



REPORT NUMBER: 100944599COQ-004
ORIGINAL ISSUE DATE: December 19, 2012

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

PRODUCT EVALUATED: LL 110 RU
EVALUATION PROPERTY: Physical Properties

Report of LL 110 RU for compliance with the applicable requirements of the following criteria: ICC-ES AC207, Acceptance Criteria for Polypropylene Roof Underlayments, Approved February 2012

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TEST REPORT

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2 Introduction

Intertek Testing Services NA Ltd. (Intertek) has conducted a test program for LinerLock, Inc. on a roofing underlayment product. The evaluation was carried out to determine whether the material would comply with the physical requirements of ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012. This evaluation was completed during the months of November and December 2012.

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. 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

Before testing, the test specimen materials were held in standard laboratory conditions for at least 24 hours at a temperature of $23 \pm 2^{\circ}\text{C}$ and relative humidity of $50 \pm 5\%$.

4.2. WATER VAPOR TRANSMISSION

The water vapour transmission was determined as per Section 4.1 of ICC-ES AC207 with reference to ASTM E96/E96M-05, *Standard Test Methods for Water Vapour Transmission of Materials*, water method. Four circular specimens of the material were prepared for testing. Three test dishes measuring 9 in. (228 mm) in diameter were filled with water to within $\frac{1}{4}$ in. (6.4 mm) 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 down. An additional control specimen was prepared in an identical manner to the other three test specimens with the exception that no water 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

4.3. PLIABILITY

Pliability was tested in accordance with Section 4.2 of ICC-ES AC207. Five (5) specimens, each measuring 1 in. x 8 in. (25 mm x 200 mm), were cut in the machine direction and five in the cross-machine direction. Samples were maintained at -10 ± 2°C (14 ± 4°F) for 24 hours prior to being bent over a 1/8 in. (3.2 mm) steel mandrel through a 90° angle. Each specimen was visually examined for signs of cracking or delamination under low power magnification.

4.4. LIQUID WATER TRANSMISSION

Liquid water transmission was tested in accordance with Section 4.3 of ICC-ES AC207 with reference to ASTM D4869-05e¹, *Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing*. A single thickness specimen was mounted on a 15 in. x 30 in. (381 mm x 762 mm) plywood board by overlapping and folding over all edges and stapling the specimen to the back of the board. The test involved positioning the test specimen at an angle of 14° with a showerhead directly overhead and 18 in. above the center of the test board. The showerhead was adjusted to impinge an area of approximately 10 in. (254 mm) to 12 in. (305 mm) diameter at a flow rate of 40 to 42 gal/hour. At the completion of a four hour running time, the water was shut off and the surfaces and edges of the test specimen were wiped free of excess dripping water. The test specimen was carefully cut open and examined for any signs of wetness on the underside, and also on the top of the plywood board. It was also inspected for any signs of visible deterioration by the action of the water.

4.5. FASTENER PULL-THROUGH RESISTANCE

Fastener pull-through resistance was tested in accordance with Section 4.4 of ICC-ES AC207 with reference to ASTM D3462-09, *Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules*. Ten (10) specimens per fastener type, each measuring 4 in. x 4 in. (100 mm x 100 mm), were prepared for testing. A 12ga roofing nail with a 0.375 in. (9.5 mm) head diameter and No. 16ga staples with 7/16 in. (11.1 mm) crowns were used for testing. The fasteners were driven through each specimen with the fastener head flush with the surface of the panel. The samples were placed directly into a universal tensile testing apparatus and fasteners were pulled through at a rate of 4 in./min (100 mm/min). The maximum load for each specimen was measured and reported.

4.6. TEAR RESISTANCE

Tear resistance was tested in accordance with Section 4.5 of ICC-ES AC207 with reference to ASTM D1922-00a, *Standard Test Method for Propagation of Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method*. Ten (10) specimens were prepared to form a constant-radius testing length in both the machine and cross directions; refer to Figure 1 below for sample template.

