TEST REPORT

REPORT NUMBER: 100944599COQ-005
ORIGINAL ISSUE DATE: January 25, 2013

EVALUATION CENTER

INTERTEK TESTING SERVICES NA LTD.
1500 BRIGANTINE DRIVE
COQUITLAM, BC V3K 7C1

RENDERED TO

LINERLOCK INC.
1509 E. MCFADDEN AVENUE
SANTA ANA, CA
92705
USA

PRODUCT EVALUATED: LL 110 RU
EVALUATION PROPERTY: Physical Properties

Report of LL 110 RU Roofing Underlayment for compliance with the testing requirements of the following criteria: CAN/CSA A220.1 Series–06, *Concrete Roof Tiles*, revised May 2010

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1 Table of Contents

2 Introduction

Intertek Testing Services NA Ltd. (Intertek) has conducted a testing evaluation for LinerLock Inc. on an engineered roofing underlayment product identified as LL 110 RU. The evaluation was carried out to determine if the material would comply with Section 4.4 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles*, revised May 2010, as a roll underlayment over solid sheathing. This evaluation was completed during the month(s) of November 2012 to January 2013.

3 Test Samples

3.1. SAMPLE SELECTION

Intertek representative, Fred Soto, randomly sampled rolls of roofing underlayment on November 2, 2012. The sample selection process was conducted at LinerLock, Inc., 1509 E. McFadden Avenue, Santa Ana, CA, 92705. The product was selected in accordance with recognized independent sampling procedures, and was received at the Evaluation Center on November 9, 2012.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The sample was identified as the LL 110 RU, a 3-layer constructed synthetic roofing underlayment (Coquitlam ID# VAN1211090741-001). The product consists of a cross-woven polypropylene base scrim and is coated with an anti-slip coating on both sides. The weight is 2.2 lbs/100 ft² (3.3 oz/yd² or 105 g/m²) and standard roll size is 4 ft x 250 ft long (1.2 m x 76.2 m).

4 Testing and Evaluation Methods

4.1. CONDITIONING

All specimens were cut to the required dimensions using a straight edge and a sharp blade. Before testing, the test specimen materials were held in standard laboratory conditions for at least 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%.

4.2. WATER PERMEABILITY

The water permeability was conducted in accordance with Section 4.4.6.3 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles*. Five 100 mm × 130 mm specimens were cut and sealed onto the bottom of a plastic frame to give it a watertight seal. A 55 mm head of water was maintained on the specimen throughout the test. The sample was monitored every hour for the first 8 hours and after 24 hours for signs of water dripping. Specimens were tested in the “as received” condition, after ultraviolet exposure and after ultraviolet exposure followed by accelerated aging.

4.3. TENSILE STRENGTH

Tensile strength was conducted in accordance with Section 4.4.6.4 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles* and ASTM D828-97 (Reapproved 2002), *Standard Test Method for*

Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus. Five 25 mm x 230 mm specimens were cut in the roll direction and five in the cross roll direction. The testing was conducted using an Instron 3382 Universal Tester with an initial jaw separation of 180 mm and a crosshead speed of 25 mm per minute. Specimens were tested in the "as received" condition, after ultraviolet exposure and after ultraviolet exposure followed by accelerated aging.

4.4. PLIABILITY

Pliability was tested in accordance with Section 4.4.6.5 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles*. Five 25 mm × 200 mm specimens were cut in the machine direction. They were placed in an -18°C cold chamber for 24 hours prior to being bent over a 3 mm diameter steel mandrel through a 90° angle within 2 seconds. Each specimen was visually examined for signs of cracking or delamination. The samples were then put back in the cold chamber for 90 hours and bent over a 3 mm diameter steel mandrel through a 180° angle within two seconds and again each specimen was visually examined for signs of cracking or delamination Specimens were tested in the "as received" condition, after ultraviolet exposure and after ultraviolet exposure followed by accelerated aging.

4.5. PUNCTURE RESISTANCE

The puncture resistance was sent to an external facility for evaluation. Three 250 mm x 250 mm specimens were cut with the orientation of the specimen being noted. The test was conducted in accordance with TAPPI Standard T803-06. A full report is included in Appendix B.

4.6. LONG-TERM SAG

The long-term sag was tested in accordance with Section 4.4.6.7 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles*. A 300 mm x 1200 mm specimen was cut from the middle of a 450 mm x 1200 mm sample. The specimen was placed over three 50 mm nominal width rafters spaced at 600 ± 5 mm on center with the ends of the specimen nailed to the outmost rafters at a temperature of 38 ± 3°C. A 450 ± 10 g sand bag was placed at the center of each span. The initial sag at the center of each span was recorded and after 48 ± 0.25 h, the sag at the same locations was recorded again.

