



Test Report

UV Exposure and Tensile Strength Measurements on White Facer Material Supplied by Innovative Energy, Inc.

Prepared For:

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Report: RD19470

A handwritten signature in black ink, appearing to read 'Stuart Ruis', is written over a horizontal line.

Stuart Ruis
President

July 1, 2019

The test results in this report apply only to the specimens tested. The tests conform to the respective test methods except for the report requirements. The report includes summary data but a full complement of data is available upon request. This report shall not be reproduced, except in full, without written approval of R & D Services, Inc. This report must not be used by the client to claim product endorsement by R & D Services, Inc., IAS or any other organization.



UV EXPOSURE SUMMARY

The following report contains results of the RIMA verification procedure for evaluation of white facer materials used in the manufacture of reflective insulation and radiant barrier products. The evaluation consists of exposing the white facers to ultra-violet light, heat, and moisture to quantify aging effects on the performance of the product.

The following product was evaluated:

Product Identification: White Facer Material for Astro Armour Reflective Insulation
Manufacturer: Innovative Energy, Inc.
Material Description: White polyethylene facer used to manufacture Astro Armour

This procedure estimates long term performance of white facer materials used in the manufacture of reflective insulation and radiant barrier materials by simulating weathering conditions in a laboratory setting. Tensile strength properties are evaluated according to ASTM D882 at increasing exposure intervals of UV, heat, and moisture weathering.

The following steps are performed during the evaluation:

1. Initial pictures of the specimens are taken
2. Initial tensile strength of the product is measured according to ASTM D882
3. Specimens are subjected to a 500 hour UV cycle according to ASTM G154, cycle 1
4. Pictures of the aged material are taken, and tensile strength of the aged product is measured
5. This process is repeated every 500 hours for a total of 2000 hour exposure

Specimens are visually inspected for deterioration. Any signs of cracking, peeling, flaking, or other signs of degradation are noted.

The results of this project are summarized in Table 1. Figure 1 presents the change in tensile strength over the duration of the test. Official test reports are included in this report.

Time (hr)	Tensile Strength (lb/in ²)	% of Original Tensile Strength	Elongation (%)	Visual Observations
0	11039	-	18.5	NONE
500	8955	81.2	18.5	NONE
1000	8238	74.7	16.7	NONE
1500	7315	66.3	15.9	NONE
2000	5845	53.0	12.9	NONE

Table 1: Summary of test results

The RIMA verification program states that white facers shall retain 50% of their initial tensile strength after 2000 hours of UV exposure, and shall exhibit no visual degradation after 2000 hour exposure.