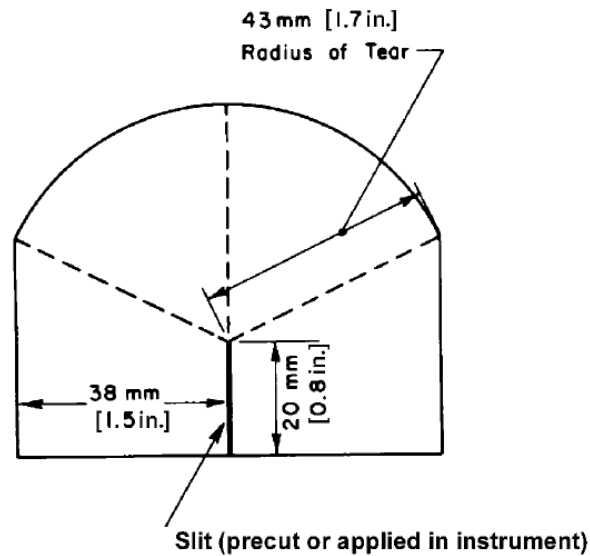


Figure 1. Constant-Radius Test Specimen

The prepared samples were placed into an Elmendorf Tear Strength Tester and a cut was made in each sample using the sharp spring-loaded knife. The pendulum of the Elmendorf tester was placed in the raised position and then released to tear the specimen. The pointer reading was measured to the nearest 0.5 units and was reported for each sample.

4.7. ACCELERATED AGING

Accelerated aging was conducted in accordance with Section 4.6 of ICC-ES AC207. Six (6) samples, each measuring 12 in. x 12 in. (305 mm x 305 mm), were subjected to 25 cycles of the following:

- Oven-drying at 49°C (120°F) for 3 hours
- Immersion in water maintained at room temperature for 3 hours
- Removal from water and blotting dry before air-drying for 18 hours at room temperature

During weekends and holidays, the accelerated aging process was suspended by holding the specimens in standard laboratory conditions. Visual examination of the specimens was made after accelerated aging for any evidence of surface or structural changes. Specimens of the examined material were later subjected to fastener pull-through resistance and tear resistance.

4.8. ULTRAVIOLET EXPOSURE

Ultraviolet exposure was conducted in accordance with Section 4.7 of ICC-ES AC207. Two (2) samples, each measuring 457 mm x 1220 mm (18 in. x 48 in.), were prepared and exposed to ultraviolet sun lamps for 210 hours (10 hours per day for 21 days). The ultraviolet exposure was directed on the specimen surfaces that are typically exposed to sunlight in normal application. The lamps and enclosure were adjusted to maintain the specimens at a product temperature of between 57.2°C and 60°C (135°F and 140°F). Sunlamp bulbs provided 5.0 W/m²/nm irradiance at a wavelength of 315 to 400 nm at one meter. Visual examination of the specimens was conducted after ultraviolet exposure for any evidence of surface or structural changes. Specimens of the examined material were later subjected to fastener pull-through resistance and tear resistance.

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

The product test results, together with the applicable requirements of ICC-ES AC207 are shown in Table 1 below. A full set of test results is included in Appendix A.

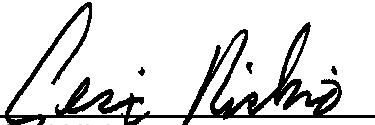
| Table 1. AC207 Physical Properties | | | |
|---|--|--|------------------|
| Property | Test Result | Requirement | Pass/Fail |
| Water Vapor Transmission, perms | 0.05 | As Reported | As Reported |
| Pliability | No cracking or delamination | No cracking or delamination | Pass |
| Liquid Water Transmission | No wetness on specimen underside or top of plywood support | No wetness on specimen underside or top of plywood support | Pass |
| Fastener Pull-Through Resistance | | | |
| ▪ No. 12 ga Roofing Nail, lbf | | | |
| ▪ Control | 54 | ≥ 25 | Pass |
| ▪ Accelerated-Aging | 50 | ≥ 25 | Pass |
| ▪ Ultraviolet-Light | 52 | ≥ 25 | Pass |
| ▪ No. 16 ga Staple, lbf | | | |
| ▪ Control | 31 | ≥ 17 | Pass |
| ▪ Accelerated-Aging | 31 | ≥ 17 | Pass |
| ▪ Ultraviolet-Light | 34 | ≥ 17 | Pass |
| Tear Resistance, g | | | |
| ▪ Control | 3200 | ≥ 2560 | Pass |
| ▪ Accelerated-Aging | 3200 | ≥ 2560 | Pass |
| ▪ Ultraviolet-Light | 3200 | ≥ 2560 | Pass |
| Accelerated Aging | No peeling, chipping, cracking, flaking or pitting | No peeling, chipping, cracking, flaking or pitting | Pass |
| Ultraviolet Exposure | No peeling, chipping, cracking, flaking or pitting | No peeling, chipping, cracking, flaking or pitting | Pass |