4.7. LINEAR DIMENSIONAL CHANGES

Tests for linear dimensional stability were conducted in accordance with ASTM D1204-08, *Standard Test Method for Linear Dimensional Changes of Non-rigid Thermoplastic Sheeting or Film at Elevated Temperatures*. Two pieces of the underlayment measuring 250 mm x 250 mm were cut, one from either edge and the other from the center of the sheet. The specimens were dusted with talc, placed in between two pieces of paper, then stored in oven at 85°C ± 1°C for 24h. After the oven exposure period, the specimens were reconditioned as per Section 4.1. The linear dimensional change was derived by the difference between the opposite edges of the specimens. The linear dimensional change was calculated as follows:

Linear change, % = $[(D_f-D_o)/D_o]$ x100

where: D_f = final length (or width) of specimen after test, mm
D_o = original length (or width) of specimen, mm

4.8. MOISTURE VAPOUR TRANSMISSION RATE

The water vapour transmission was determined as per ASTM E96-05, *Standard Test Methods for Water Vapour Transmission of Materials*, desiccant method. Four circular specimens of the material were prepared for testing. Three test dishes measuring 229 mm (9 in.) in diameter were filled with calcium chloride to within 6.4 mm (¼-in.) of the top. The circular specimens were then attached to the top of each dish by sealing the perimeter of the material to the dish with a molten wax blend. The specimens were prepared with the product exterior surface placed face up. An additional control specimen was prepared in an identical manner to the other three test specimens with the exception that no calcium chloride was placed in the dish. The four assemblies were placed in a controlled chamber operating at a temperature and relative humidity of 23°C and 50% respectively. The assemblies were then weighed periodically until 8 (eight) data points were obtained. The water-vapor transmission was calculated as follows:

$WVT = G/tA$

where: WVT = rate of water vapor transmission, g/m²s
G = weight change, g
t = time during which G occurred
A = test area, m²

4.9. ULTRAVIOLET EXPOSURE

Two 450 mm × 1200 mm specimens were prepared and exposed to ultraviolet sun lamps for 10 ± 0.2 hours a day for 21 days (210 ± 1 hour) as per Section 4.4.5.2 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles*. The lamps and enclosure were adjusted to maintain the specimens at a product temperature of between 55 and 60°C. Visual examination of the specimens was conducted after ultraviolet exposure for any evidence of surface or structural changes. One of the samples was then subjected to accelerated aging.

4.10. ACCELERATED AGING

Following UV exposure, one 450 mm × 1200 mm specimen was subjected to 25 cycles of accelerated aging in accordance with the procedure described in Section 4.4.5.3 of CAN/CSA A220.1 Series-06, *Concrete Roof Tiles*. During weekends and holidays, the accelerated aging process was suspended by holding the specimens in standard laboratory conditions. The cycling consists of oven drying for 3 hours, immersion in water for 3 hours, and then air-drying for a minimum of 18 hours. Visual examination of the specimen was made after accelerated aging for any evidence of surface or structural changes.

5 Testing and Evaluation Results

5.1. EXAMINATION OF RESULTS

The product test results, together with the applicable requirements of Table 1a, *Underlayment Performance Requirements* (*For Use Throughout Canada)* of CAN/CSA A220.1 Series-06, revised August 2008 are shown in Table 1 below (a full set of test data is included in Appendix A).

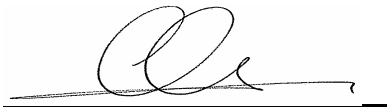
Table 1. CAN/CSA A220.1-06 Physical Properties – LL 110 RU

