

NATURES COMPOSITES TEST REPORT

SCOPE OF WORK

DYNAMIC WIND LOAD PERFORMANCE TEST OF *NCTERRA* COMPOSITE PRIVACY FENCE ASSEMBLIES

REPORT NUMBER Q6380.01-119-19 R1

TEST DATES 12/05/23 - 12/06/23

 ISSUE DATE
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 01/22/24
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REPORT ISSUED TO

NATURES COMPOSITES 1302 Industrial Park Avenue Torrington, Wyoming 82240

SECTION 1

SCOPE

Architectural Testing, Inc. (an Intertek company) dba Intertek Building & Construction (B&C) was contracted by Natures Composites to perform dynamic wind load testing on their *NCterra* composite privacy fence systems. Results obtained are tested values and were secured through the test procedure outlined below. Testing was conducted at Intertek B&C's test facility in York, PA where testing was completed.

Intertek B&C in York, Pennsylvania has demonstrated compliance with ISO/IEC International Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc. (IAS).

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For INTERTEK B&C	2:		
COMPLETED BY:	Jordan M. Gault	REVIEWED BY:	Travis A. Hoover
TITLE:	Technician III	TITLE:	Senior Manager
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DATE:	01/26/24	DATE:	01/26/24
JMG:tah/aas			

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SECTION 2

MATERIAL SOURCE/INSTALLATION

Test samples were provided by the client. Test samples were inspected by a representative of Intertek B&C prior to testing. No compromising defects were observed. Representative samples of the test specimens will be retained by Intertek B&C for a minimum of four years from the test completion date.

Test specimens were assembled by representatives from Natures Composites.

SECTION 3

EQUIPMENT

Two propeller fan wind generators were utilized for testing. The propeller of each fan had a diameter of 84 in and was comprised of either three or four Kevlar composite airfoil units beltdriven by a high-output V8 engine. Wind speed for each wind generator was calibrated according to AAMA 501.1-05. Deflections were measured with linear displacement transducers accurate to 0.01 in.

SECTION 4

LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Jordan M. Gault	Intertek B&C
Adam J. Schrum	Intertek B&C
Shawn E. Beamer	Intertek B&C
John Mitchell	Natures Composites
Roberto Lebrija	Natures Composites



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SECTION 5

TEST PROCEDURES

One specimen of each of the following 2-panel/3-post fully assembled privacy fence sections were tested:

- 69 in wide by 69 in high *NCterra* full privacy horizontal fence
- 74 in wide by 72 in high *NCterra* commercial full privacy horizontal fence
- 74 in wide by 96 in high NCterra commercial full privacy horizontal fence

See drawings in Section 10 for detailed descriptions of components.

A steel test fixture was designed and fabricated to simulate a rigid post embedment. The bottom of the bottom rail was fixed 2 in above the top of the test fixture. Each wind generator outlet was located 4 ft from the face of the specimen and centered on the fence panel. Linear transducers were fixed on the midspan of the top rail, middle of each infill area, and midspan of the bottom rail for deflection measurements. See drawings in Section 10 for detailed descriptions of components and photographs in Section 9 for specimen orientation with respect to wind direction.

Wind load testing began at 30 mph and increased until failure or a maximum wind speed of 130 mph. Wind loads were performed with a relaxation period, following 50, 80, 115, and 130 mph wind loads, to record permanent set measurements.



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TEST CALCULATIONS

The duration of the applied wind load at each wind speed was determined by using the following equation:

t = 3600 / V_{fm}

(Equation 1)

where:

t = duration (s), required for a one mile long sample of air to pass V_{fm} = "fastest mile" wind speed (mph)

Wind speeds used in testing correlate with "fastest mile" wind speeds (V_{fm}) for reference to codes and design standards. Maximum deflections were recorded at each load level.

