



---

## ***APA Report T2010Q-03***

---

*Evaluation of APA Custom Product V-180  
to the Structural and Durability Requirements of  
CSA O325  
for  
Warmboard, Inc.  
Aptos, California*

*1-1/8-inch 24 o.c. Plywood*

---

©2009 APA - The Engineered Wood Association

***by Benjamin J. Herzog  
Technical Services Division  
January 13, 2010***

Accredited by



**ACCREDITED** TL-215



No. 89

**REPRESENTING THE ENGINEERED WOOD INDUSTRY**

7011 South 19th Street • Tacoma, Washington 98466-5333 • Phone: (253) 565-6600 • Fax: (253) 565-7265 • [www.apawood.org](http://www.apawood.org)

*Evaluation of APA Custom Product V-180  
to the Structural and Durability Requirements of  
CSA O325  
for  
Warmboard, Inc.  
Aptos, California*

*1-1/8-inch 24 o.c. Plywood*

**SUMMARY**

This report contains results of qualification testing and product evaluation of 1-1/8-inch thick plywood panels manufactured and processed for Warmboard, Inc., Aptos, California.

Panels described in the Product Description section of this report have been previously evaluated under the *APA Custom Product Program* for suitability as floor panels in a radiant heat system. As described previously in APA Report T2002Q-37, the plywood panels manufactured and processed for Warmboard, Inc., satisfied the requirements of tests methods deemed suitable for this application from the *APA Rated Sturd-I-Floor Standard*.

The objective of the testing described herein was to supplement the previous evaluation in order to evaluate the plywood as a single floor panel in conformance to the CSA Construction Sheathing Standard, CSA O325-09.

The 1-1/8-inch thick plywood panels manufactured and processed for Warmboard, Inc., satisfied the requirements for CSA Construction Sheathing with a Single Floor – 24 Span Rating. As a result of the testing described herein, as well as the previous testing, an APA Custom Product V-180 trademark may be applied to the 1-1/8-inch panels with a 24 o.c. Span Rating.

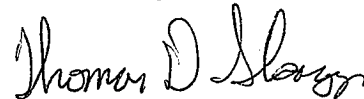
Reported by:



---

BENJAMIN J. HERZOG  
Staff Scientist  
Technical Services Division

Reviewed by:



---

THOMAS D. SKAGGS, Ph.D., P.E.  
Manager, Product Evaluation  
Technical Services Division

This report shall not be reproduced except in full and only with the written approval of *APA - The Engineered Wood Association* laboratory management.

Accredited by



TL-215



No. 89

## **LABORATORY ACCREDITATIONS AND LISTINGS HELD BY APA**

APA – *The Engineered Wood Association* is committed to providing its clients with high-quality service and information through documented test procedures and thorough, accurate collection of data. As a part of that commitment, a Quality Program has been established by APA based on the international document ISO/IEC Guide 17025: *General Requirements for the Competence of Testing and Calibration Laboratories*. The APA Quality Program follows the Accreditation Criteria and Requirements for Testing Organizations (CAN-P-4) and National Accreditation Program for Testing Organizations, Standards Council of Canada (SCC). APA is accredited or listed as a testing laboratory for specific scopes by the following agencies (certification agency accreditations also shown where applicable):

- Standards Council of Canada (SCC), as an accredited Testing Organization (No. 89)
- Standards Council of Canada (SCC), as an accredited Certification Body
- International Accreditation Service (IAS), as an accredited Testing Laboratory (TL-215)
- International Accreditation Service (IAS), as an accredited Inspection Agency (AA-649)
- Japanese Ministry of Agriculture, Forestry, and Fisheries (MAFF), as a Registered Foreign Certification Organization (RFCO), Notification No. 414: May 10, 2002
- City of Los Angeles, as a Compliance Assurance and Testing Agency (No. 22192)
- Miami-Dade County, as a Testing Laboratory (Certification No. 00-1114.02)
- The Florida Department of Committee Affairs, as a Product Testing Laboratory (TST2513)
- The Florida Department of Committee Affairs, as a Product Quality Assurance Entity (QUA2521)
- The Florida Department of Committee Affairs, as a Product Validation Entity (VAL3120)

This report contains data generated through testing of engineered wood products according to various test methods. Many accepted test methods conducted by APA are accredited or listed by organizations listed above. A list of methods is available upon request. Any test data in this report that is derived from test methods, which deviate from accepted procedure are noted. Accreditation or listing does not constitute endorsement of this report by the accrediting or listing agency or government.