Property (Roll Underlayment)	Test Result	Requirement	Pass/Fail
Water Permeability			
• As Received	No dripping	No dripping	Pass
• After Ultraviolet Aging	No dripping	No dripping	Pass
• After Ultraviolet and Accelerated Aging	No dripping	No dripping	Pass
Tensile Strength, kN/m			
• As Received			
o Machine Direction	13.4	3.5 min.	Pass
o Cross – Machine Direction	6.8	3.5 min.	Pass
• After Ultraviolet Aging			
o Machine Direction	13.0	3.5 min.	Pass
o Cross – Machine Direction	12.9	3.5 min.	Pass
• After Ultraviolet and Accelerated Aging			
o Machine Direction	11.8	3.5 min.	Pass
o Cross – Machine Direction	10.2	3.5 min.	Pass
Pliability			
• As Received	No cracking	No cracking	Pass
• After Ultraviolet Aging	No cracking	No cracking	Pass
• After Ultraviolet and Accelerated Aging	No cracking	No cracking	Pass
Puncture Resistance, J			
• As Received	8.9	$\geq$ 0.34	Pass
• After Ultraviolet Aging	8.0	$\geq$ 0.34	Pass
• After Ultraviolet and Accelerated Aging	8.5	$\geq$ 0.34	Pass
Long-term Sag, %	1	≤ 5	Pass
Linear Dimensional Change, %			
• Length	2.6	≤ 3	Pass
• Width	2.9	≤ 3	Pass
Moisture Vapour Transmission, g/m^2-24 h	0.31	< 70	Pass

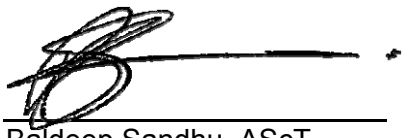
6 Conclusion

The LL 110 RU Underlayment product identified and evaluated in this report has met the physical requirements of Section 4.4 of CAN/CSA A220.1 Series–06, *Concrete Roof Tiles,* revised August 2008 for use throughout Canada as presented in Section 5 of this report.

INTERTEK TESTING SERVICES NA LTD.

Tested/Reported by: 

Chris Chang. EIT
Engineer, Building Products

Reviewed by: 

Baldeep Sandhu, AScT
Technologist, Building Products

APPENDIX A: Test Data (12 pages)

Company	LinerLock Inc.	Technician(s)	Geri Nishio
Project No.	G100944599	Reviewer	Baldeep Sandhu
Models	N/A	Start/End Date	Nov. 2012 - Jan.2012
Product Name	LL 110 RU	Sample ID	VAN1211090741-001
Standard	**CAN/CSA A220.1-06**		

Test Data Package

Table of Contents

Test:	**Water Permeability**
Date:	15-Nov-12
Client:	LinerLock
Project:	G100944599
Eng/Tech:	G. Nishio
Reviewer:	B. Sandhu
Product:	**LL 110 RU**
Test Method:	CAN/CSA A220.1
Exposure:	As Received, after Ultraviolet Light and after UV followed by Accelerated Aging
Ambient:	21°C, 50% RH, 07:59
Conditioning:	Min 40 hrs @ 21±2°C and 50% RH
Equipment:	Permeability test jigs with 60mm wall ht.
Sample size:	100mm x 130mm

Test Pressure	**As Received**				
(mm of water)	1	2	3	4	5
55	No Drip	No Drip	No Drip	No Drip	No Drip

Test Pressure	**After Ultraviolet Light**				
(mm of water)	1	2	3	4	5
55	No Drip	No Drip	No Drip	No Drip	No Drip

Test Pressure	**After UV followed by Accelerated Aging**				
(mm of water)	1	2	3	4	5
55	No Drip	No Drip	No Drip	No Drip	No Drip

Test: **Tensile Testing**
Date: 13-Nov-12
Client: LinerLock
Project: G100944599
Eng/Tech: G. Nishio
Reviewer: B. Sandhu
Product: **LL 110 RU**
Test Method(s): CAN/CSA A220.1
Exposure: **As Received**
Ambient: 12:26 PM/ 21.7°C/ 49 %RH
Conditioning: 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Equipment: Instron 3382 loading apparatus (Intertek ID# P60553, cal due July 2013)
Mitutoyo Digital Calipers (Intertek ID# P52652, cal due May 2013)
Sample size: 1"x10"
Gauge Length: 180 mm
Crosshead Speed: 25.4 mm/min

Machine direction				
Specimen	Width (m)	Max Load (N)	Max Load (kN)	Brk Str (kN/m)
1	0.025	333.95	0.334	**13.1**
2	0.025	342.70	0.343	**13.5**
3	0.025	338.78	0.339	**13.3**
4	0.025	348.27	0.348	**13.7**
5	0.025	332.85	0.333	**13.1**
Mean:		339.3	0.339	**13.4**
StdDev:		6.4	0.0	0.3
COV:		1.88%	1.88%	1.88%

Cross-machine direction				
Specimen	Width (m)	Max Load (N)	Max Load (kN)	Brk Str (kN/m)
1	0.025	163.63	0.164	**6.4**
2	0.025	168.39	0.168	**6.6**
3	0.025	161.84	0.162	**6.4**
4	0.025	182.19	0.182	**7.2**
5	0.025	184.10	0.184	**7.2**
Mean:		172.0	0.172	**6.8**
StdDev:		10.4	0.0	0.4
COV:		6.07%	6.07%	6.07%

