Roof Maxx Technical Report

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The document contains information pertaining to ASTM testing of Roof Maxx. The evaluations were completed by PRI Construction Materials Technologies, one of the two main ASTM testing laboratories utilized by asphalt shingle manufacturers.

WHAT IS ROOF MAXX?

Roof Maxx is a soy methyl ester based water emulsion used on asphalt roofing shingles that restores flexibility, and therefore extends the service life of the roof.

As an asphalt roof ages, oil dries causing the asphalt to become increasingly brittle. This lessens the shingle's ability to expand and contract, causing deterioration that results in shingles breakage.

Roof Maxx is spray applied absorbing into the shingle within 30 minutes to one hour, depending on ambient temperature.

As documented in this report, treatment with Roof Maxx reverses the shingle's aging process. Therefore, Roof Maxx exhibits great potential to be an economical biobased solution for both maintaining and increasing a roof's service life.

Table 1. Properties of Roof Maxx emulsion*

Properties	Test Conditions	Value
Color	Visual Observation	Milky Emulsion
Density, lb/gal	ASTM D 1475	8.24
Active, %	Estimated based on actives loading in the formulation	10 ± 1
Viscosity, cps	Brookfield viscometer @ 20°C, LV62 Spindle, 3 rpm	5400 ± 300
pH	Non-aqueous glass electrode at 20°C	6.02 ± 0.5
Surface Tension, dynes/cm	Du Nouy ring method	32 ± 0.5
Particle Size range in microns	Mastersizer 2000, Malvern Instruments	0.6 to 120
Particle Size distribution		Broad, bimodal
Freeze Thaw Stability	ASTM D5678-01	Very mild separation, re-dispersible on agitation

*Data from this table was determined by Battelle Memorial Institute

ROOF MAXX ASTM PERFORMANCE TESTING

Three-tab asphalt shingles were obtained from a 17 years-old roof in central Ohio. Half of the shingles were used as control (untreated) and the rest were sprayed with Roof Maxx at a rate of 1 gallon of Roof Maxx emulsion per 100 square feet. Roof Maxx treated shingles were left to air dry for 3 days at room temperature. Then, samples were packed securely and shipped to PRI Construction Material Technologies, LLC, an independent accredited laboratory, for testing of different properties, as discussed below.

The results discussed hereafter are based on the test results provided by PRI Construction Materials Technologies. The PRI report can be read here.

SHINGLE PLIABILITY TESTING / ASTM D3462

The pliability of asphalt shingles was tested according to the ASTM D3462 Standard (Table 2). This is a Pass/Fail test that bends 1 by 6 inch samples, cut of parallel to the shingle length (machine direction – MD) and perpendicular to the shingle length (cross machine direction – CMD), over a 90 degree angle, with either the granules up (weather-side up) or with the granules down (weather-side down). Five samples were tested in each case, and at least 4 should pass for the test to pass. Failure is defined as visible cracking of the asphalt coating of the shingle.

Results of pliability testing:

Table 2. Pliablity results for untreated and Roof Maxx treated shingles

	Roof Maxx treated	Untreated
Weather-Side Up MD	Pass	Pass
Weather-Side Up CMD	Pass	Pass
Weather-Side Down MD	Pass	Fail
Weather-Side Down CMD	Pass	Fail

Roof Maxx significantly improved the flexibility of the asphalt shingles passing ASTM testing.

The weather-side down test simulates the direction that shingles are bent by external effects on a roof, such as wind. The improvement observed in the Roof Maxx treated samples suggests that Roof Maxx application improves the durability of asphalt shingles and their wind resistance.

GRANULE ADHESION TESTING / ASTM D3462 & D4977

The weight of displaced granules was measured according to the ASTM D3462 and D4977 Standards. Treated and untreated shingles were tested in duplicates and the weight (g) of the granules displaced by a test brush in 50 cycles is reported (Figure 1). New shingles are expected to have an average weight of displaced granules of equal or less than 1.

Results of granule adhesion testing:

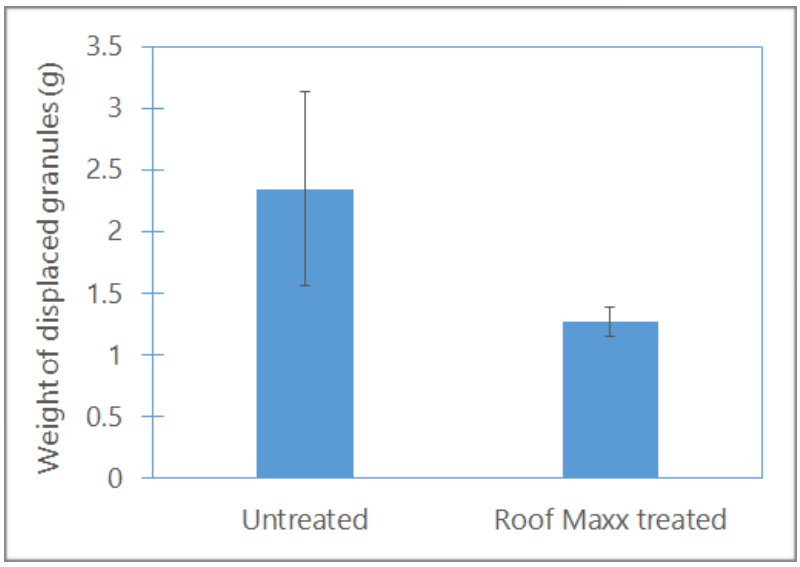

Figure 1. Weight of displaced granules for untreated and Roof Maxx treated asphalt shingles

Roof Maxx significantly improved the granule adhesion, to levels close to those of new shingles.

It was observed that the average weight of displaced granules decreased 46% after the treatment with Roof Maxx, in comparison to the untreated shingle. This implies a significant improvement in granule adhesion, restoring the old shingles to properties close to those of new shingles.

PERMEABILITY TESTING / ASTM E96

Vapor water transmission through the asphalt shingles was measured following the desiccant method of the ASTM E96 Standard to determine their permeability (Figure 2). Permeability of individual new asphalt shingles has been reported to be around 0.9 (Lstiburek et al., 2011).

Results of permeability testing:

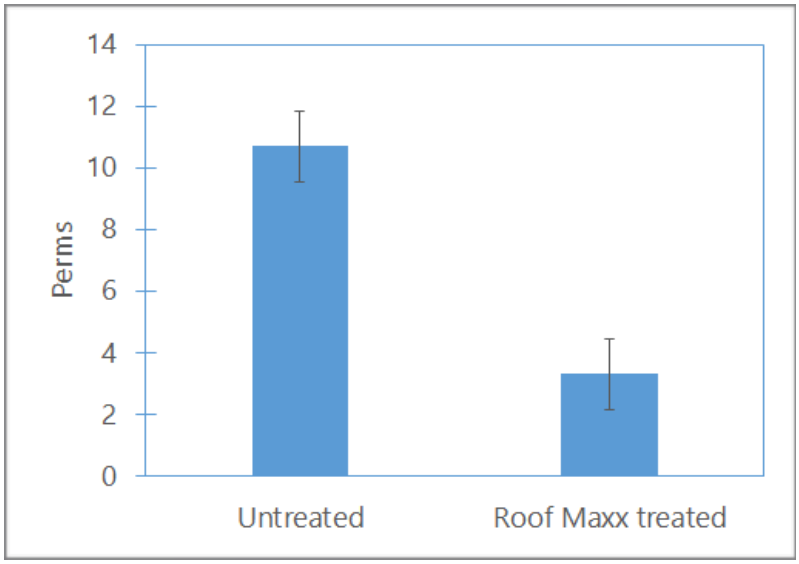

Figure 2. Perms as a measure of vapor water transmission through untreated and Roof Maxx treated asphalt shingles

Roof Maxx improved the permeability by about 60%, restoring values closer to those of new shingles.

Results of this test showed that Roof Maxx reduced the permeability of the old asphalts shingles by about 60% in comparison with untreated shingles, restoring it to values closer to those of new shingles.

SPREAD OF FLAME TESTING

A PRI proprietary test was performed to determine the spread of a flame in a shingles deck placed at a 5:12 slope, simulating ASTM E108 Class A Spread of Flame testing. The edge of the roof was ignited with two gas torches and sustained for 10 minutes at an air velocity of 1056 ft/min. Visual inspection of the flame spread was reported (Figure 3).

Results of spread of flame testing:

Figure 3. Spread of flame in decks of untreated and Roof Maxx treated asphalt shingles

Roof Maxx does not increase fire risk.

This test showed that there was no visual difference between the spread of flame in the untreated shingles and the Roof Maxx treated shingles, suggesting that Roof Maxx application does not increase fire risks.

HAIL IMPACT TESTING / UL2218 CLASS 4 STANDARD

Hail impact resistance was determined following the UL2218 Class 4 Standard on a deck of 3 by 3 feet. The results showed visible depressions after each drop test, and the average size of the depressions are shown in Figure 4.