*The precision and bias of the test methods given in this report are being established.*

## TABLE OF CONTENTS

SUMMARY.....	1
TABLE OF CONTENTS.....	3
OVERVIEW.....	4
Introduction .....	4
Results of Qualification Tests.....	4
Conclusion .....	4
BOND PERFORMANCE TEST FOR PLYWOOD WITH KNOTS AND KNOTHOLES - CONCENTRATED STATIC AND IMPACT LOADS.....	5
Introduction .....	5
Performance Test.....	5
Performance Criteria .....	5
Test Results .....	5
BOND PERFORMANCE TEST FOR PLYWOOD WITH KNOTS AND KNOTHOLES - RADIAL PROBE .....	6
Introduction .....	6
Performance Test.....	6
Performance Criteria .....	6
Test Results .....	6
FASTENER HOLDING .....	7
Introduction .....	7
Performance Test.....	7
Performance Criteria .....	7
Test Results .....	7
MILL SPECIFICATION .....	8
APPENDIX.....	11
PRODUCT DESCRIPTION.....	12
Introduction .....	12
Material Description.....	12

# OVERVIEW

## Introduction

This report contains results of qualification testing and product evaluation of 1-1/8-inch thick plywood panels manufactured and processed for Warmboard, Inc., Aptos, California. Panels described in the Product Description section of this report have been previously evaluated under the *APA Custom Product Program* for suitability as floor panels in a radiant heat system. As described previously in APA Report T2002Q-37, the plywood panels manufactured and processed for Warmboard, Inc., satisfied the requirements of tests methods deemed suitable for this application from the *APA Rated Sturd-I-Floor Standard*.

The objective of the testing described herein was to supplement the previous evaluation in order to evaluate the plywood as a single floor panel in conformance to the CSA Construction Sheathing Standard, CSA O325-09. The 1-1/8-inch thick plywood panels manufactured and processed for Warmboard, Inc., satisfied the requirements for CSA Construction Sheathing with a Single Floor – 24 Span Rating. As a result of the testing described herein, as well as the previous testing, an APA Custom Product V-180 trademark may be applied to the 1-1/8-inch panels with a 24 o.c. Span Rating.

A description of each performance test is presented in this report. The areas of investigation included:

**Structural Performance.** Testing was conducted to verify resistance to deflection and damage under concentrated static and impact loads applied at the location of the maximum knot or knothole. Fastener-holding resistance tests were also conducted; including direct withdrawal loads and the single-shear resistance of a nail to lateral movement of the panel.

**Physical Properties.** Delamination associated with knots and knotholes in plywood panels was evaluated.

## Results of Qualification Tests

Summaries of each test appear in the body of this report. Following is a brief summary of the results.

**Structural Performance.** The plywood satisfied the bond performance test for plywood with knots and knotholes. The plywood also satisfied the fastener-holding resistance test requirements for Single Floor panels with a 24 o.c. Span Rating.

**Physical Properties.** The plywood satisfied the performance requirements for delamination associated with knots and knotholes.

## Conclusion

The 1-1/8-inch thick plywood panels manufactured and processed for Warmboard, Inc., have been tested and meet all the structural and durability requirements of CSA O325 with a Single Floor – 24 Span Rating. When manufactured according to the Mill Specification at the end of this report and installed according to the manufacturer's requirements, an APA Custom Product V-180 trademark may be applied to the 1-1/8-inch panels with a 24 o.c. Span Rating.