6 Conclusion

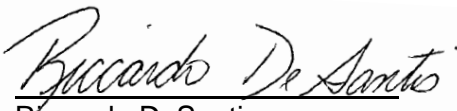
The LL 110 RU product identified and evaluated in this report has met the requirements contained in ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012. The product test results are presented in Section 5 of this report.

INTERTEK TESTING SERVICES NA LTD.

Tested by:


Geri Nishio
Technician, Construction Products

Reviewed by:


Riccardo DeSantis
Manager, Building Products

APPENDIX A: Test Data (12 pages)



Test: **Water Vapor Transmission**
 Date: 14-Nov-12
 Client: Linerlock
 Product: **LL 110 RU**

Project: G100944599
 Eng/Tech: Chris Chang *CC*
 Reviewer: Baldeep Sandhu *BSS*

Test Methods: ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
 ASTM E96/E96M-10, *Test Method for Water Vapour Transmission of Materials*

Test Procedure: **Method B (Wet Cup 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 (%) | 100 | 100 | 100 |
| Specimen Weight Change (g) | 0.238 | 0.138 | 0.188 |
| Moisture Gain of Dessicant (%) | n/a | n/a | n/a |
| Moisture Gain Control Limit (%) | n/a | n/a | n/a |
| Test Dish Diameter (mm) | 230.0 | 230.0 | 230.0 |
| Test Area (m²) | 4.15E-02 | 4.15E-02 | 4.15E-02 |
| Gradient of weight/time graph (g/hour) | 7.01E-04 | 4.06E-04 | 5.38E-04 |
| Specimen Mean Thickness (mm) | 0.14 | 0.14 | 0.14 |
| Uncorrected Water Transmission (g/hour.m²) | 1.69E-02 | 9.77E-03 | 1.30E-02 |
| Uncorrected Water Permeance (ng/Pa.s.m²) | 3.81E+00 | 2.21E+00 | 2.93E+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.m) | 2.01E-03 | 1.19E-03 | 1.52E-03 |
| Mask-corrected Water Permeance (ng/Pa.s.m²) | 3.81E+00 | 2.21E+00 | 2.92E+00 |
| Water Vapour Transmission (g/hour.m²) | 1.69E-02 | 9.77E-03 | 1.29E-02 |
| Water Vapour Permeance (ng/Pa.s.m²) | 3.81E+00 | 2.21E+00 | 2.93E+00 |
| Water Vapour Permeability (ng/Pa.s.m) | 5.24E-04 | 3.09E-04 | 3.95E-04 |

¹Estimated by the Clausius-Clapeyron equation

| Test Result Summary | Metric units | Imperial Units |
|--------------------------|---------------------|-----------------------|
| Water Vapor Transmission | 1.32E-02 g/hr.m² | 1.89E-02 grns/hr.ft² |
| | 3.17E-01 g/day.m² | 4.53E-01 grns/day.ft² |
| Water Vapor Permeance | 2.98E+00 ng/Pa.s.m² | 5.21E-02 perms |
| Water Vapor Permeability | 4.09E-04 ng/Pa.s.m | 2.82E-04 Perm inch |



Test: **Water Vapor Transmission**
Date: 14-Nov-12
Client: Linerlock
Product: **LL 110 RU**

