as follows; (1) top end of the wall opposite the load side; (2) bottom end of the wall opposite the load side (slip); (3) edge of wall on the load side (uplift); and (4) edge of wall opposite the load side (compression).

10. TEST PROCEDURE

The data acquisition was started. The load was applied in four successive increments 790 lbf, 1570 lbf, 2360 lbf and failure. The load was released between each increment. The residual deflections were taken one minute after the load was released. The load rate throughout the test was approximately 395 lbf/minute.

APPENDIX

Innovated Structures, Inc.

ISIA021723-33

ASTM E72 Wall Racking Test

Date: 8/1/2023
Client: Innovated Structures, Inc.
Description: 7/16" OSB Sheathing attached to 2" WarmStud & SPF Framing. The WarmStuds consisted of ~2" Foam & 2x4 SPF lumber.

Temperature: 71° F
Relative Humidity: 55%
Preload: none
Sample Width: 8 ft
Sample Height: 8 ft
Total Test Time (h:mm): 0:48

Test No. E72-WS-1

	Load lbf	Deflection in Inches				Net* Defl. (in)
		Gauge 1	Gauge 2	Gauge 3	Gauge 4	
3.51 kN (790 lbf)	0	.000	.000	.000	.000	--
	112	.005	.000	.000	-.001	.004
	223	.011	.000	.001	-.002	.008
	338	.020	.000	.002	-.004	.015
	450	.028	.000	.003	-.005	.020
	564	.039	.000	.004	-.007	.028
	675	.051	.000	.005	-.009	.037
	793	.065	.000	.006	-.012	.047
Seconds Between Loading = 181						
6.98 kN (1570 lbf)	0	.013	.000	.000	-.004	.009
	227	.022	.000	.000	-.006	.016
	449	.038	.000	.002	-.008	.027
	673	.057	.000	.005	-.011	.041
	899	.083	.000	.007	-.015	.060
	1,124	.116	.000	.010	-.021	.085
	1,347	.153	.000	.014	-.027	.112
1,572	.195	.000	.019	-.032	.143	
Seconds Between Loading = 170						
10.5 kN (2360 lbf)	0	.060	.001	.002	-.014	.042
	338	.077	.001	.004	-.018	.054
	676	.105	.001	.008	-.022	.075
	1,013	.141	.001	.012	-.026	.102
	1,351	.180	.001	.016	-.030	.133
	1,687	.226	.001	.021	-.036	.168
	2,024	.296	.002	.029	-.044	.220
	2,360	.387	.003	.040	-.053	.291
Seconds Between Loading = 134						
Load to Ultimate	0	.122	.003	.011	-.021	.088
	811	.196	.002	.021	-.033	.140
	1,617	.295	.003	.031	-.044	.217
	2,426	.421	.004	.044	-.057	.316
	3,233	.729	.007	.078	-.080	.563
	4,041	1.169	.011	.117	-.107	.934
	4,848	1.876	.014	.172	-.142	1.548
	5,656	4.006	.020	.398	-.236	3.352
Load @ .200" Net Deflection = 1,911 lbf or 239 plf						
Ultimate Load = 5,656 lbf or 707 plf						

Moisture Content		
Studs:	10.9	%
Plates:	11.8	%
Sheathing:	N/A	%

Sheathing Details	
SIDE ONE	Thickness: 7/16"
	Size: 48" x 96"
	Weight: N/A
	Orientation: Vertical
SIDE TWO	Perimeter Sp: 3" o.c.
	Field Spacing: 6" o.c.
	Adhesive: N/A
	Thickness: N/A
	Size: N/A
	Weight: N/A
SIDE ONE	Orientation: N/A
	Perimeter Sp: N/A
	Field Spacing: N/A
	Adhesive: N/A

Framing Details	
Studs:	2x6 WarmStud
Plates:	2x6
Grade:	MSR 1650
Spacing:	16" o.c.

Fastener Details	
Type:	Nail
Size:	.131" 16D Common
Length:	3-1/2"

Deflection Ind. Location	
Gauge #1:	Top Plate
Gauge #2:	Slip
Gauge #3:	Uplift
Gauge #4:	Compression

* - According to ASTM E72-22 Equation (1) the Net Deflection equals: Gauge 1 - Gauge 2 - (Gauge 3 - Gauge 4).
 ** - See attached verification drawing for fastener details.