# **BOND PERFORMANCE TEST FOR PLYWOOD WITH KNOTS AND KNOTHOLES - CONCENTRATED STATIC AND IMPACT LOADS**

## **Introduction**

Structural-use panels are required to withstand concentrated static and impact loads. Concentrated static loads are imposed during construction by workers and by various construction equipment. In service, concentrated loads are imposed by the supporting feet of water heaters, appliances and furniture. Impact loads can result from people jumping or when objects are dropped. Performance tests and associated criteria have been developed to simulate these field conditions.

The bond performance test for plywood with knots and knotholes is a moisture cycle and loading procedure for verifying resistance to deflection and damage under concentrated static and impact loads applied at the location of the maximum knot or knothole. The method is used to evaluate knots and knotholes greater than 2 inches but not exceeding 3 inches in width measured across the grain of Exposure 1 plywood panels.

## **Performance Test**

Panels are subjected to concentrated static loads applied through a 3-inch diameter loading disc. Impact loads are applied by incremental drops of a 30- or 60-lb shotbag, and are followed by a concentrated static load. Panels are performance tested in the wet/redry condition. These procedures follow ASTM Standard E 661 as modified in 7.18.3 of CSA O325.

## **Performance Criteria**

Performance criteria under concentrated loads are based on an extensive study of actual construction and service loads found in light-frame construction, requirements of building codes, as well as the generally acceptable performance of plywood. Panels that meet these performance levels should perform adequately in service under concentrated loads.

## **Test Results**

Panels described in this report were evaluated for performance under concentrated static and impact loads. Test results along with comparisons made to the appropriate performance criteria appear in the Appendix.

# **BOND PERFORMANCE TEST FOR PLYWOOD WITH KNOTS AND KNOTHOLES - RADIAL PROBE**

## **Introduction**

This method defines a procedure for determining delamination associated with knots and knotholes in plywood panels.

## **Performance Test**

Each specimen is cut into 8 sectors with radii intersecting at the center of the knot or knothole. The area surrounding the knot or knothole is visibly inspected for delamination. Where separations are visible, the probe is inserted with a force of  $8\pm 1$  lbf. No prying action or lateral movement is applied.

For each sector, the radial distance from the tip of the sector to the boundary of separation beyond the knot or knothole is measured along both edges of the sector and recorded. Where a separation is not found, the distance from the tip of the sector to the boundary of the knot or knothole is measured and recorded.

Panels are tested in the wet/redry condition. These procedures follow Section 7.19 of CSA O325.

## **Performance Criteria**

The total area of separation for each specimen shall be calculated as:

$$A = \pi r^2$$

Where: A = total area of separation (in.<sup>2</sup>)

r = average radius of separation, calculated as the average of 16 distances (measured at edges of sectors) from the tips of the sectors to either the boundary of separation or the boundary of the knot or knothole (in.)

For each lot of 20 specimens, 95% of the samples with knots and/or knotholes tested shall not exhibit delamination extending radially more than 3/4 inch beyond the boundary of the knot or knothole and across the width of a full sector or the continuous equivalent of the width of a full sector.

## **Test Results**

Panels described in this report were evaluated for delamination associated with knots and knotholes. Test results along with comparisons made to the appropriate performance criteria appear in the Appendix.

# **FASTENER HOLDING**

## **Introduction**

Fastener holding on sheathing or single-panel flooring may affect overall performance if the panel cannot resist service loads that exist between the framing and the panel. Two types of fastener holding tests were conducted: single-shear resistance of a nail to lateral movement of a panel, and direct nail withdrawal.

## **Performance Test**

Lateral load tests are performed following the procedures of Section 7.4.3 of CSA O325. Fasteners are 8d common nails. Nail heads lay flush with the panel surface in all tests. The test specimen is loaded continuously and the ultimate load is recorded. Panels are tested in the dry condition (as-received) and in the wet-redry condition (following a three-day exposure to continuous wetting followed by testing dry).