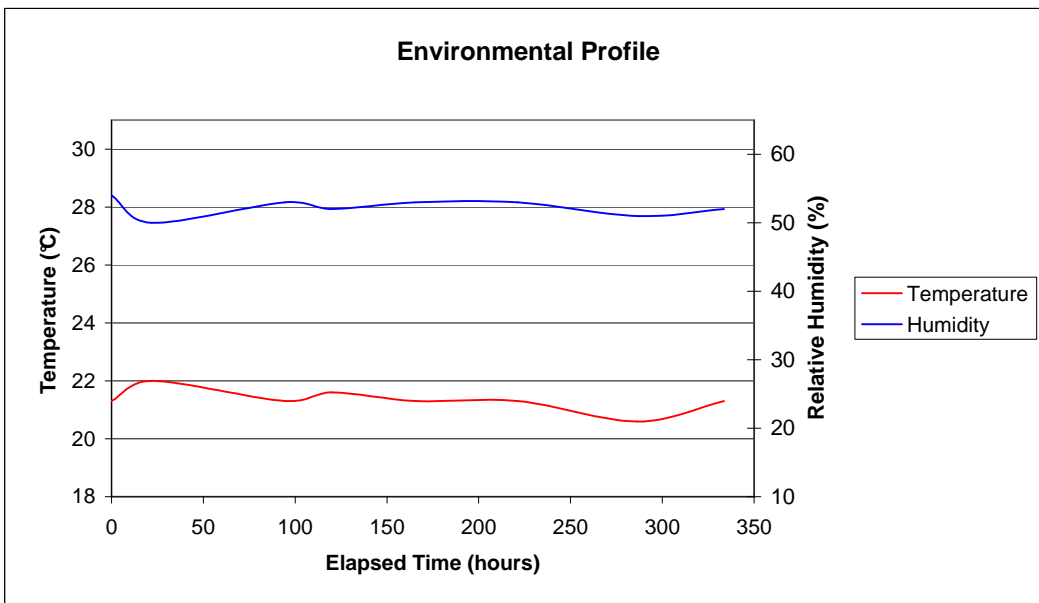
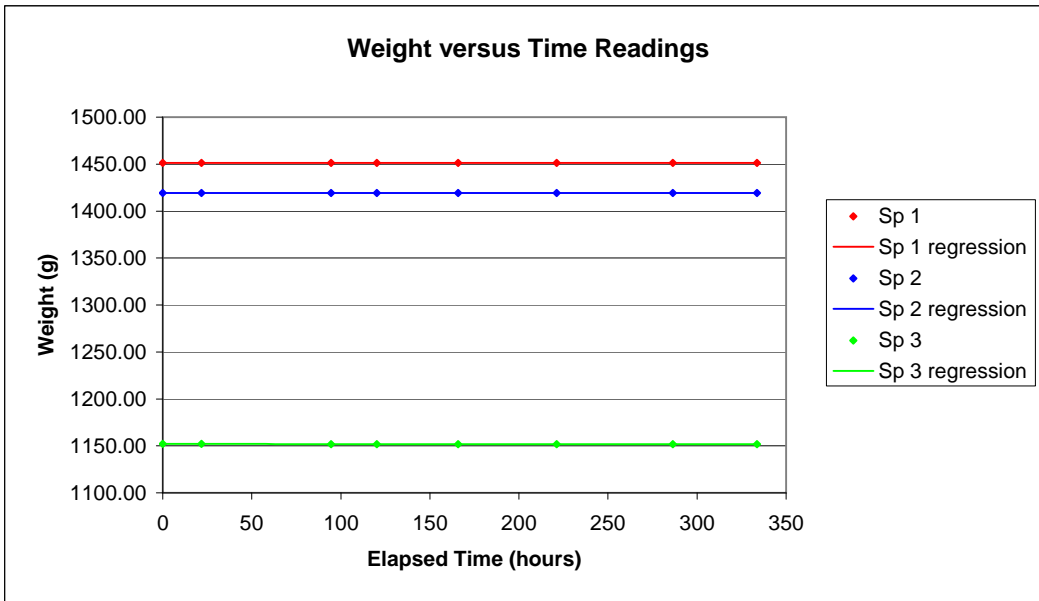
Project: G100944599
Eng/Tech: Chris Chang
Reviewer: Baldeep Sandhu