Test: **Tensile Testing**
Date: 13-Dec-12
Client: LinerLock
Project: G100944599
Eng/Tech: G. Nishio
Reviewer: B. Sandhu
Product: **LL 110 RU**
Test Method(s): CAN/CSA A220.1
Exposure: **After 21d UV exposure**
Ambient: 21.6°C, 48% RH, 2:41 PM
Conditioning: 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Equipment: Instron 3382 loading apparatus (Intertek ID# P60553, cal due July 2013)
Mitutoyo Digital Calipers (Intertek ID# P52652, cal due May 2013)
Sample size: 1"x10"
Gauge Length: 180 mm
Crosshead Speed: 25.4 mm/min
Tested:

Machine direction				
Specimen	Width (m)	Max Load (N)	Max Load (kN)	Brk Str (kN/m)
1	0.025	340.1	0.340	**13.4**
2	0.025	343.2	0.343	**13.5**
3	0.025	325.3	0.325	**12.8**
4	0.025	329.0	0.329	**13.0**
5	0.025	318.8	0.319	**12.6**
Mean:		331.3	0.331	**13.0**
StdDev:		10.2	0.0	0.4
COV:		3.08%	3.08%	3.08%

Cross-machine direction				
Specimen	Width (m)	Max Load (N)	Max Load (kN)	Brk Str (kN/m)
1	0.025	321.1	0.321	**12.6**
2	0.025	323.5	0.324	**12.7**
3	0.025	328.8	0.329	**12.9**
4	0.025	338.3	0.338	**13.3**
5	0.025	327.9	0.328	**12.9**
Mean:		327.9	0.328	**12.9**
StdDev:		6.6	0.0	0.3
COV:		2.02%	2.02%	2.02%

Test:	**Tensile Testing**
Date:	18-Jan-13
Client:	LinerLock
Project:	G100944599
Eng/Tech:	G. Nishio GN
Reviewer:	B. Sandhu BS
Product:	**LL 110 RU**
Test Method(s):	CAN/CSA A220.1
Exposure:	**After 21d UV exposure and 25 cycles of accelerated aging**
Ambient:	22.1°, 48% RH, 12:37 PM
Conditioning:	24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Equipment:	Instron 3382 loading apparatus (Intertek ID# P60553, cal due July 2013)
	Mitutoyo Digital Calipers (Intertek ID# P52652, cal due May 2013)
Sample size:	1"x10"
Gauge Length:	180 mm
Crosshead Speed:	25.4 mm/min
Tested:	12:37PM/ 22.1°C/48.2%RH

As Received in machine direction				
Specimen	Width (m)	Max Load (N)	Max Load (kN)	Brk Str (kN/m)
1	0.025	307.1	0.307	**12.1**
2	0.025	317.6	0.318	**12.5**
3	0.025	334.1	0.334	**13.2**
4	0.025	296.5	0.297	**11.7**
5	0.025	237.9	0.238	**9.4**
Mean:		298.6	0.299	**11.8**
StdDev:		36.7	0.0	1.4
COV:		12.28%	12.28%	12.28%

As Received in cross-machine direction				
Specimen	Width (m)	Max Load (N)	Max Load (kN)	Brk Str (kN/m)
1	0.025	239.3	0.239	**9.4**
2	0.025	246.0	0.246	**9.7**
3	0.025	273.8	0.274	**10.8**
4	0.025	278.0	0.278	**10.9**
5	0.025	256.5	0.256	**10.1**
Mean:		258.7	0.259	**10.2**
StdDev:		16.9	0.0	0.7
COV:		6.54%	6.54%	6.54%

Intertek

Test: **Pliability**
Date: 15-Nov-12
Client: LinerLock
Project: G100944599
Eng./Tech: G. Nishio
Reviewer: B. Sandhu
Product: **LL 110 RU**
Test method: CAN/CSA A220.1
Exposure: 24 hrs @ -18 ± 2°C followed by 90 hrs @ -18 ± 2°C
Ambient: 23.4°C, 47% RH, 08:15,
Equipment: Cold Temperature Chamber
Fluke Thermometer (Intertek ID# 51295, cal due Feb 8, 2013)
3mm mandrel and test jig
Samp size: 1 in. x 8 ins. (25mm x 200mm)
Test Temp: 0°F (-18°C)
Test Method: Samples conditioned at -18°C for 24 hours before testing
Samples bent 90° around 1/8 inch mandrel in 2 s at -18°C
Sample then maintained at -18°C for 90 hours
Samples bent 180° around 1/8 inch mandrel in 2 s at -18°C