Mode of Failure:

Sheathing break out around some of the fasteners along the bottom and top plates. Fastener rotation occurred along much of the perimeter of the wall as well. **Note: This wall had an average measured fastener edge inset around the perimeter of the wall of 3/4".*

ASTM E72 Wall Racking Test

Date: 8/2/2023
Client: Innovated Structures, Inc.
Description: 7/16" OSB Sheathing attached to 2" WarmStud & SPF Framing. The WarmStuds consisted of ~2" Foam & 2x4 SPF lumber.

Temperature: 71° F
Relative Humidity: 68%
Preload: none
Sample Width: 8 ft
Sample Height: 8 ft
Total Test Time (h:mm): 0:47

Test No. E72-WS-3

	Load lbf	Deflection in Inches				Net* Defl. (in)
		Gauge 1	Gauge 2	Gauge 3	Gauge 4	
3.51 kN (790 lbf)	0	.000	.000	.000	.000	--
	111	.005	.000	.000	.000	.005
	225	.012	.000	.000	-.001	.011
	338	.020	.000	.000	-.002	.018
	451	.030	.000	.001	-.004	.025
	563	.040	.000	.001	-.006	.033
	677	.052	.000	.002	-.009	.042
	792	.065	.000	.003	-.011	.052
Seconds Between Loading = 172						
6.98 kN (1570 lbf)	0	.019	.000	.001	-.005	.014
	226	.028	.000	.001	-.005	.023
	450	.042	.000	.001	-.007	.034
	676	.058	.000	.002	-.009	.047
	899	.079	.000	.003	-.012	.064
	1,123	.110	.000	.006	-.017	.088
	1,347	.146	.000	.009	-.021	.116
	1,571	.189	.000	.013	-.026	.150
Seconds Between Loading = 118						
10.5 kN (2360 lbf)	0	.059	.000	.003	-.008	.048
	338	.074	.000	.003	-.010	.062
	677	.100	.000	.004	-.014	.082
	1,014	.133	.000	.007	-.019	.107
	1,349	.170	.000	.010	-.024	.136
	1,688	.216	.000	.015	-.029	.171
	2,025	.297	.000	.024	-.037	.236
	2,361	.389	.001	.033	-.044	.311
Seconds Between Loading = 132						
Load to Ultimate	0	.131	.000	.006	-.014	.111
	839	.193	.000	.010	-.023	.160
	1,680	.303	.000	.022	-.037	.244
	2,515	.434	.001	.037	-.048	.348
	3,353	.781	.002	.081	-.070	.627
	4,195	1.320	.004	.147	-.101	1.067
	5,031	2.032	.006	.223	-.144	1.660
	5,867	3.519	.012	.351	-.259	2.897
Load @ .200" Net Deflection = 1,848 lbf or 231 plf						
Ultimate Load = 5,867 lbf or 733 plf						

Moisture Content		
Studs:	10.9	%
Plates:	13.3	%
Sheathing:	N/A	%

Sheathing Details

SIDE ONE	SIDE TWO
Thickness: 7/16"	
Size: 48" x 96"	
Weight: N/A	
Orientation: Vertical	
Perimeter Sp: 3" o.c.	
Field Spacing: 6" o.c.	
Adhesive: N/A	
Thickness: N/A	
Size: N/A	
Weight: N/A	
Orientation: N/A	
Perimeter Sp: N/A	
Field Spacing: N/A	
Adhesive: N/A	

Framing Details

Studs: 2x6 WarmStud
Plates: 2x6
Grade: MSR 1650
Spacing: 16" o.c.

Fastener Details

Type: Nail
Size: .131" 16D Common
Length: 3-1/2"

Deflection Ind. Location

Gauge #1: Top Plate
Gauge #2: Slip
Gauge #3: Uplift
Gauge #4: Compression

* - According to ASTM E72-22 Equation (1) the Net Deflection equals: Gauge 1 - Gauge 2 - (Gauge 3 - Gauge 4).

** - See attached verification drawing for fastener details.

Mode of Failure:

Sheathing break out around some of the fasteners along the bottom and top plates. Fastener rotation occurred along much of the perimeter of the wall as well. **Note: This wall had an average measured fastener edge inset around the perimeter of the wall of 5/8".*

ASTM E72 Wall Racking Test

Date: 9/18/2023
Client: Innovated Structures, Inc.
Description: 7/16" OSB Sheathing attached to 2" WarmStud & SPF Framing. The WarmStuds consisted of ~2" Foam & 2x4 SPF lumber.