Test Methods: ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
ASTM E96/E96M-10, *Test Method for Water Vapour Transmission of Materials*

Test Procedure: **Method B (Wet Cup Method)**

Conditioning: 24 hours at a temperature of $23 \pm 2^\circ\text{C}$ and relative humidity of $50 \pm 2\%$

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: **Pliability**
Date: 15-Nov-12
Client: LinerLock, Inc.
Product: **LL 110 RU**
Specimen ID: **As Received**
Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Samp size: 1 in. x 8 in. (25mm x 200mm)
Test Temp: -10°C (14°F)
Equipment: Cold Temperature Chamber NuAire 20050410
Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
1/8 in. (3.2 mm) steel mandrel
Time/Temp/RH: 8:10AM / 23.5°C / 47.0% RH

Project: G100944599
Eng./Tech: G. Nishio *GN*
Reviewer: B. Sandhu *BS*

| Machine Direction | | |
|-------------------|----------------------|-----------------------------|
| Specimen | Specimen Orientation | Observations |
| 1 | Weathering side up | no cracking or delamination |
| 2 | Weathering side up | no cracking or delamination |
| 3 | Weathering side up | no cracking or delamination |
| 4 | Weathering side up | no cracking or delamination |
| 5 | Weathering side up | no cracking or delamination |

| Cross Direction | | |
|-----------------|----------------------|-----------------------------|
| Specimen | Specimen Orientation | Observations |
| 1 | Weathering side up | no cracking or delamination |
| 2 | Weathering side up | no cracking or delamination |
| 3 | Weathering side up | no cracking or delamination |
| 4 | Weathering side up | no cracking or delamination |
| 5 | Weathering side up | no cracking or delamination |



Test: **Liquid Water Transmission**
Date: 19-Nov-12
Client: LinerLock, Inc.
Product: **LL 110 RU**
Specimen ID: **As Received**
Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
ASTM D4869-05e1, *Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing*
Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
Samp size: 15 in. x 30 in. (381mm x 762mm)
Flow Rate: 40-42 ga/hour
Equipment: T&D Thermorecorder TR72Ui (Intertek ID# P60554, cal due August 2013)
Time/Temp/RH: 8:00AM / 22.1°C / 49.0% RH

Project: G100944599
Eng./Tech: G. Nishio *GN*
Reviewer: B. Sandhu *BS*

| Specimen | Observations |
|----------|--|
| 1 | No wetness on specimen underside or top of plywood support |
| 2 | No wetness on specimen underside or top of plywood support |



Test: **Fastener Pull-Through Resistance**

Date: Nov. 13/12

Client: LinerLock, Inc.

Product: **LL 110 RU**

Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
ASTM D3462-09, *Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules*

Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%

Load Rate: 4 in./min (100 mm/min)

Equipment: Instron 3382 (Intertek ID# P60553, cal due July 2013)

T&D Thermorecorder TR-72Ui (Intertek ID# P60554, cal due August 2013)

Time/Temp/RH: 1:39PM / 21.7°C / 51% RH

Project No: G100944599

Eng/Tech: G. Nishio *GN*

Reviewer: B. Sandhu *BSS*

Roofing Nail

| Specimen | Max Load (N) | Max Load (lbf) |
|----------|--------------|----------------|
| 1 | 244.6 | 55.0 |
| 2 | 227.8 | 51.2 |
| 3 | 230.9 | 51.9 |
| 4 | 250.9 | 56.4 |
| 5 | 226.9 | 51.0 |
| 6 | 253.8 | 57.1 |
| 7 | 240.7 | 54.1 |
| 8 | 233.5 | 52.5 |
| 9 | 251.6 | 56.6 |
| 10 | 258.5 | 58.1 |
| Mean | 242 | 54 |
| StdDev: | 12 | 3 |
| COV: | 5% | 5% |