As Received

	Testing	Date:	Status
	After 24 hrs @ -18°C	Nov. 13	**Pass**
Sample Roll I - Machine Direction	After 90 hrs @ -18°C	Nov. 17	**Pass**

Specimen	Sample Orientation	Observations	
1	Weathering side up	no cracking or delamination	Pass
2	Weathering side up	no cracking or delamination	Pass
3	Weathering side up	no cracking or delamination	Pass
4	Weathering side up	no cracking or delamination	Pass
5	Weathering side up	no cracking or delamination	Pass

After UV Exposure

	Testing	Date:	Status
	After 24 hrs @ -18°C	Dec. 13	**Pass**
Sample Roll I - Machine Direction	After 90 hrs @ -18°C	Dec. 17	**Pass**

Specimen	Sample Orientation	Observations	
1	Weathering side up	no cracking or delamination	Pass
2	Weathering side up	no cracking or delamination	Pass
3	Weathering side up	no cracking or delamination	Pass
4	Weathering side up	no cracking or delamination	Pass
5	Weathering side up	no cracking or delamination	Pass

After UV Exp . Followed by Acc. Aging

	Testing	Date:	Status
	After 24 hrs @ -18°C	Jan.21	**Pass**
Sample Roll I - Machine Direction	After 90 hrs @ -18°C	Jan.25	**Pass**

Specimen	Sample Orientation	Observations	
1	Weathering side up	no cracking or delamination	Pass
2	Weathering side up	no cracking or delamination	Pass
3	Weathering side up	no cracking or delamination	Pass
4	Weathering side up	no cracking or delamination	Pass
5	Weathering side up	no cracking or delamination	Pass

Test:	**Long - Term Sag**
Date:	14-Nov-12
Client:	LinerLock
Project No:	**G100944599**
Technician(s):	G. Nishio
Reviewer:	B. Sandhu
Product:	**LL 110 RU**
Test Methods:	CAN/CSA A220.1
Exposure:	48 hrs in enclosed chamber with 4 100W incandescent light bulbs
Ambient:	22.3°C, 48% RH, 10:05
Conditioning:	24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Equipment:	Mitutoyo Digital Calipers (Intertek ID# P52652, cal due May 2013)
	Fluke Thermometer (Intertek ID# D2679, cal due May, 2013)

Sample size: 300mm x 1200mm

Span	Initial Height (mm)	Height after 48 hours (mm)	Final Sag (%)
1	317	315	**0.6**
2	314	311	**1.0**
		Mean:	**0.8**
		StdDev:	0.23
		COV:	28.93%

Test:	**Dimensional change**
Date:	14-Nov-12
Client:	LinerLock
Project No:	G100944599
Technician(s):	G. Nishio
Reviewer:	B. Sandhu
Product:	**LL 110 RU**
Method:	CAN/CSA A220.1
Exposure:	**24 hour @ 85 ± 1°C, followed by a minimum of 1 hr at 23°C and 50% RH.**
Ambient:	21.9°C, 48% RH, 10:30
Conditioning:	not less than 40 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Equipment:	Mitutoyo Digital Calipers (ID P53639, cal due November 2013)
	Temperature-controlled oven (ID 9-0477)
	Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
Specimen Size:	250 x250 mm

Initial Measurement		
Specimen	Length (mm)	Width (mm)
1	249.82	249.92
2	249.48	249.69
After Exposure - 24 hrs		
Specimen	Length (mm)	Width (mm)
1	242.81	242.47
2	243.32	242.86

Dimensional Stability		
Specimen	Length (%)	Width (%)
	24 hrs	24 hrs
1	-2.81%	-2.98%
2	-2.47%	-2.74%
Mean:	**-2.64%**	**-2.86%**
StdDev:	0.0	0.0