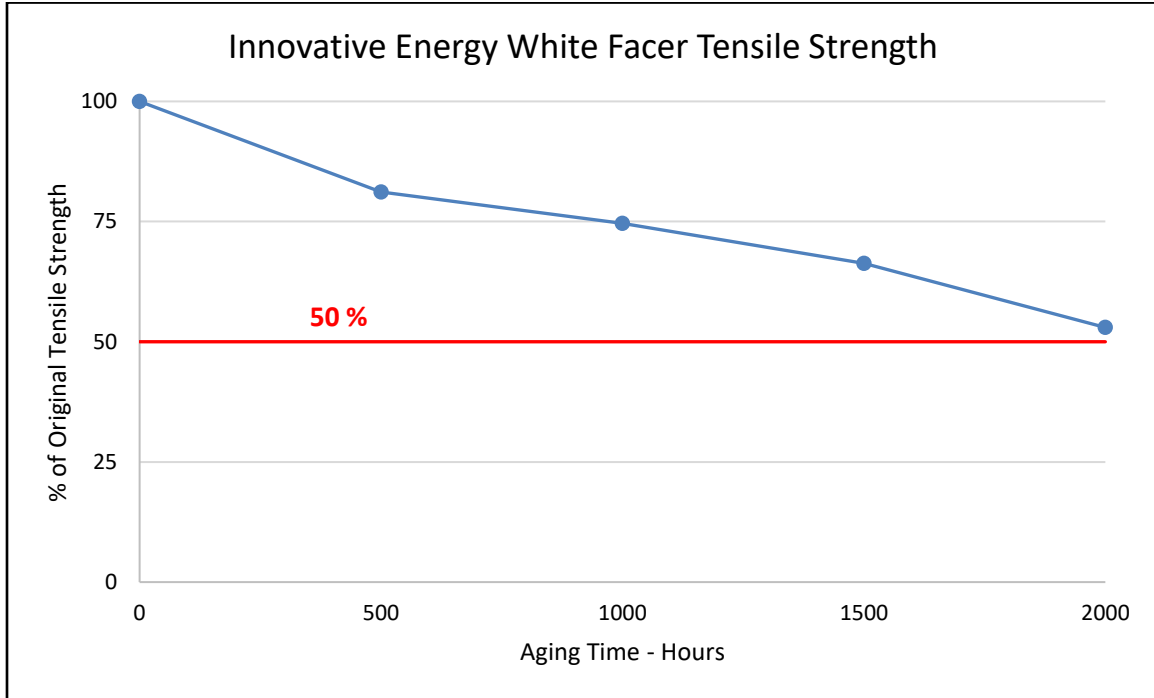


Figure 1: % of original tensile strength vs. hours of exposure

Conclusion

The white facer material product meets the requirements of the RIMA verification program for UV resistance. No visual degradation was noted during this evaluation.

Photos of specimens are included in this report.