Temperature: 72° F
Relative Humidity: 43%
Preload: none
Sample Width: 8 ft
Sample Height: 8 ft
Total Test Time (h:mm): 0:52

Test No. E72-WS-4

	Load lbf	Deflection in Inches				Net* Defl. (in)
		Gauge 1	Gauge 2	Gauge 3	Gauge 4	
3.51 kN (790 lbf)	0	.000	.000	.000	.000	--
	109	.005	.000	.000	-.001	.004
	223	.011	.000	.000	-.002	.009
	338	.017	.000	.001	-.003	.013
	450	.025	.000	.002	-.005	.018
	564	.033	.000	.003	-.006	.025
	675	.042	.000	.004	-.007	.031
	791	.052	.000	.005	-.009	.038
Seconds Between Loading = 184						
6.98 kN (1570 lbf)	0	.002	.000	.001	-.001	.001
	227	.012	.000	.000	-.003	.009
	451	.026	.000	.002	-.005	.018
	675	.043	.000	.004	-.008	.031
	899	.062	.000	.006	-.011	.045
	1,123	.093	.000	.010	-.018	.065
	1,348	.138	.000	.020	-.027	.090
	1,571	.187	.001	.031	-.036	.119
Seconds Between Loading = 216						
10.5 kN (2360 lbf)	0	.050	.000	.015	-.015	.020
	340	.068	.000	.015	-.018	.034
	676	.093	.000	.017	-.023	.054
	1,013	.125	.000	.021	-.028	.076
	1,351	.163	.000	.027	-.033	.103
	1,687	.218	.001	.038	-.040	.138
	2,025	.310	.002	.059	-.051	.198
	2,361	.423	.004	.083	-.061	.275
Seconds Between Loading = 78						
Load to Ultimate	0	.154	.002	.042	-.028	.081
	701	.194	.002	.044	-.036	.113
	1,399	.278	.003	.056	-.046	.173
	2,099	.391	.004	.077	-.058	.252
	2,799	.621	.007	.123	-.077	.415
	3,500	1.064	.009	.214	-.108	.734
	4,199	1.828	.009	.326	-.156	1.336
	4,525	2.516	.012	.407	-.197	1.900
Load @ .200" Net Deflection = 2,032 lbf or 254 plf						
Ultimate Load = 4,898 lbf or 612 plf						

Moisture Content		
Studs:	13.1	%
Plates:	13.9	%
Sheathing:	N/A	%

Sheathing Details	
SIDE ONE	Thickness: 7/16"
	Size: 48" x 96"
	Weight: N/A
	Orientation: Vertical
SIDE TWO	Perimeter Sp: 3" o.c.
	Field Spacing: 6" o.c.
	Adhesive: N/A
	Thickness: N/A
	Size: N/A
	Weight: N/A
SIDE ONE	Orientation: N/A
	Perimeter Sp: N/A
	Field Spacing: N/A
	Adhesive: N/A

Framing Details	
Studs:	2x6 WarmStud
Plates:	2x6
Grade:	STUD Grade SPF
Spacing:	16" o.c.

Fastener Details	
Type:	Nail
Size:	.131" 16D Common
Length:	3-1/2"

Deflection Ind. Location	
Gauge #1:	Top Plate
Gauge #2:	Slip
Gauge #3:	Uplift
Gauge #4:	Compression