Results of hail impact testing:

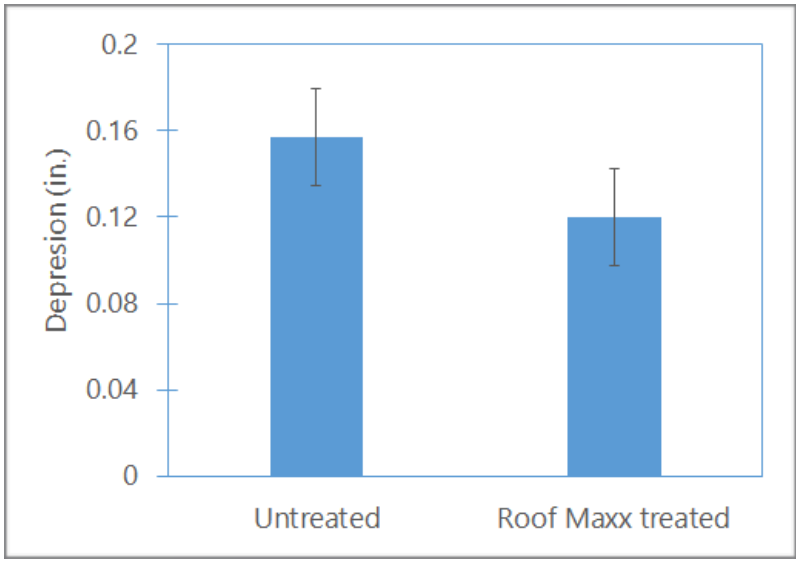

Figure 4. Depression size after impact test on decks of untreated and Roof Maxx treated asphalt shingles

The average depression size decreased by about 24% after Roof Maxx treatment.

After the Roof Maxx treatment, the average depression size decreased by about 24% compared to the untreated shingles. This is probably due to an increase in old shingles flexibility after Roof Maxx treatment.

CONCLUSIONS FROM ASTM TESTING OF A 17 YEAR OLD 3-TAB SHINGLE TREATED WITH ROOF MAXX

The International Association of Home Inspectors states that the average replacement age of an asphalt 3-tab shingle ranges between 10 and 15 years.

Roof Maxx treatment of a 17 year old 3-tab shingle showed considerable improvement of the shingle's characteristics indicating that the treatment reversed the aging process of the asphalt shingles.

Therefore, by increasing the flexibility and granule adhesion of the asphalt shingles, and restoring the permeability to levels close to those of new shingles, Roof Maxx has potential to extend the service life of a roof, without increasing fire risks.

REFERENCES

1. Lstiburek, J., Karagiozis, A., and Gassman, P., 2011, "Vapor Permeability Provides No Performance Benefit for Roofing Underlayments in Ventilated Attics," Owens Corning Roofing and Asphalt, LLC. USA.

2. ASTM Standard D3462, 2016, "Specification for Asphalt Shingles Made from Glass Felt and Surface with Mineral Granules," ASTM International, West Conshohocken, PA, 2016. DOI: 10.1520/D3462_D3462M-16.

3. ASTM Standard D4977, 2013, "Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion," ASTM International, West Conshohocken, PA, 2016. DOI: 10.1520/D4977_D4977M-03R13E01.

4. ASTM Standard E96, 2016, "Test Methods for Water Vapor Transmission of Materials," ASTM International, West Conshohocken, PA, 2016. DOI: 10.1520/E0096_E0096M-16.

5. ASTM Standard E108 Class A, 2017, "Test Methods for Fire Tests of Roof Coverings," ASTM International, West Conshohocken, PA, 2016. DOI: 10.1520/E0108-17.

6. UL2218 Class 4 Standard, 2010, "Standard for Impact Resistance of Prepared Roof Covering Materials", Underwriters Laboratories, Northbrook, IL, 2010.

ACKNOWLEDGEMENTS

This report was prepared at the request of Roof Maxx Technologies and the Ohio Soybean Council, as part of a project funded by the Ohio Soybean Council grant GRT00047431.

Discussion of a specific product or company does not constitute endorsement by The Ohio State University.

Appendix:

PRI Construction Materials Technology Report

CONSTRUCTION MATERIALS

TECHNOLOGIES

EVALUATION OF ROOF MAXX COATED SHINGLES

(PROJECT NO. OSBC-001-02-1)

For

OHIO SOYBEAN COUNCIL
918 PROPRIETORS RD, STE A
WORTHINGTON, OH 43085

DECEMBER 15, 2017

Purpose: PRI was contracted to evaluate the physical properties of ASTM D 3462 type 3-tab asphalt shingles that have been treated with Roof Maxx, a soy-based emulsion used to rejuvenate asphalt shingles. The product is spray applied to shingles in the field to prologue their life.

The Ohio Soybean Council submitted 3-tab shingles that were taken from the field. One (1) set was provided as is, and one (1) set was provided after being treated with Roof Maxx. In addition, the Roof Maxx emulsion was provided. The following properties and testing were requested.

Sample	Test Method - Property
Roof Maxx treated shingles and untreated shingles	ASTM E 96 Procedure A – Water Vapor Transmission
	ASTM D 3462 - Pliability
	ASTM D 3462 – Granule Adhesion
	UL 2218 Class 4 – Impact Resistance
	Proprietary - Spread of Flame
Roof Maxx (liquid)	ASTM D 93 – Flash Point

Test Methods: Testing was completed as described in following test methods.