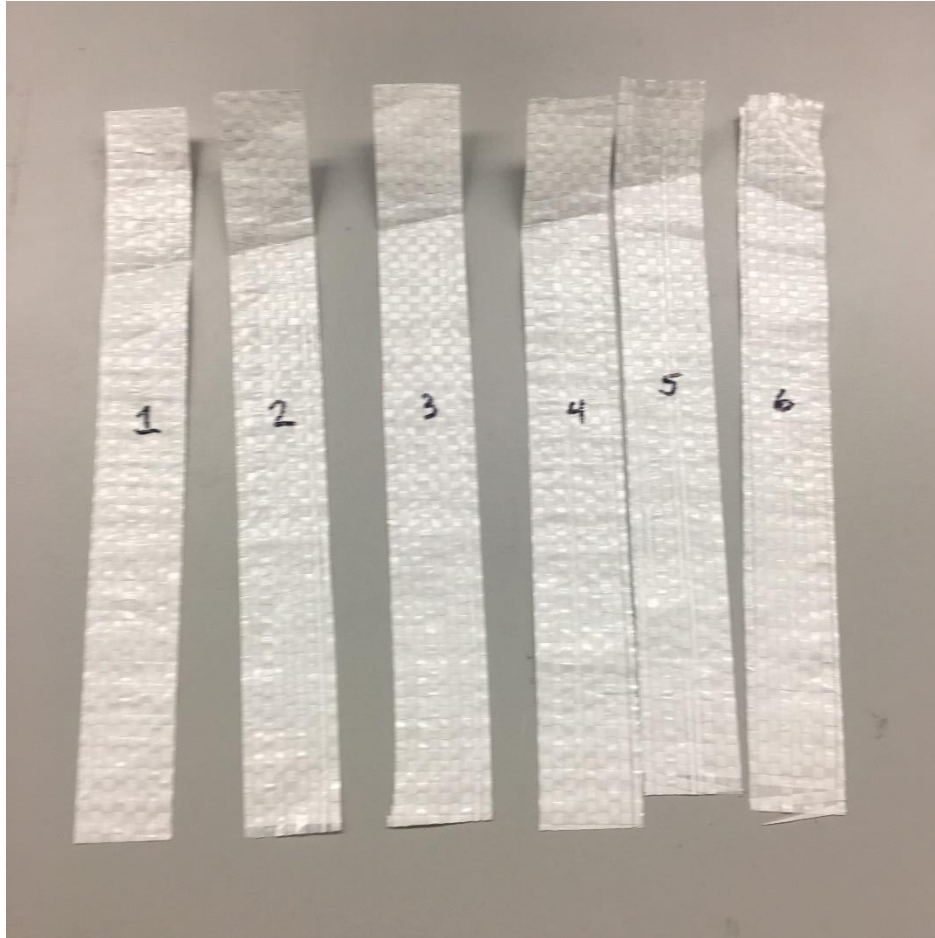


Figure 2. Initial specimens – 0 hours UV exposure

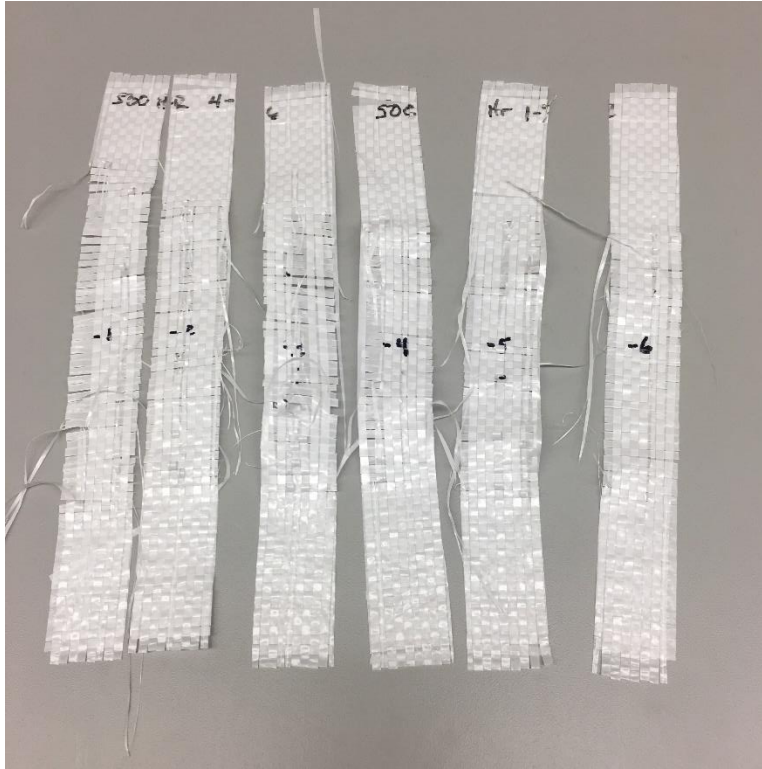


Figure 3. 500 hours UV exposure

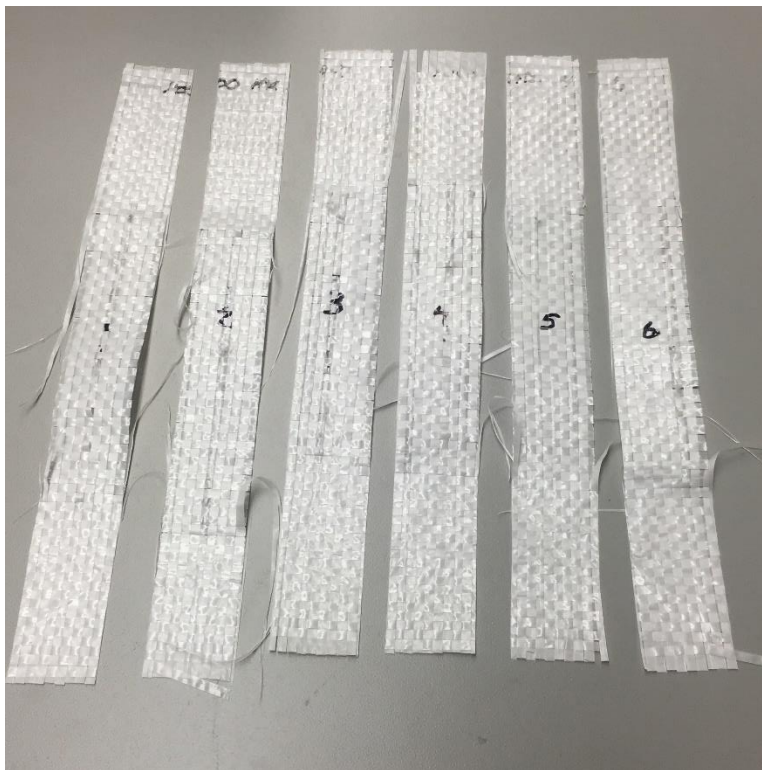


Figure 4. 1000 hours UV exposure