Withdrawal tests are performed following the procedures of Section 7.4.3 of CSA O325 and ASTM D 1761. Fasteners are 8d common nails. Nails are driven through the panel perpendicular to the face and at least 1/2 inch of the shank portion shall project above the surface of the material. The test specimen is loaded continuously and the ultimate load is recorded. Panels are tested in the dry condition (as-received) and in the wet-redry condition (following a three-day exposure to continuous wetting followed by testing dry).

## **Performance Criteria**

Performance criteria for nail lateral and withdrawal load tests are as given in CSA O325.

## **Test Results**

Panels described in this report were evaluated for performance under nail lateral loads and nail withdrawal loads. Test results along with comparisons made to the appropriate performance criteria appear in the Appendix.

## ***MILL SPECIFICATION***

Following is the Mill Specification used under the APA Quality Assurance Policy. Should conditions change, the manufacturer is free to request a change in a Mill Specification, so long as the product change is demonstrated to be satisfactory with regard to the performance criteria under which the product was qualified.

# APA Confidential Mill Specification

**Serial No:** Ply-911  
**Mill No:** 487  
**Company:** Warmboard, Inc.  
**Address:** 8035 Soquel Ave, Suite 41A  
 Aptos, CA 95003-3948  
**Product or Grade:** Cp-D  
**Standard:** APA Custom Product V-180  
**Span Index:** 24 o.c.  
**Exposure:** EXPOSURE 1

**Revision:** 6 : October 23, 2009  
**Supersedes:** 5 : April 22, 2009  
**Issue Date:** July 25, 2002  
**Report:** T2002Q-37  
**Second Mill Approval Procedure:** No

**Nominal Thickness:** 1-1/8  
**Minimum Thickness:** 1.065  
**Measured After - :** PRESSING

## Panel Construction

**Number of plies:**  **Number of layers:**

Ply No.	Nominal Veneer Thickness (in.)	Veneer Direction	Species of Veneer
1:	1/6	1	Douglas-fir
2:	1/6	2	White fir
3:	1/6	1	White fir
4:	1/6	2	White fir
5:	1/6	1	White fir
6:	1/6	2	White fir
7:	1/6	1	Douglas-fir
8:			
9:			
10:			
11:			
12:			
13:			

1: Along Strength Axis  
 2: Across Strength Axis

**Face Grade:** Cp-grade per PS 1  
**Back Grade:** D-grade per PS 1  
**Inner Plies Grade:** Per PS 1  
**Groove Description:** See attached supplement.

## Reference Values

Test Procedure	Along Major Axis	Across Major Axis	Requirements
Stiffness (lb-in <sup>2</sup> /ft)	1,514,000		Average >= Reference Value
Strength (lb-in /ft)	5,950		Minimum >= Reference Value

**Note:** Douglas-fir. Minimum net thickness 0.370". Span Rating of 24 o.c. based on application of panels with strength axis across supports. Reference values for stiffness and strength based on bending properties of panels after grooving. See attached supplement.

{APA Use Only}

**Change History:**

1. Revision based on testing and analysis.
2. Revision based on testing.
3. Revision based on testing and analysis.
4. Revision based on testing and analysis.
5. Revision based on analysis.
6. Approval of limber slots based on testing.