*Note: Negative value- shrinkage
Postive value- expansion

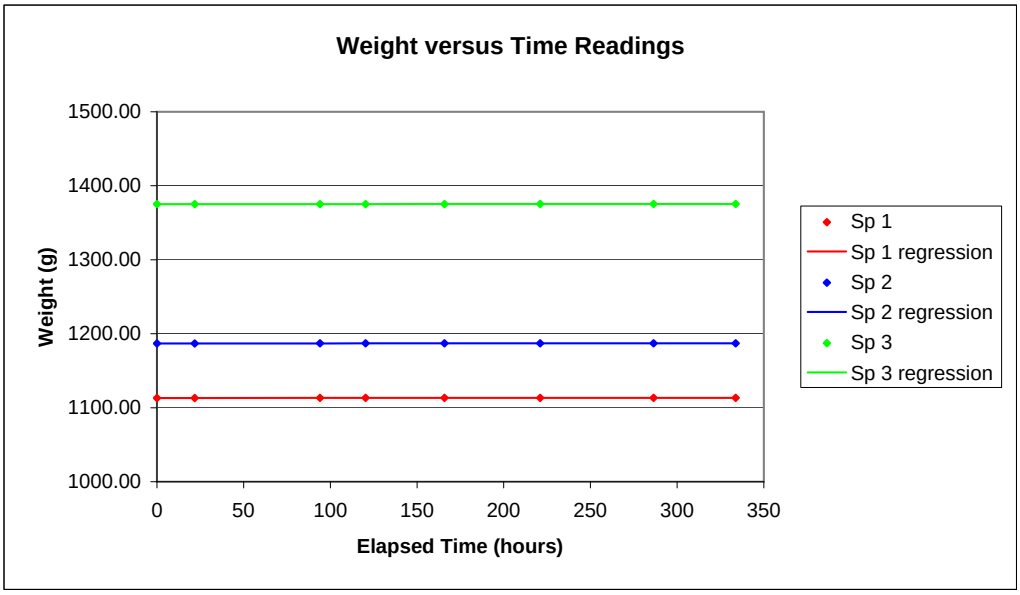
Test: **Water Vapor Transmission** Project: G100944599
Date: 14-Nov-12 Eng/Tech: Chris Chang
Client: Linerlock Reviewer: Baldeep Sandhu
Product: **LL 110 RU**
Test Methods: ASTM E96/E96M-10, *Test Method for Water Vapour Transmission of Materials*
Test Procedure: **Method A (Dessicant Method)**
Conditioning: 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 2%
Equipment: Setra Balance 2000g (Intertek ID# P52606, cal due February 2013)
Test Chamber (Intertek ID# 9-0473)
Digital Calipers (Intertek ID# P60005, cal due May 2013)
Digital Anemometer (Intertek ID# P60000, cal due December 2012)
T&D Thermorecorder TR72Ui (Intertek ID# P60554, cal due August 2013)