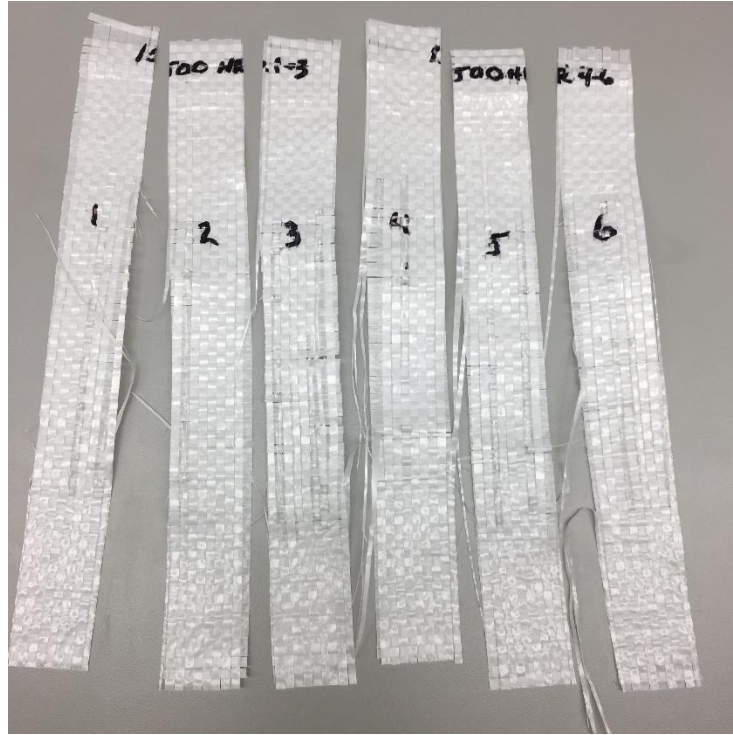


Figure 4. 1500 hours UV exposure

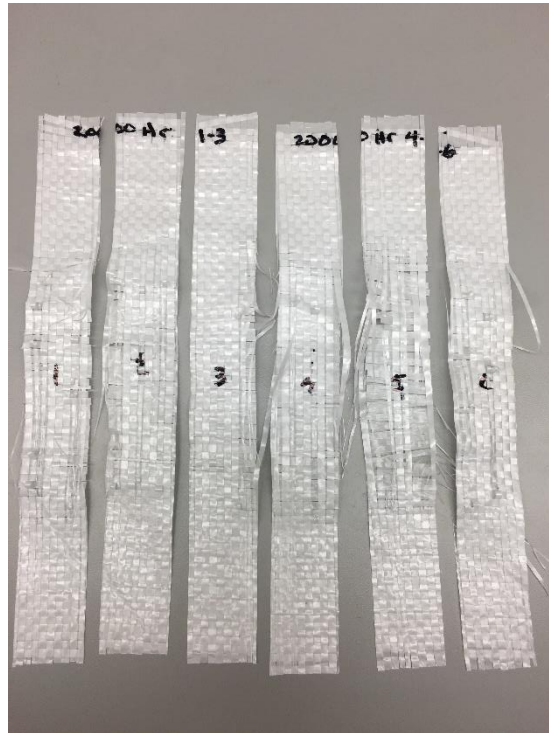


Figure 4. 2000 hours UV exposure



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Test Report for Tensile Strength