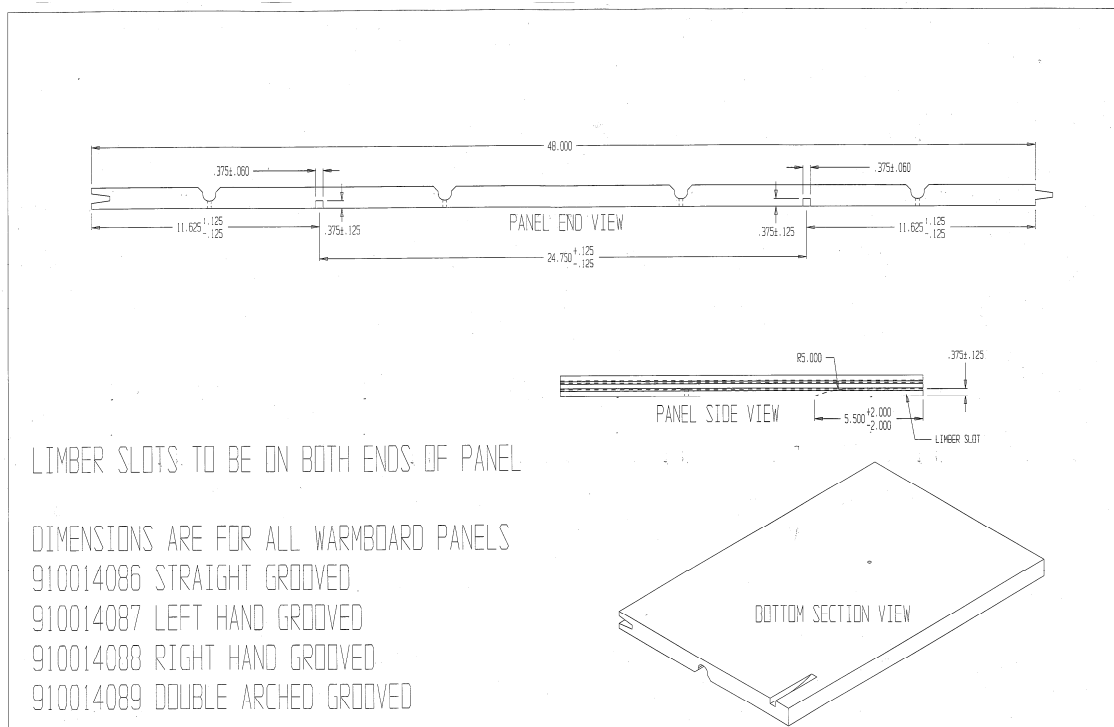
**Supplement to Mill Specification Serial No. PLY-911 for panel trademarked by Warmboard, Inc.**

All specifications and manufacturing parameters listed herein are part of the attached Mill Specification which is being issued under the APA Series Program for 1-1/8" plywood at a 24 o.c. Span Rating. The base panels shall be manufactured by Swanson Group Manufacturing LLC in Glendale, Oregon, or Murphy Plywood Company in Eugene, Oregon, or Roseburg Forest Products Company in Coquille, Dillard, or Riddle, Oregon.

Grooves spaced 12" o.c. are cut into the panel surface to accommodate tubes filled with warm water for a radiant floor heating system. Cross-panel grooves are spaced 9" from the end of the panel to the center of the groove. Target width of the grooves is  $.680 + .000 / - .015$ ". Target depth of the grooves is  $.690 + .010 / - .010$ ". Groove depth is subject to minimum net thickness of the panel except that an additional  $.060$ " may be removed in limited areas shown in the Warmboard Product Quality Control Manual, drawing number 910014088 (Revision B, dated June 25, 2002). Grooving shall be done by Bentwood in Junction City, Oregon or Metalfx in Willits, California.

Limber slots (2) are permitted to be on the back of the panel at both ends. Target width of the slots is  $0.375 \pm 0.60$ ". Target depth of the slots is  $0.375 \pm 0.125$ ". The limber slot is targeted at 5-1/2:" in length. The slots are located  $11.625 \pm 0.125$ " from the panel sides, and are installed at a  $24.750 \pm 0.125$ " on-center spacing. (See figure below.)

Reference values are based on properties of the base panel after sanding and grooving. The panel is sanded to a target thickness of  $1.075 + .010 / - .010$ " prior to applying  $.025$ " thick aluminum overlay which is molded into the grooves before installing the warm water tubing. The aluminum overlay shall be applied by Metalfx in Willits, California.