Staples

| Specimen | Max Load (N) | Max Load (lbf) |
|----------|--------------|----------------|
| 1 | 204.6 | 46.0 |
| 2 | 120.5 | 27.1 |
| 3 | 135.6 | 30.5 |
| 4 | 133.3 | 30.0 |
| 5 | 130.4 | 29.3 |
| 6 | 138.9 | 31.2 |
| 7 | 127.0 | 28.6 |
| 8 | 139.8 | 31.4 |
| 9 | 130.2 | 29.3 |
| 10 | 116.8 | 26.3 |
| Mean | 138 | 31 |
| StdDev: | 25 | 6 |
| COV: | 18% | 18% |



Test: **Fastener Pull-Through Resistance after Accelerated Aging**
 Date: Dec. 12/12
 Client: LinerLock, Inc.
 Product: **LL 110 RU**
 Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
 ASTM D3462-09, *Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules*
 Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 Load Rate: 4 in./min (100 mm/min)
 Equipment: Instron 3382 (Intertek ID# P60553, cal due July 2013)
 T&D Thermorecorder TR-72Ui (Intertek ID# P60554, cal due August 2013)
 Time/Temp/RH: 10:29AM / 21.6°C / 48.0% RH

Project No: G100944599
 Eng/Tech: G. Nishio *GN*
 Reviewer: R. DeSantis *R.D.*

Roofing Nail

| Specimen | Max Load (N) | Max Load (lbf) |
|----------|--------------|----------------|
| 1 | 246.1 | 55.3 |
| 2 | 215.9 | 48.5 |
| 3 | 250.7 | 56.4 |
| 4 | 225.6 | 50.7 |
| 5 | 216.0 | 48.6 |
| 6 | 214.5 | 48.2 |
| 7 | 222.5 | 50.0 |
| 8 | 185.2 | 41.6 |
| 9 | 251.4 | 56.5 |
| 10 | 188.9 | 42.5 |
| Mean | 222 | 50 |
| StdDev: | 23 | 5 |
| COV: | 10% | 10% |

Staples

| Specimen | Max Load (N) | Max Load (lbf) |
|----------|--------------|----------------|
| 1 | 154.1 | 34.6 |
| 2 | 132.9 | 29.9 |
| 3 | 157.7 | 35.5 |
| 4 | 119.9 | 27.0 |
| 5 | 121.8 | 27.4 |
| 6 | 142.9 | 32.1 |
| 7 | 127.4 | 28.6 |
| 8 | 137.6 | 30.9 |
| 9 | 139.7 | 31.4 |
| 10 | 142.8 | 32.1 |
| Mean | 138 | 31 |
| StdDev: | 13 | 3 |
| COV: | 9% | 9% |



Test: **Fastener Pull-Through Resistance after UV Exposure**

Date: Dec. 12/12

Client: LinerLock, Inc.

Product: **LL 110 RU**

Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
ASTM D3462-09, *Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules*

Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%

Load Rate: 4 in./min (100 mm/min)

Equipment: Instron 3382 (Intertek ID# P60553, cal due July 2013)

T&D Thermorecorder TR-72Ui (Intertek ID# P60554, cal due August 2013)

Time/Temp/RH: 9:12AM / 21.3°C / 50.0% RH

Project No: G100944599

Eng/Tech: G. Nishio *GN*

Reviewer: R. DeSantis *R.D.*

Roofing Nail

| Specimen | Max Load (N) | Max Load (lbf) |
|----------|--------------|----------------|
| 1 | 216.6 | 48.7 |
| 2 | 223.7 | 50.3 |
| 3 | 247.0 | 55.5 |
| 4 | 240.8 | 54.1 |
| 5 | 242.9 | 54.6 |
| 6 | 223.8 | 50.3 |
| 7 | 233.6 | 52.5 |
| 8 | 200.0 | 45.0 |
| 9 | 219.0 | 49.2 |
| 10 | 250.0 | 56.2 |
| Mean | 230 | 52 |
| StdDev: | 16 | 4 |
| COV: | 7% | 7% |