SECTION 7

TEST SPECIMEN DESCRIPTIONS

SERIES/MODEL	6 ft NCterra Full Privacy Horizontal Fence			
DESCRIPTION	69 in wide by 69 in high composite privacy fence			
PANELS	Eleven, 6-3/8 in wide by 66 in long by 0.142 in thick Hollow T&G			
	Pickets, per panel			
POSTS	Two, 2-9/16 in wide by 93-3/16 in high by 2-5/8 in deep by 0.983 in			
	thick Composite C Post T&G Fit, per panel. One 2-1/2 in wide by 2-			
	1/2 in long by 5/8 in deep plastic Top Cap inserted into the routed			
	space of the top of each Composite C Post T&G Fit and secured with			
	one #10 x 1-3/4 in self-drilling composite screw.			
TOP ALIGNMENT	Top Cable Assembly: One, 1/16 in steel 7x7 strand core cable			
COMPONENT	spanning from post to post. The top cable assembly slides into			
	grooves of the Composite C Post T&G Fit allowing the cable to rest in			
	the grooved portion of the top Hollow T&G Picket			
BOTTOM ALIGNMENT	Base Cable Assembly (Broad Stop) to Post: One, 1-5/8 in wide by 4 in			
COMPONENT /	tall by 7/8 in deep Support block T&G Fit located at each bottom end			
GROUND CLEARANCE	of the post, attached to posts with two #10 x 1-3/4 in self-drilling			
SPACER	composite screws. The Support block T&G Fit includes a 1/16 in steel			
	7x7 strand core cable which spans from post to post			

Test Specimen No. 1



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Test Specimen No. 2

SERIES/MODEL	6 ft NCterra Commercial Full Privacy Horizontal Fence			
DESCRIPTION	74 in wide by 72 in high composite privacy fence			
PANELS	Eleven, 6-3/8 in wide by 66 in long by 0.142 in thick Hollow T&G			
	Pickets, per panel			
POSTS	Two, 2-9/16 in wide by 93-3/16 in high by 2-5/8 in deep by 0.983 in			
	thick Composite C Post T&G Fit, attached to two, 5 in wide by 5 in			
	deep by 95 in high by 1/2 in thick composite hollow posts with eight			
	#10 x 1-3/4 in self-drilling composite screws, per panel. One 2-1/2 in			
	wide by 2-1/2 in long by 5/8 in deep plastic Top Cap inserted into the			
	routed space of the top of each Composite C Post T&G Fit and			
	secured with one #10 x 1-3/4 in self-drilling composite screw.			
TOP ALIGNMENT	Top Cable Assembly: One, 1/16 in steel 7x7 strand core cable			
COMPONENT	spanning from post to post. The top cable assembly slides into			
	grooves of the Composite C Post T&G Fit allowing the cable to rest in			
	the grooved portion of the top Hollow T&G Picket			
BOTTOM ALIGNMENT	Base Cable Assembly (Broad Stop) to Post: One, 1-5/8 in wide by 4 in			
COMPONENT /	tall by 7/8 in deep Support block T&G Fit located at each bottom end			
GROUND CLEARANCE	of the post, attached to posts with two #10 x 1-3/4 in self-drilling			
SPACER	composite screws. The Support block T&G Fit includes a 1/16 in steel			
	7x7 strand core cable which spans from post to post			