## ***APPENDIX***

## PRODUCT DESCRIPTION

### Introduction

Plywood panels with a nominal thickness of 1-1/8 inch were submitted by Warmboard, Inc. to APA - The Engineered Wood Association for evaluation as Single Floor - 24. Twenty 4x8-foot panels with a 7-ply, 7-layer construction were submitted.

### Material Description

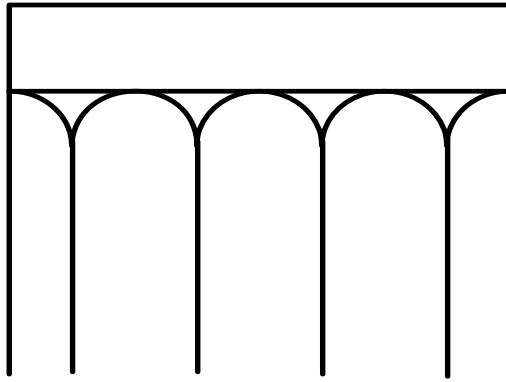
Panels described in this section have been previously evaluated under the *APA Custom Product Program* for suitability as floor panels in a radiant heat system. As described previously in APA Report T2002Q-37, the plywood panels manufactured and processed for Warmboard, Inc., satisfied the requirements of tests methods deemed suitable for this application from the *APA Rated Sturd-I-Floor Standard*.

As reported by the manufacturer, the plywood panels were manufactured from Douglas-fir face and back veneers and white fir inner plies. The layup is shown below:

Ply No.	Layer Thickness (inch)	Layer Direction	Layer Description
1	1/6	Parallel	Douglas-fir
2	1/6	Perpendicular	White fir
3	1/6	Parallel	White fir
4	1/6	Perpendicular	White fir
5	1/6	Parallel	White fir
6	1/6	Perpendicular	White fir
7	1/6	Parallel	Douglas-fir

The panels were tongue-and-grooved on the edges. They also contained grooves routed into the face surface of the base panel. These grooves were targeted to be approximately .690-inch deep and .680-inch wide and were spaced 12 inches apart starting at 6 inches from the panel edge (see Figure 1). Panels used in the field of the floor system contain straight grooves that are parallel to the long panel direction. End panels contain curved grooves to provide a continuous loop through the floor system. As shown in Figure 1, the cross-panel grooves are part of a “turnaround loop” which provides continuous waterflow in polyethylene tubes through the floor system. The width of the grooves at the juncture of the cross-panel groove and the turnaround grooves was targeted to be approximately 1.070 inches. For the testing described herein, end panels, i.e., panels containing the “turnaround loop”, were used.

After grooving, the panels were overlaid with .025-inch thick aluminum. The aluminum overlay is pressed into the grooves to accommodate polyethylene tubing used to conduct warm water through the floor system.



**Figure 1. Grooving pattern for panels with turnaround loop**

TABLE 1. Bond Performance Test for Plywood with Knots and Knotholes. Concentrated wet/redry static load test results according to Section 7.18 of CSA O325.

Test Date: December 16, 2009  
 Company: Warmboard, Inc.  
 Location: Aptos, California  
 Product: 1-1/8-inch 7ply, 7 layer Cp-D Douglas-fir plywood with white fir innerplies

		<b>APA Custom Product V-180</b>
		<b>24 o.c.</b>
<b>Deflection at 200 lbs</b>  Data is in inches	1	0.028
	2	0.024
	3	0.065
	4	0.024
	5	0.023
	6	0.046
	7	0.035
	8	0.044
	9	0.026
	10	0.030
Statistics:		
Minimum (in.)		0.023
Maximum (in.)		0.065
Mean (in.)		0.035
Standard Deviation (in.)		0.014
Coefficient of Variation (%)		39.1
Performance Criteria:		
Maximum Defl. (in.)		0.108
Number [pass/fail]		10/0
<b>RESULT</b>		<b>PASS</b>
<b>Ultimate Concentrated Load</b>  Data is in pounds	1	550
	2	550
	3	550
	4	550
	5	550
	6	550
	7	550
	8	550
	9	550
	10	550
Statistics:		
Minimum (lbf)		550
Maximum (lbf)		550
Mean (lbf)		550
Standard Deviation (lbf)		na
Coefficient of Variation (%)		na
Performance Criteria:		
Minimum Load (lbf)		550
Number [pass/fail]		10/0
<b>RESULT</b>		<b>PASS</b>

Note: Specimens were loaded to 550 lbf only.