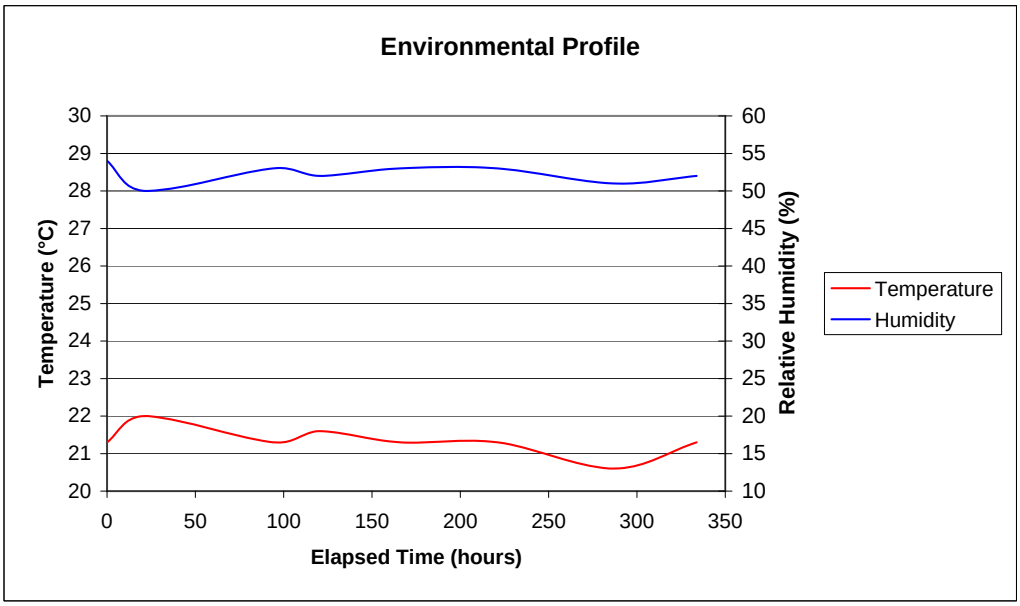
Measurement	Specimen		
	1	2	3
Mean Barometric Pressure (kPa)	101.53	101.53	101.53
Mean Air Temperature (°C)	21.3	21.3	21.3
Mean Saturation Vapour Pressure[1] (Pa)	2575	2575	2575
Mean Relative Humidity in chamber (%)	52.3	52.3	52.3
Relative Humidity in test dish (%)	0	0	0
Specimen Weight Change (g)	0.151	0.211	0.202
Moisture Gain of Dessicant (%)	0	0	0
Moisture Gain Control Limit (%)	10	10	10
Effective Test Dish Diameter (mm)	230.0	230.0	230.0
Effective Test Area (m²)	4.15E-02	4.15E-02	4.15E-02
Gradient of weight/time graph (g/hour)	4.31E-04	5.83E-04	5.87E-04
Specimen Mean Thickness (mm)	0.14	0.13	0.14
Uncorrected Water Transmission (g/hour.m²)	1.04E-02	1.40E-02	1.41E-02
Uncorrected Water Permeance (ng/Pa.s.m²)	2.14E+00	2.90E+00	2.92E+00
Permeability of Still Air (ng/Pa.s.m)	1.94E+02	1.94E+02	1.94E+02
Permeance of Still Air (ng/Pa.s.m²)	3.03E+04	3.03E+04	3.03E+04
Vapor Resistance of Still Air (m².s.Pa/kg)	3.30E+07	3.30E+07	3.30E+07
Surface Resistances (m².s.Pa./kg)	4.00E+07	4.00E+07	4.00E+07
Total Still Air and Specimen Surface (m².s.Pa/kg)	7.30E+07	7.30E+07	7.30E+07
Four Times Test Area Divided By Perimeter (m)	2.30E-01	2.30E-01	2.30E-01
Excess Water Transmission Due to Mask (%)	0.05	0.05	0.05
Excess Water Permeance Due to Mask (ng/Pa.s.m²	1.15E-03	1.47E-03	1.54E-03
Mask-corrected Water Permeance (ng/Pa.s.m²)	2.14E+00	2.90E+00	2.92E+00
Water Vapour Transmission (g/hour.m²)	1.04E-02	1.40E-02	1.41E-02
Water Vapour Permeance (ng/Pa.s.m²)	2.14E+00	2.90E+00	2.92E+00
Water Vapour Permeability (ng/Pa.s.m)	3.00E-04	3.84E-04	4.01E-04

[1]Estimated by the Clausius-Clapeyron equation

Test Result Summary	Metric units	Imperial Units
Water Vapor Transmission	1.28E-02 g/hr.m²	1.84E-02 grns/hr.ft²
	3.08E-01 g/day.m²	4.41E-01 grns/day.ft²
Water Vapor Permeance	2.65E+00 ng/Pa.s.m²	4.64E-02 perms
Water Vapor Permeability	3.62E-04 ng/Pa.s.m	2.49E-04 Perm inch

Test:	**Water Vapor Transmission**	Project:	G100944599
Date:	14-Nov-12	Eng/Tech:	Chris Chang
Client:	Linerlock	Reviewer:	Baldeep Sandhu
Product:	**LL 110 RU**		
Test Methods:	ASTM E96/E96M-10, *Test Method for Water Vapour Transmission of Materials*		
Test Procedure:	**Method A (Dessicant Method)**		
Conditioning:	24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 2%		
Equipment:	Setra Balance 2000g (Intertek ID# P52606, cal due February 2013)		
	Test Chamber (Intertek ID# 9-0473)		
	Digital Calipers (Intertek ID# P60005, cal due May 2013)		
	Digital Anemometer (Intertek ID# P60000, cal due December 2012)		
	T&D Thermorecorder TR72Ui (Intertek ID# P60554, cal due August 2013)		





Test:	**Ultraviolet Exposure-21d**
Date:	19-Nov-12
Client:	LinerLock
Project:	G100944599
Eng./Tech:	G. Nishio
Reviewr:	B. Sandhu
Product:	**LL 110 RU**
Test Method:	CAN/CSA A220.1
Exposure:	Ultraviolet light produced by four Osram 300 watt Ultra Vitalux UV lamps, 10 hours per day for 21
Specimen Temp:	131-140°F (55-60°C)
Equipment:	Ultraviolet light chamber
	Fluke Thermometer (Intertek ID# D2679, cal due May, 2013)