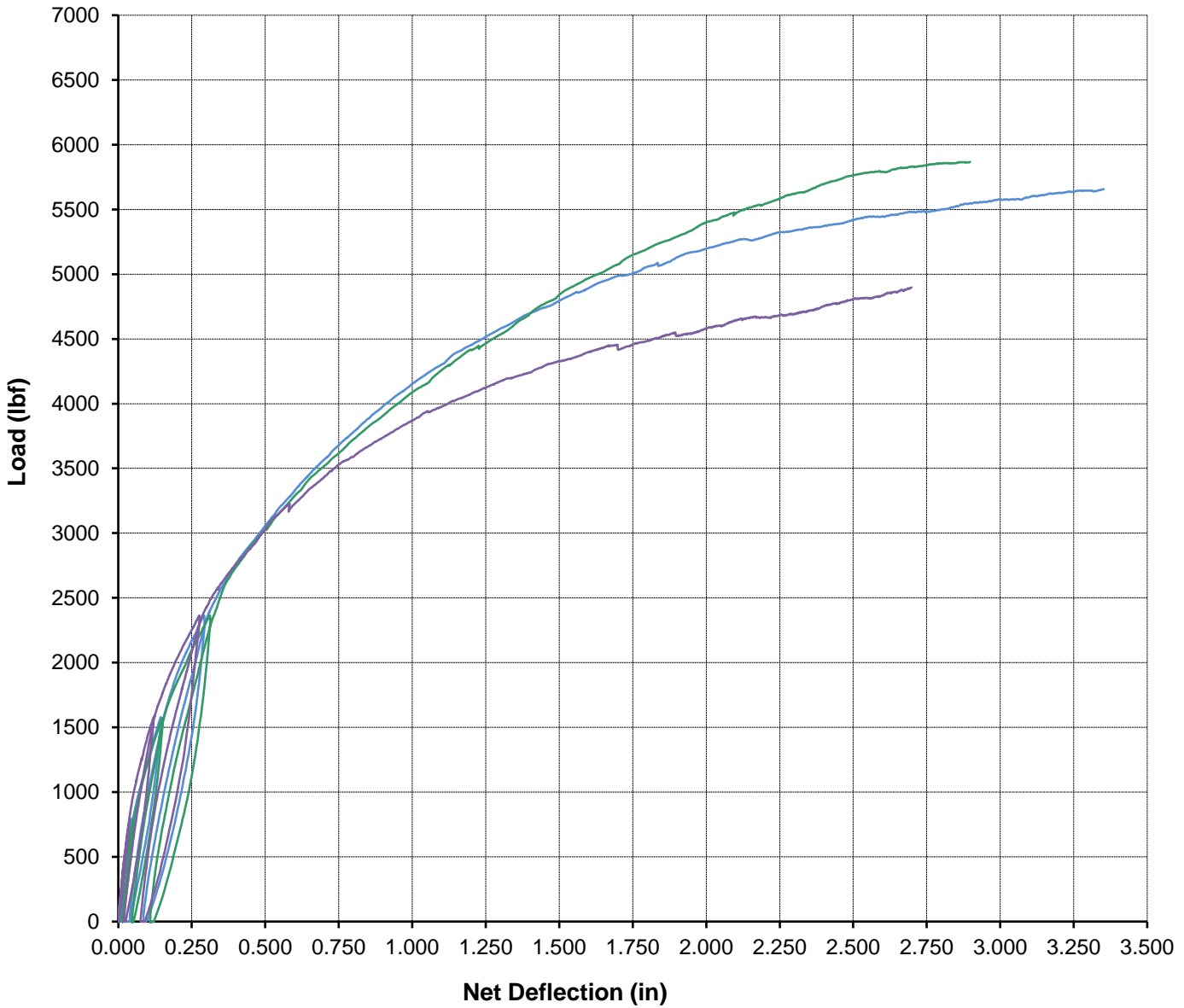
* - According to ASTM E72-22 Equation (1) the Net Deflection equals: Gauge 1 - Gauge 2 - (Gauge 3 - Gauge 4).
 ** - See attached verification drawing for fastener details.

Mode of Failure:

Sheathing break out around some of the fasteners along the bottom and top plates. Fastener rotation occurred along much of the perimeter of the wall as well. **Note: This wall had a measured fastener edge inset around the perimeter of the wall of 3/4", and 3/8" inset at the seam.*

Innovated Structures, Inc.
ASTM E72 Wall Racking Test (single-sided)
using 7/16" OSB Sheathing on 2" WarmStud & Lumber Framing

— E72-WS-1
 — E72-WS-3
 — E72-WS-4





Typical Test Setup (Arrows indicate positive deflection, per ASTM E72-22)



Typical Failure
www.ICC-NTA.org



E72-WS-1 - Test Failure



E72-WS-1 - Test Failure



E72-WS-3 - Test Failure



E72-WS-3 - Test Failure



E72-WS-4 - Test Failure



E72-WS-4 - Test Failure

Fastener Measurements

Date: 8/1/2023

Project No.: 021723-33

Client: Innovated Structures, Inc.

Specimen: .131" x 3-1/2" long 16D Common Nails			
Fastener	Head Diameter	Shank / Thread Dia.	Length
1	0.272"	0.129"	3.483"
2	0.272"	0.129"	3.471"
3	0.277"	0.129"	3.474"
4	0.275"	0.129"	3.474"
5	0.272"	0.129"	3.475"
6	0.277"	0.129"	3.469"
7	0.277"	0.129"	3.470"
8	0.281"	0.129"	3.471"
9	0.278"	0.130"	3.469"
10	0.270"	0.129"	3.477"
Average:	0.275"	0.129"	3.473"

Comments / Observations:

Ten (10) fasteners were randomly selected by Chris Stutzman of NTA and measured as indicated above using a digital caliper. These fasteners were used to fasten the sheathing to the framing.

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	09/25/2023	N/A	Original report issue