Test Number: RD190894TS

Date of Test: March 26, 2019

Specimen Number: 1021190320-7

Date of Manufacture: Unknown

Description of Test Specimen: White Facer Material for Astro Armour; Initial Test; Tested in machine direction

Test Method: ASTM D882-12 "Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

Report Prepared For: Innovative Energy, Inc. / Mr. Eric Baker

Procedure

Six (6) 7 by 1 inch specimens were cut from material as-received. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at 73.4 ± 3.6 °F and $50 \pm 5\%$ relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 4.0 inches was used, and the tensile load was applied at the rate of 2 inch per minute until failure occurred. These values were selected in accordance with Table 1 in ASTM D882-12. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lb _f)	Maximum Load/Width (lb _f /in)	Maximum Tensile Strength (lb _f /in ²)/(MPa)	Elongation (%)
1	0.967	0.005	52.67	54.47	10972.9 / 75.66	19.2
2	0.981	0.005	51.28	52.27	10465.3 / 72.16	16.3
3	0.997	0.005	53.99	54.15	10798.0 / 74.45	16.4
4	1.026	0.005	59.25	57.75	11617.7 / 80.10	21.1
5	1.015	0.005	61.85	60.94	12127.5 / 83.62	20.3
6	0.989	0.005	50.23	50.79	10251.0 / 70.68	17.6

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lb _f /in ²	Std Dev	(%)	Std Dev
76.1	4.91	11038.7	711.6	18.5	2.0

Reviewed By: 

Date: 7/1/19



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Test Report for Tensile Strength

Test Number: RD190895TS

Date of Test: May 6, 2019

Specimen Number: 1021190320-7

Date of Manufacture: Unknown

Description of Test Specimen: White Facer Material for Astro Armour; Tested After 500 Hours of UV Exposure; Tested in machine direction

Test Method: ASTM D882-12 "Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

Report Prepared For: Innovative Energy, Inc. / Mr. Eric Baker

Procedure

Six (6) 7 by 1 inch specimens were prepared. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at 73.4 ± 3.6 °F and $50 \pm 5\%$ relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 4.0 inches was used, and the tensile load was applied at the rate of 2 inch per minute until failure occurred. These values were selected in accordance with Table 1 in ASTM D882-12. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lb _f)	Maximum Load/Width (lb _f /in)	Maximum Tensile Strength (lb _f /in ²)/(MPa)	Elongation (%)
1	0.961	0.005	38.15	39.70	7947.9 / 54.80	22.4
2	0.989	0.005	47.52	48.05	9698.0 / 66.87	18.9
3	0.987	0.005	45.15	45.74	9214.3 / 63.53	17.9
4	0.978	0.005	45.50	46.52	9285.7 / 64.02	18.7
5	0.990	0.005	42.66	43.09	8532.0 / 58.83	16.0
6	0.975	0.005	44.35	45.49	9051.0 / 62.40	17.2

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lb _f /in ²	Std Dev	(%)	Std Dev
61.7	4.28	8954.8	621.4	18.5	2.2

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Test Report for Tensile Strength

Test Number: RD190896TS

Date of Test: May 30, 2019

Specimen Number: 1021190320-7

Date of Manufacture: Unknown

Description of Test Specimen: White Facer Material for Astro Armour; Tested After 1000 Hours of UV Exposure; Tested in machine direction

