



Test Report No: RJ2765	Date: January 29, 2014
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SAMPLE ID: Raptor Underlayment

SAMPLING DETAIL: Sampled by QAI Representative Edward Li on Sept. 24, 2013

DATE OF RECEIPT: Samples were received on September 24, 2013.

TESTING PERIOD: September 25, 2013 through January 29, 2014

AUTHORIZATION: Signed QAI Test Proposals MB-2013-090201-R1 dated 09/06/13.

TEST PROCEDURE: Testing was performed in accordance with ICC-ES AC 188, *ACCEPTANCE CRITERIA FOR ROOF UNDERLAYMENT*, Approved February 2012.

See subsequent pages of this report for detailed test procedures.

TEST RESULTS: Raptor Underlayment has met the requirements for ICC- ES AC188 (2012). See the following pages of this report for detailed test results.

Prepared By

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**Signed for and on behalf of
QAI Laboratories Inc.**

Chris Scoville, M. Sc.
Operations Manager



AC188 Test Results Summary

Table 1 – Test Summary

Test Description	Standard	Test Requirement	Test Results	Pass/Fail
Pliability	ASTM D146 section 14	No cracking shall occur when bent 90° at a uniform speed over a rounded corner of ½-inch radius.	No cracking occurred	Pass
Accelerated Aging	AC48 Section 4.7	No visible damage to the specimens such as cracking, chipping or delamination shall occur.	No visible damage Occurred	Pass
UV Exposure	AC48 Section 4.8	No visible surface or structural changes such as peeling, chipping, cracking, flaking or pitting shall occur when observed under a minimum of five-power magnification.	No Visible Changes Occurred	Pass
Tensile Strength	AC48 Sections 4.1, 4.7, 4.8 and ASTM D1970	Control, accelerated-aged, and ultraviolet samples shall have a minimum breaking strength of 25 lbf/in-width for both machine and cross-directions.	Control Samples: CD= 40 lbf, MD= 71 lbf	Pass
			Aged Samples: CD= 37 lbf, MD= 77 lbf	Pass
			UV Exposed Samples: CD= 40 lbf, MD= 80 lbf	Pass
Adhesion in Peel	N/A	This was not a requirement for this product, as it is not an adhered membrane.	N/A	N/A
Liquid Water Transmission	ASTM D4869 Section 8.3.5	Shall meet the “Pass” requirements of Section 8.3.5 of ASTM D4869	Pass	Pass
Cycling and Elongation	N/A	This was not a requirement for this product, as it is not an adhered membrane.	N/A	N/A

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Table 1 – Test Summary (Continued)

Unroll-ability	AC188 Section 3.2	The finished product shall not crack or become so sticky as to cause tearing or other damage, upon being unrolled at temperatures between 50°F and 140°F (10°C and 60°C).	No cracking, tearing or other damage was observed upon being unrolled at specified temperatures	Pass
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UNROLLABILITY TEST PER SECTION 3.2 OF ICC ES AC 188

Test Procedure: The sampled material was placed in an environmental chamber and conditioned for a minimum of 24 hours at a temperature of 50°F (10°C). The sampled material was then removed from the chamber and unrolled within 30 seconds from being removed from the chamber. The sampled roll was then placed back into the environmental chamber and conditioned for a minimum of 24 hours at a temperature of 140°F (60°C). The sampled material was then removed from the chamber and unrolled within 30 seconds from being removed from the chamber.

Test Requirements: The finished product shall not crack or become so sticky as to cause tearing or other damage, upon being unrolled at temperatures between 50°F and 140°F (10°C and 60°C).

Test Results: The sampled material did not crack or become so sticky as to cause tearing or other damage, when unrolled at temperatures of 50°F and 140°F (10°C and 60°C).

PLIABILITY TEST PER TABLE 1 OF ICC ES AC 188

Test Procedure: Testing was conducted in accordance with ASTM D226-06, *Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing*. Ten, 1-inch wide by 8-inch long specimens were cut from the sampled material, immersed in 77°F water for 15 minutes, removed from the water one at a time and bent 90° at a uniform speed over a rounded corner of ½-inch radius.

Test Requirements: No cracking shall occur when bent 90° at a uniform speed over a rounded corner of ½-inch radius.

Test Results: Table 2 – Pliability Test Results

Specimen #	Observations
1	No cracking occurred
2	No cracking occurred
3	No cracking occurred
4	No cracking occurred
5	No cracking occurred
6	No cracking occurred
7	No cracking occurred
8	No cracking occurred
9	No cracking occurred
10	No cracking occurred



ACCELERATED AGING PER TABLE 1 OF ICC ES AC 188

Test Procedure: Testing was conducted in accordance with Section 4.7 of ICC ES AC48. Six, 12-inch by 12-inch specimens were cut from the sampled material and subjected to 25 cycles of accelerated aging with each cycle consisting of oven drying at 120°F for three hours followed by immersion in water at room temperature (73°F) for three hours followed by air-drying for 18 hours at room temperature (73°F).