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Test Specimen No. 3

SERIES/MODEL	8 ft NCterra Commercial Full Privacy Horizontal Fence			
DESCRIPTION	74 in wide by 96 in high (nominal) composite privacy fence			
PANELS	Fifteen, 6-3/8 in wide by 66 in long by 0.142 in thick Hollow T&G			
	Pickets, per panel			
POSTS	Two, 2-9/16 in wide by 131 in high by 2-5/8 in deep by 0.983 in thick			
	Composite C Post T&G Fit, attached to two, 5 in wide by 5 in deep by			
	131 in long by 1/2 in thick composite hollow posts with eight #10 x			
	1-3/4 in self-drilling composite screws, per panel. One 2-1/2 in wide			
	by 2-1/2 in long by 5/8 in deep plastic Top Cap inserted into the			
	routed space of the top of each Composite C Post T&G Fit and			
	secured with one #10 x 1-3/4 in self-drilling composite screw.			
TOP ALIGNMENT	Top Cable Assembly: One, 1/16 in steel 7x7 strand core cable			
COMPONENT	spanning from post to post. The top cable assembly slides into			
	grooves of the Composite C Post T&G Fit allowing the cable to rest in			
	the grooved portion of the top Hollow T&G Picket			
BOTTOM ALIGNMENT	Base Cable Assembly (Broad Stop) to Post: One, 1-5/8 in wide by 4 in			
COMPONENT /	tall by 7/8 in deep Support block T&G Fit located at each bottom end			
GROUND CLEARANCE	of the post, attached to posts with two #10 x 1-3/4 in self-drilling			
SPACER	composite screws. The Support block T&G Fit includes a 1/16 in steel			
	7x7 strand core cable which spans from post to post			



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SECTION 8

TEST RESULTS

Test Specimen No. 1 - 6 ft NCterra Full Privacy Horizontal Fence

Test Date: 12/05/23

WIND	DURATION	MAXIMUM DEFLECTION (in)					
SPEED		LEFT	LEFT		RIGHT		
		ТОР	MID	BOTTOM	ТОР	MID	BOTTOM
30 mph	120 sec.	0.57	0.33	0.03	0.52	0.35	0.09
40 mph	90 sec.	0.99	0.47	0.10	1.08	0.58	0.15
50 mph	72 sec.	2.07	1.13	0.27	1.95	1.05	0.23
Permanent	t Set	0.03	0.04	0.05	0.04	0.06	0.06
60 mph	60 sec.	3.35	1.71	0.35	2.72	1.43	0.36
70 mph	51 sec.	3.40	1.87	0.55	3.04	1.72	0.43
80 mph	45 sec.	4.45	2.36	0.79	4.39	2.41	0.56
Permanent	t Set	0.51	0.27	0.06	0.46	0.18	0.04
90 mph	40 sec.	6.96	3.40	0.84	6.23	3.28	0.73
100 mph	36 sec.	8.01	4.27	1.26	7.66	4.15	0.91
115 mph	31 sec.						
Permanent	t Set						

Observation: Specimen failed upon reaching 115 mph target. Posts sheared at base.

Maximum Sustained Wind, $V_{fm} = 100 \text{ mph}$ Equivalent 3-second gust, $V_{3s, ASD} = (1.05 \times V_{fm}) + 10.5 = 116 \text{ mph}$ Equivalent 3-second gust, $V_{3s, LRFD} = \frac{V_{3s, ASD}}{\sqrt{0.6}} = 150 \text{ mph}$



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Test Specimen No. 2 - 6 ft *NCterra* Commercial Full Privacy Horizontal Fence Test Date: 12/05/23

WIND	DURATION	MAXIMUM DEFLECTION (in)						
SPEED	SPEED		LEFT			RIGHT		
		ТОР	MID	BOTTOM	ТОР	MID	BOTTOM	
30 mph	120 sec.	0.32	0.21	0.10	0.31	0.27	0.14	
40 mph	90 sec.	0.55	0.35	0.16	0.50	0.41	0.18	
50 mph	72 sec.	0.83	0.54	0.25	0.76	0.61	0.26	
Permanent	t Set	0.17	0.08	0.03	0.11	0.06	0.00	
60 mph	60 sec.	1.23	0.84	0.42	1.05	0.78	0.36	
70 mph	51 sec.	1.53	0.96	0.46	1.42	0.95	0.40	
80 mph	45 sec.	1.95	1.22	0.60	1.61	1.14	0.50	
Permanent	t Set	0.44	0.20	0.05	0.27	0.12	0.00	
90 mph	40 sec.	2.29	1.54	0.69	2.47	1.65	0.69	
100 mph	36 sec.	2.67	1.88	0.84	2.57	1.67	0.79	
115 mph	31 sec.	3.31	2.29	1.07	¹	2.34	1.07	
Permanent	t Set	0.75	0.33	0.09		0.25	0.06	
120 mph	30 sec.	3.34	2.29	1.09		2.75	1.23	
130 mph	28 sec.	4.19	2.97	1.43		3.14	1.43	
Permanent	t Set	1.17	0.45	0.16		0.39	0.11	