Staples

| Specimen | Max Load (N) | Max Load (lbf) |
|----------|--------------|----------------|
| 1 | 147.6 | 33.2 |
| 2 | 131.0 | 29.5 |
| 3 | 181.5 | 40.8 |
| 4 | 159.3 | 35.8 |
| 5 | 164.0 | 36.9 |
| 6 | 126.3 | 28.4 |
| 7 | 127.7 | 28.7 |
| 8 | 174.9 | 39.3 |
| 9 | 136.0 | 30.6 |
| 10 | 158.2 | 35.6 |
| Mean | 151 | 34 |
| StdDev: | 20 | 4 |
| COV: | 13% | 13% |



Test: **Tear Resistance**
 Date: Nov. 14/12
 Client: LinerLock, Inc.
 Product: **LL 110 RU**

Project No: G100944599
 Eng/Tech: G. Nishio *GN*
 Reviewer: B. Sandhu *BSS*

Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
 ASTM D1922-00a, *Standard Test Method for Propagation of Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method* (3200g capacity)

Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 Equipment: 3200 g capacity Elmendorf Tear Tester (Intertek ID# P52690, cal B/U)

Time/Temp/RH: 8:10AM / 23.0°C / 47.0%

Roll direction

| Specimen | Max Load (%) | Max Load (g) |
|----------|--------------|--------------|
| 1 | 100 | 3200 |
| 2 | 100 | 3200 |
| 3 | 100 | 3200 |
| 4 | 100 | 3200 |
| 5 | 100 | 3200 |
| 6 | 100 | 3200 |
| 7 | 100 | 3200 |
| 8 | 100 | 3200 |
| 9 | 100 | 3200 |
| 10 | 100 | 3200 |
| Mean | 100 | 3200 |
| StdDev: | 0 | 0 |
| COV: | 0% | 0% |

Cross Roll direction

| Specimen | Max Load (%) | Max Load (g) |
|----------|--------------|--------------|
| 1 | 100 | 3200 |
| 2 | 100 | 3200 |
| 3 | 100 | 3200 |
| 4 | 100 | 3200 |
| 5 | 100 | 3200 |
| 6 | 100 | 3200 |
| 7 | 100 | 3200 |
| 8 | 100 | 3200 |
| 9 | 100 | 3200 |
| 10 | 100 | 3200 |
| Mean | 100 | 3200 |
| StdDev: | 0 | 0 |
| COV: | 0% | 0% |



Test: **Tear Resistance After Accelerated Aging**

Date: Dec. 10/12

Client: LinerLock, Inc.

Product: **LL 110 RU**

Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
 ASTM D1922-00a, *Standard Test Method for Propagation of Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method* (3200g capacity)

Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%

Equipment: 3200 g capacity Elmendorf Tear Tester (Intertek ID# P52690, cal B/U)

Project No: G100944599

Eng/Tech: G. Nishio *GN*

Reviewer: R. DeSantis *R.D.*

Time/Temp/RH: 10:05AM / 23.0°C / 48.0%

Roll direction

| Specimen | Max Load (%) | Max Load (g) |
|----------|--------------|--------------|
| 1 | 100 | 3200 |
| 2 | 100 | 3200 |
| 3 | 100 | 3200 |
| 4 | 100 | 3200 |
| 5 | 100 | 3200 |
| 6 | 100 | 3200 |
| 7 | 100 | 3200 |
| 8 | 100 | 3200 |
| 9 | 100 | 3200 |
| 10 | 100 | 3200 |

Mean 100 3200
 StdDev: 0 0
 COV: 0% 0%

Cross Roll direction

| Specimen | Max Load (%) | Max Load (g) |
|----------|--------------|--------------|
| 1 | 100 | 3200 |
| 2 | 100 | 3200 |
| 3 | 100 | 3200 |
| 4 | 100 | 3200 |
| 5 | 100 | 3200 |
| 6 | 100 | 3200 |
| 7 | 100 | 3200 |
| 8 | 100 | 3200 |
| 9 | 100 | 3200 |
| 10 | 100 | 3200 |

Mean 100 3200
 StdDev: 0 0
 COV: 0% 0%



Test: **Tear Resistance After UV**
 Date: Dec. 10/12
 Client: LinerLock, Inc.
 Product: **LL 110 RU**