Date	Day	UV lamps on	UV lamps off
November 19, 2012	1	8:00 AM	6:00 PM
November 20, 2012	2	8:00 AM	6:00 PM
November 21, 2012	3	8:00 AM	6:00 PM
November 22, 2012	4	8:00 AM	6:00 PM
November 23, 2012	5	8:00 AM	6:00 PM
November 24, 2012	6	8:00 AM	6:00 PM
November 25, 2012	7	8:00 AM	6:00 PM
November 26, 2012	8	8:00 AM	6:00 PM
November 27, 2012	9	8:00 AM	6:00 PM
November 28, 2012	10	8:00 AM	6:00 PM
November 29, 2012	11	8:00 AM	6:00 PM
November 30, 2012	12	8:00 AM	6:00 PM
December 1, 2012	13	8:00 AM	6:00 PM
December 2, 2012	14	8:00 AM	6:00 PM
December 3, 2012	15	8:00 AM	6:00 PM
December 4, 2012	16	8:00 AM	6:00 PM
December 5, 2012	17	8:00 AM	6:00 PM
December 6, 2012	18	8:00 AM	6:00 PM
December 7, 2012	19	8:00 AM	6:00 PM
December 8, 2012	20	8:00 AM	6:00 PM
December 9, 2012	21	8:00 AM	6:00 PM

Comments: No visible damage to the specimens after ultraviolet conditioning.

Test:	**Accelerated Aging**
Date:	11-Dec-12
Client:	LinerLock
Project:	G100944599
Eng./Tech:	Geri Nishio GN
	B. Sandhu BS
Product:	**LL 110 RU**
Exposure:	**After 21d UV**
Test Standard(s):	CAN/CSA A220.1
Equipment:	Temperature Controlled Oven (Intertek ID C-04585)
	Water bath
	Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
Exposure cycle:	Oven drying at a temperature of 50 ± 2°C for 3 hours
	Water immersion at a temperature of 23 ± 2°C for 3 hours
	Air drying at a temperature and RH of 23 ± 2°C and 50 ± 5% respectively for 12 hours min.

Date	Cycle	Air Drying	Oven Drying		Immersion in water		Air Drying
		Out	In	Out	In	Out	In
December 11, 2012	1		7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 12, 2012	2	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 13, 2012	3	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 14, 2012	4	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 15, 2012	5	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 17, 2012	6	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 18, 2012	7	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 19, 2012	8	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 20, 2012	9	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
December 21, 2012	10	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 2, 2013	11	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 3, 2013	12	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 4, 2013	13	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 5, 2013	14	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 6, 2013	15	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 7, 2013	16	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 8, 2013	17	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 9, 2013	18	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 10, 2013	19	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 11, 2013	20	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 14, 2013	21	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 15, 2013	22	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 16, 2013	23	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 17, 2013	24	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM
January 18, 2013	25	7:30 AM	7:30 AM	10:30 AM	10:30 AM	1:30 PM	1:30 PM

Comments: **No visible damage to the specimens after accelerated aging.**

APPENDIX B: Beach Puncture Test Report (2 pages)

Intertek Testing Services NA Ltd
1500 Brigantine Drive
Coquitlam, British Columbia
Canada

Attn: Baldeep Sandhu

Test Report No: 3044807PP01	**Date: 23 January 2013**

SAMPLE(S) SUBMITTED BY THE CLIENT AS: Three (3) lots of Roof Underlayment Material, three (3) samples each, identified as: As Received, After 21 d. UV, and After 21 d. UV + Acc. Aging.

DATE OF RECEIPT: 21 January 2013.

TEST PERIOD: 23 January 2013.

TEST(S) REQUESTED: The materials were tested in Cross-Machine Direction for Puncture Resistance in accordance with TAPPI T-803 (Beach Puncture).

Prior to actual testing, the samples were exposed to a controlled atmosphere maintained at 73° F - 50% RH for 24 hours.

TEST RESULTS: See Page 2.

PREPARED BY:

DIMITAR DIMOV, PH. D.
SR. PROJECT ENGINEER

SIGNED FOR AND ON BEHALF OF SGS NORTH AMERICA INC.:

JASON SHERRIER, CPLP
LAB. MANAGER, PACKAGING&MATERIALS

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TEST RESULTS

Test: **PUNCTURE RESISTANCE (BEACH PUNCTURE METHOD),** TAPPI T-803

(Joules)

Material:	AS RECEIVED	AFTER 21 D. UV	AFTER 21 D. UV + ACC. AGING
	9.27	7.18	7.03
	8.22	9.12	9.72
	9.27	7.62	8.67
Avg.	**8.92**	**7.97**	**8.47**

We trust the results and will prove useful and informative. Should you have any questions, please feel free to contact us.

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END OF REPORT

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