Test Method: ASTM D882-12 "Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

Report Prepared For: Innovative Energy, Inc. / Mr. Eric Baker

Procedure

Six (6) 7 by 1 inch specimens were prepared. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at 73.4 ± 3.6 °F and $50 \pm 5\%$ relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 4.0 inches was used, and the tensile load was applied at the rate of 2 inch per minute until failure occurred. These values were selected in accordance with Table 1 in ASTM D882-12. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lb _f)	Maximum Load/Width (lb _f /in)	Maximum Tensile Strength (lb _f /in ²)/(MPa)	Elongation (%)
1	0.970	0.005	37.61	38.77	7675.5 / 52.92	17.0
2	0.976	0.005	39.68	40.66	8098.0 / 55.83	17.9
3	0.978	0.005	43.06	43.63	8787.8 / 60.59	17.0
4	0.989	0.005	44.24	44.73	9028.6 / 62.25	17.0
5	0.990	0.005	38.95	39.34	7790.0 / 53.71	15.2
6	0.988	0.005	39.44	39.92	8049.0 / 55.50	16.2

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lb _f /in ²	Std Dev	(%)	Std Dev
56.8	3.78	8238.1	547.7	16.7	0.9

Reviewed By: 

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Test Report for Tensile Strength

Test Number: RD190897TS

Date of Test: June 17, 2019

Specimen Number: 1021190320-7

Date of Manufacture: Unknown

Description of Test Specimen: White Facer Material for Astro Armour; Tested After 1500 Hours of UV Exposure; Tested in machine direction

Test Method: ASTM D882-12 "Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

Report Prepared For: Innovative Energy, Inc. / Mr. Eric Baker

Procedure

Six (6) 7 by 1 inch specimens were prepared. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at 73.4 ± 3.6 °F and $50 \pm 5\%$ relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 4.0 inches was used, and the tensile load was applied at the rate of 2 inch per minute until failure occurred. These values were selected in accordance with Table 1 in ASTM D882-12. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lb _f)	Maximum Load/Width (lb _f /in)	Maximum Tensile Strength (lb _f /in ²)/(MPa)	Elongation (%)
1	0.985	0.005	36.59	37.15	7467.4 / 51.49	16.3
2	1.011	0.005	38.77	38.35	7602.0 / 52.41	17.1
3	0.987	0.005	38.82	39.33	7922.5 / 54.62	16.9
4	1.001	0.005	36.64	36.60	7328.0 / 50.52	15.6
5	1.003	0.005	32.86	32.76	6572.0 / 45.31	13.6
6	1.007	0.005	34.98	34.74	6996.0 / 48.24	15.9

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lb _f /in ²	Std Dev	(%)	Std Dev
50.4	3.27	7314.6	475.1	15.9	1.2

Reviewed By: 

Date: 7/1/19



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Test Report for Tensile Strength

Test Number: RD190898TS

Date of Test: June 19, 2019

Specimen Number: 1021190320-7

Date of Manufacture: Unknown

Description of Test Specimen: White Facer Material for Astro Armour; Tested After 2000 Hours of UV Exposure; Tested in machine direction

Test Method: ASTM D882-12 "Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

Report Prepared For: Innovative Energy, Inc. / Mr. Eric Baker

Procedure

Six (6) 7 by 1 inch specimens were prepared. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at 73.4 ± 3.6 °F and $50 \pm 5\%$ relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 4.0 inches was used, and the tensile load was applied at the rate of 2 inch per minute until failure occurred. These values were selected in accordance with Table 1 in ASTM D882-12. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lb _f)	Maximum Load/Width (lb _f /in)	Maximum Tensile Strength (lb _f /in ²)/(MPa)	Elongation (%)
1	0.985	0.005	28.46	28.89	5808.2 / 40.05	12.4
2	1.006	0.005	26.47	26.31	5294.0 / 36.50	10.7
3	0.994	0.005	30.23	30.41	6046.0 / 41.69	13.6
4	0.976	0.005	29.42	30.14	6004.1 / 41.40	14.1
5	0.995	0.005	32.56	32.72	6512.0 / 44.90	16.0
6	0.996	0.005	27.03	27.14	5406.0 / 37.27	10.7

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lb _f /in ²	Std Dev	(%)	Std Dev
40.3	3.10	5845.0	449.1	12.9	2.1

Reviewed By: 

Date: 7/1/19