Project No: G100944599
 Eng/Tech: G. Nishio *GN*
 Reviewer: R. DeSantis *RD*

Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012
 ASTM D1922-00a, *Standard Test Method for Propagation of Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method* (3200g capacity)

Conditioning: Minimum 24 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 Equipment: 3200 g capacity Elmendorf Tear Tester (Intertek ID# P52690, cal B/U)

Time/Temp/RH: 3:41PM / 21.0°C / 52.0% RH

Roll direction

| Specimen | Max Load (%) | Max Load (g) |
|-------------|--------------|--------------|
| 1 | 100 | 3200 |
| 2 | 100 | 3200 |
| 3 | 100 | 3200 |
| 4 | 100 | 3200 |
| 5 | 100 | 3200 |
| 6 | 100 | 3200 |
| 7 | 100 | 3200 |
| 8 | 100 | 3200 |
| 9 | 100 | 3200 |
| 10 | 100 | 3200 |
| Mean | 100 | 3200 |
| StdDev: | 0 | 0 |
| COV: | 0% | 0% |

Cross Roll direction

| Specimen | Max Load (%) | Max Load (g) |
|-------------|--------------|--------------|
| 1 | 100 | 3200 |
| 2 | 100 | 3200 |
| 3 | 100 | 3200 |
| 4 | 100 | 3200 |
| 5 | 100 | 3200 |
| 6 | 100 | 3200 |
| 7 | 100 | 3200 |
| 8 | 100 | 3200 |
| 9 | 100 | 3200 |
| 10 | 100 | 3200 |
| Mean | 100 | 3200 |
| StdDev: | 0 | 0 |
| COV: | 0% | 0% |



Test: **Accelerated Aging**

Date: 13-Nov-12

Client: LinerLock, Inc.

Product: **LL 110 RU**

Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February 2012

Equipment: Temperature Controlled Oven (Intertek ID C-04585)

Water bath

Fluke Thermometer (Intertek ID# D2679, cal due May 10, 2013)

Exposure cycle: Oven drying at a temperature of 49 ± 2°C for 3 hour s

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 18 hours min.

Project No: G100944599

Eng/Tech: G. Nishio

Reviewer: B. Sandhu

GM
BSS

| Date | Cycle | Air Drying | Oven Drying | | Immersion in water | | Air Drying |
|-------------------|-------|------------|-------------|----------|--------------------|---------|------------|
| | | Out | In | Out | In | Out | In |
| November 13, 2012 | 1 | | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 14, 2012 | 2 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 15, 2012 | 3 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 16, 2012 | 4 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 17, 2012 | 5 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 18, 2012 | 6 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 19, 2012 | 7 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 20, 2012 | 8 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 21, 2012 | 9 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 22, 2012 | 10 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 23, 2012 | 11 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 26, 2012 | 12 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 27, 2012 | 13 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 28, 2012 | 14 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 29, 2012 | 15 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| November 30, 2012 | 16 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 1, 2012 | 17 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 2, 2012 | 18 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 3, 2012 | 19 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 4, 2012 | 20 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 5, 2012 | 21 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 6, 2012 | 22 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 7, 2012 | 23 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 8, 2012 | 24 | 7:30 AM | 7:30 AM | 10:30 AM | 10:30 AM | 1:30 PM | 1:30 PM |
| December 10, 2012 | 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.



Test: **Ultraviolet Exposure-21d** Project No: G100944599
 Date: 19-Nov-12 Eng/Tech: G. Nishio *GN*
 Client: LinerLock, Inc. Reviewer: B. Sandhu *BS*
 Product: **LL 110 RU**
 Test Standard(s): ICC-ES AC207, *Acceptance Criteria for Polypropylene Roof Underlayments*, Approved February
 Equipment: Ultraviolet light chamber
 Fluke Thermometer (Intertek ID# D2679, cal due May 10, 2013)
 Exposure cycle: Ultraviolet light produced by four Osram 300 watt Ultra Vitalux UV lamps, 10 hours per day for 21
 Specimen Temp: 135-140°F (57.2-60°C)

| 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.