TABLE 2. Bond Performance Test for Plywood with Knots and Knotholes. Concentrated wet/redry static load test results according to Section 7.18 of CSA O325.

Test Date: December 16, 2009  
 Company: Warmboard, Inc.  
 Location: Aptos, California  
 Product: 1-1/8-inch 7ply, 7 layer Cp-D Douglas-fir plywood with white fir innerplies

		<b>APA Custom Product V-180</b>
		<b>24 o.c.</b>
<b>Deflection at 200 lbs</b>  Data is in inches	1	0.026
	2	0.036
	3	0.069
	4	0.025
	5	0.034
	6	0.054
	7	0.036
	8	0.058
	9	0.037
	10	0.052
Statistics:		
Minimum (in.)		0.025
Maximum (in.)		0.069
Mean (in.)		0.043
Standard Deviation (in.)		0.015
Coefficient of Variation (%)		34.3
Performance Criteria:		
Maximum Defl. (in.)		0.108
Number [pass/fail]		10/0
<b>RESULT</b>		<b>PASS</b>
<b>Ultimate Concentrated Load</b>  Data is in pounds	1	400
	2	400
	3	400
	4	400
	5	400
	6	400
	7	400
	8	400
	9	400
	10	400
Statistics:		
Minimum (lbf)		400
Maximum (lbf)		400
Mean (lbf)		400
Standard Deviation (lbf)		na
Coefficient of Variation (%)		na
Performance Criteria:		
Minimum Load (lbf)		400
Number [pass/fail]		10/0
<b>RESULT</b>		<b>PASS</b>

Note: Specimens were loaded to 400 lbf only.

TABLE 3. Direct nail withdrawal test results according to Section 7.4 of CSA O325. Specimens tested in the dry (as-received) condition.

Test Date: January 11, 2010  
 Company: Warmboard, Inc.  
 Location: Aptos, California  
 Product: 1-1/8-inch 7ply, 7 layer Cp-D Douglas-fir plywood with white fir innerplies

		APA Custom Product V-180		
		24 o.c.		
		Panel Thickness (in.)	Nail Diameter (in.)	Nail Withdrawal (lbf)
1		1.108	0.130	142
2		1.104	0.130	170
3		1.103	0.130	233
4		1.101	0.131	170
5		1.105	0.130	176
6		1.101	0.130	156
7		1.099	0.130	139
8		1.098	0.130	77
9		1.105	0.130	106
10		1.101	0.130	92
11		1.104	0.130	206
12		1.098	0.130	137
13		1.097	0.130	117
14		1.104	0.130	118
15		1.099	0.130	202
16		1.099	0.130	214
17		1.101	0.130	221
18		1.096	0.130	315
19		1.102	0.130	177
20		1.101	0.130	149
Statistics:				
Minimum		77		
Maximum		233		
Mean		146		
Standard Deviation		46.1		
Coefficient of Variation (%)		31.6		
Performance Criteria:				
Maximum Defl.		20		
Number [pass/fail]		20/0		
<b>RESULT</b>		<b>PASS</b>		

TABLE 4. Direct nail withdrawal test results according to Section 7.4 of CSA O325. Specimens tested in the wet/redry condition.