Test Requirements: No visible damage to the specimens such as cracking, chipping or delamination shall occur.

Test Results: Table 3 – Accelerated Aging Results

Specimen #	Observations
1	No visible damage occurred
2	No visible damage occurred
3	No visible damage occurred
4	No visible damage occurred
5	No visible damage occurred
6	No visible damage occurred

ULTRAVIOLET EXPOSURE PER TABLE 1 OF ICC ES AC 188

Test Procedure: Testing was conducted in accordance with Section 4.8 of ICC ES AC48. Two, 18-inch by 48-inch specimens were cut from the sampled material and subjected to 210 hours of UV exposure. The temperature of the specimens was maintained between 135°F and 140°F during the exposure period.

Test Requirements: No visible surface or structural changes such as peeling, chipping, cracking, flaking or pitting shall occur when observed under a minimum of five-power magnification.

Test Results: No visible damage to the specimens such as peeling, chipping, cracking, flaking or pitting occurred when observed under a minimum of five-power magnification.

TENSILE STRENGTH TEST PER TABLE 1 OF ICC ES AC 188

Test Procedure: Testing was conducted in accordance with Section 4.1 of ICC ES AC 48 and ASTM D1970. The test specimens were conditioned for 4 h at 23 ± 2°C [73.4 ± 3.6°F] and 50 ± 5% relative humidity prior to testing. Five specimens from each condition in both the longitudinal and transverse directions were prepared. The specimens were cut into strips with the dimensions of 25 mm [1 in.] ± 5% wide by a minimum 150 mm [6 in.] ± 5% long. A constant rate of elongation tension testing machine with automatic load and strain recording equipment and clamps that permitted a uniform clamping pressure on the specimen without slipping was used for testing.

Initial Grip Separation: 3 inches
 Crosshead Speed: 2 inches per minute
 Front Jaw face Size: 1 inch x 1 inch
 Rear Jaw face size: 1 inch x 3 inch

Test Requirements: Control, accelerated-aged, and ultraviolet samples shall have a minimum breaking strength of 25 lbf/in.-width for both machine and cross-directions.

Test Results:

Table 4 – Control Samples

Control Sample Machine Direction		Control Sample Cross-Machine Direction	
Specimen #	Breaking Strength (lbf/in.-width)	Specimen #	Breaking Strength (lbf/in.-width)
1	72.4	1	40.8
2	69.7	2	38.6
3	66.4	3	39.0
4	69.6	4	40.6
5	74.3	5	39.8
Average	70.5	Average	39.8

Table 5 – Aged Samples

Aged Sample Machine Direction		Aged Sample Cross-Machine Direction	
Specimen #	Breaking Strength (lbf/in.-width)	Specimen #	Breaking Strength (lbf/in.-width)
1	76.0	1	36.8
2	75.4	2	38.4
3	77.7	3	37.7
4	73.4	4	34.1
5	81.7	5	38.1
Average	76.8	Average	37.0



TENSILE STRENGTH TEST PER TABLE 1 OF ICC ES AC 188 (CONT.)

Test Results (Cont.)

Table 6 – UV Samples

UV Sample Machine Direction		UV Sample Cross-Machine Direction	
Specimen #	Breaking Strength (lbf/in.-width)	Specimen #	Breaking Strength (lbf/in.-width)
1	79.5	1	36.7
2	81.1	2	43.2
3	86.0	3	41.7
4	78.0	4	41.3
5	77.1	5	38.6
Average	80.3	Average	40.3

LIQUID WATER TRANSMISSION TEST PER TABLE 1 OF ICC ES AC 188

Test Procedure: Testing was performed in accordance with Section 8.3 of ASTM D 4869-05e1, *Standard Specification for Asphalt-Saturated (Organic Felt) Underlayment Used in Steep Slope Roofing*. Two pieces of the sampled A3 underlayment were individually mounted on two 15-inch by 30-inch by 3/8-inch thick pieces of plywood. The specimens were then conditioned for 24 hours at 73°F and 50% relative humidity. The specimens were positioned at a 20° incline with the shower head 18 inches above the center of the board. A water spray was applied to the top surface of the specimen over a 12 inch area at rate of 42 gallons per hour for a period of 4 hours. At the end of the test period the underlayment was removed from the plywood and the top and bottom surfaces inspected for wetness. The underlayment was also examined for deterioration by the action of water.

Requirement: Material shall meet the “pass” requirements of Section 8.3.5 of ASTM D 4869 as follows: No sign of any liquid water wetness on either specimen underside or top of plywood support or visible deterioration of the specimen.

Results: There were no signs of wetness on the top or bottom surfaces of the plywood on either specimen. No deterioration of either specimen was observed.

***** END OF REPORT*****