¹ Top right transducer fell off of the specimen.

Maximum Sustained Wind, $V_{fm} = 130 \text{ mph}$ Equivalent 3-second gust, $V_{3s, ASD} = (1.05 \times V_{fm}) + 10.5 = 147 \text{ mph}$ Equivalent 3-second gust, $V_{3s, LRFD} = \frac{V_{3s, ASD}}{\sqrt{0.6}} = 190 \text{ mph}$



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Test Specimen No. 3 - 8 ft *NCterra* Commercial Full Privacy Horizontal Fence Test Date: 12/06/23

WIND	DURATION	MAXIMUM DEFLECTION (in)						
SPEED		LEFT			RIGHT			
		ТОР	MID	BOTTOM	ТОР	MID	BOTTOM	
30 mph	120 sec.	0.21	0.12	0.03	0.32	0.21	0.06	
40 mph	90 sec.	0.47	0.30	0.07	0.59	0.37	0.11	
50 mph	72 sec.	0.91	0.50	0.13	0.97	0.64	0.16	
Permanent	t Set	0.08	0.04	0.00	0.02	0.02	0.01	
60 mph	60 sec.	1.80	0.86	0.21	1.57	1.00	0.25	
70 mph	51 sec.	2.26	1.17	0.26	2.00	1.17	0.30	
80 mph	45 sec.	2.62	1.52	0.30	2.71	1.63	0.42	
Permanent	t Set	0.38	0.17	0.01	0.25	0.14	0.02	
90 mph	40 sec.	3.78	2.09	0.45	3.23	2.10	0.55	
100 mph	36 sec.	4.47	2.64	0.50	4.21	2.45	0.66	
115 mph	31 sec.	5.60	3.25	0.65	5.13	3.14	0.78	
Permanent	t Set	0.86	0.39	0.05	0.65	0.34	0.00	
120 mph	30 sec.	6.80	3.54	0.74	6.72	4.02	1.01	
130 mph	28 sec.	8.70	4.59	1.01	8.42	4.62	1.18	
Permanent	t Set	1.16	0.51	0.27	1.26	0.52	0.03	

Maximum Sustained Wind, $V_{fm} = 130 \text{ mph}$ Equivalent 3-second gust, $V_{3s, ASD} = (1.05 \text{ x } V_{fm}) + 10.5 = 147 \text{ mph}$ Equivalent 3-second gust, $V_{3s, LRFD} = \frac{V_{3s,ASD}}{\sqrt{0.6}} = 190 \text{ mph}$



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SECTION 9

PHOTOGRAPHS



Photo No. 1 Test Setup (Front Side) - Wind Generator Relative to Test Specimen



Photo No. 2 Test Setup (Back Side)



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Photo No. 3 8 ft *NCterra* Commercial Full Privacy Horizontal Fence (Front Side)



Photo No. 4 6 ft *NCterra* Full Privacy Horizontal Fence (Front Side)



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SECTION 10

DRAWINGS

The "As-Built" drawings for the various PVC privacy fence systems which follow have been reviewed by Intertek B&C and are representative of the project reported herein. Project construction was verified by Intertek B&C per the drawings included in this report. Any deviations are documented herein or on the drawings.





















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REVISION LOG

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1	01/26/24	12	Replaced Photo No. 4