Test Date: January 12, 2010  
 Company: Warmboard, Inc.  
 Location: Aptos, California  
 Product: 1-1/8-inch 7ply, 7 layer Cp-D Douglas-fir plywood with white fir innerplies

		APA Custom Product V-180		
		24 o.c.		
		Panel Thickness (in.)	Nail Diameter (in.)	Nail Withdrawal (lbf)
	1	1.118	0.130	112
	2	1.115	0.130	111
	3	1.123	0.131	106
	4	1.129	0.130	195
	5	1.149	0.130	117
	6	1.150	0.131	156
	7	1.131	0.130	223
	8	1.121	0.130	183
	9	1.126	0.130	150
	10	1.128	0.130	194
	11	1.130	0.131	149
	12	1.107	0.130	104
	13	1.119	0.130	143
	14	1.134	0.130	124
	15	1.136	0.130	231
	16	1.121	0.130	124
	17	1.130	0.130	127
	18	1.136	0.130	144
	19	1.123	0.130	106
	20	1.133	0.129	122
Statistics:				
Minimum		106		
Maximum		223		
Mean		155		
Standard Deviation		42.5		
Coefficient of Variation (%)		27.5		
Performance Criteria:				
Maximum Defl.		15		
Number [pass/fail]		20/0		
<b>RESULT</b>		<b>PASS</b>		

TABLE 5. Nail lateral loads test results according to Section 7.4 of CSA O325.

Test Date: January 13, 2010  
 Company: Warmboard, Inc.  
 Location: Aptos, California  
 Product: 1-1/8-inch 7ply, 7 layer Cp-D Douglas-fir plywood with white fir innerplies

		<b>APA Custom Product V-180</b>	
		<b>24 o.c.</b>	
		<b>Dry</b>	<b>Wet/Redry</b>
Data is in pounds (lbf)	1	210	160
	2	210	160
	3	210	160
	4	210	160
	5	210	160
	6	210	160
	7	210	160
	8	210	160
	9	210	160
	10	210	160
	11	210	160
	12	210	160
	13	210	160
	14	210	160
	15	210	160
	16	210	160
	17	210	160
	18	210	160
	19	210	160
	20	210	160
<b>Statistics:</b>			
Minimum (lbf)		210	160
Maximum (lbf)		210	160
Mean (lbf)		210	160
Standard Deviation (lbf)		na	na
Coefficient of Variation (%)		na	na
<b>Performance Criteria:</b>			
Minimum Load (lbf) – Dry		210	
Minimum Load (lbf) – Wet/Redry			160
Number [pass/fail]		20/0	20/0
<b>RESULT</b>		<b>PASS</b>	<b>PASS</b>

Note: Dry specimens were loaded to 210 lbf only. Wet/Redry specimens were loaded to 160 lbf only.

TABLE 6. Radial probe test results according to Section 7.19 of CSA O325. Specimens tested in the wet/redry condition.

Test Date: January 12, 2010  
 Company: Warmboard, Inc.  
 Location: Aptos, California  
 Product: 1-1/8-inch 7ply, 7 layer Cp-D Douglas-fir plywood with white fir innerplies

	APA Custom Product V-180			
	24 o.c.			
	Avg. Boundary Radius (in.)	Delamination Beyond Boundary (in.)	Total Area of Separation	Result
1	1.15	0	4.15	Pass
2	1.26	0	5.01	Pass
3	1.25	0	4.90	Pass
4	1.25	0	4.89	Pass
5	1.46	0	6.69	Pass
6	1.48	0	6.88	Pass
7	1.46	0	6.69	Pass
8	1.34	0	5.68	Pass
9	1.23	0	4.71	Pass
10	1.89	0	11.21	Pass
11	1.41	0	6.28	Pass
12	1.26	0	5.00	Pass
13	1.08	0	3.68	Pass
14	1.36	0	5.78	Pass
15	1.27	0	5.03	Pass
16	1.06	0	3.50	Pass
17	1.05	0	3.49	Pass
18	1.29	0	5.22	Pass
19	1.21	0	4.57	Pass
20	1.11	0	3.90	Pass