- ASTM D93 - 16a *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester*
- ASTM D3462 / D3462M - 16 *Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules*
- ASTM E96 / E96M - 16 *Standard Test Methods for Water Vapor Transmission of Materials*
- UL 2218 *Impact Resistance of Prepared Roof Coverings*

In addition, a proprietary method of Spread of Flame testing was utilized to simulate ASTM E 108 Class A Spread of Flame testing conducted over combustible deck at a 5:12 roof slope. Briefly, this testing was conducted using a 12” specimen place at a 5:12 slope. An air velocity of the 1056 ft/min was sustained over the specimen throughout the duration of test. The eave of the roof was ignited with two gas torches and sustained for 10 minutes. At the end of the 10 minutes the samples were visually inspected for the flame spread.

Sampling: All samples were provided by the Ohio Soybean Council.

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Results:

Table 1 – ASTM E 96 for Roof Maxx Treated 3-Tab Asphalt Shingles

Property	Test Method	Results						
Water Vapor Transmission, Min. 3 specimens; *Desiccant Method* Test @ 73.4±3.6°F & 50±10%RH;	ASTM E 96	1	2	3	4	5	**Avg.**	St.Dev.
Water Vapor Transmission, (grains/h·ft^2)		1.14	1.92	0.80	2.10	0.82	**1.36**	0.62
Water Vapor Permeance, (U.S. Perms)		2.79	4.68	1.94	5.13	2.00	**3.31**	1.50
Water Vapor Permeability, (Perm-inch)		0.33	0.56	0.23	0.61	0.24	**0.39**	0.18
Water Vapor Transmission, (g/h·m^2)		0.80	1.34	0.55	1.46	0.57	**0.94**	0.43
Water Vapor Permeance, (ng/Pa·s·m^2)		159	268	111	293	114	**189**	86
Water Vapor Permeability, (ng/Pa·s·m)		0.48	0.81	0.34	0.88	0.34	**0.57**	0.26

Table 2 – ASTM E 96 for Untreated 3-Tab Asphalt Shingles

Property	Test Method	Results						
Water Vapor Transmission, Min. 3 specimens; *Desiccant Method* Test @ 73.4±3.6°F & 50±10%RH;	ASTM E 96	1	2	3	4	5	**Avg.**	St.Dev.
Water Vapor Transmission, (grains/h·ft^2)		4.08	3.87	5.03	4.21	4.72	**4.38**	0.48
Water Vapor Permeance, (U.S. Perms)		9.95	9.45	12.27	10.28	11.51	**10.69**	1.17
Water Vapor Permeability, (Perm-inch)		1.18	1.12	1.46	1.22	1.37	**1.27**	0.14
Water Vapor Transmission, (g/h·m^2)		2.84	2.70	3.50	2.94	3.29	**3.05**	0.33
Water Vapor Permeance, (ng/Pa·s·m^2)		569	540	702	588	658	**612**	67
Water Vapor Permeability, (ng/Pa·s·m)		1.72	1.63	2.12	1.77	1.99	**1.85**	0.20

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Table 3 – ASTM D 3462 “Pliability” for Roof Maxx Treated 3-Tab Asphalt Shingles

Property	Test Method	Results					Requirement
Pliability *[Pass/Fail]*, 1” x6” specimens; Cond. 73±4°F for 2±0.1h; Test @ 73.4±3.6°F; Bend 90° at 1” radius;	ASTM D 3462	1	2	3	4	5	
Weather-Side Up MD		Pass	Pass	Pass	Pass	Pass	4 of 5 shall pass
Weather-Side Up CMD		Pass	Pass	Pass	Pass	Pass	4 of 5 shall pass
Weather-Side Down MD		Pass	Pass	Pass	Pass	Fail	4 of 5 shall pass
Weather-Side Down CMD		Pass	Pass	Pass	Pass	Pass	4 of 5 shall pass

Table 4 – ASTM D 3462 “Pliability” for Untreated 3-Tab Asphalt Shingles

Property	Test Method	Results					Requirement
Pliability *[Pass/Fail]*, 1” x6” specimens; Cond. 73±4°F for 2±0.1h; Test @ 73.4±3.6°F; Bend 90° at 1” radius;	ASTM D 3462	1	2	3	4	5	
Weather-Side Up MD		Pass	Pass	Pass	Pass	Pass	4 of 5 shall pass
Weather-Side Up CMD		Pass	Pass	Pass	Pass	Pass	4 of 5 shall pass
Weather-Side Down MD		Pass	Fail	Fail	Fail	Fail	4 of 5 shall pass
Weather-Side Down CMD		Pass	Pass	Pass	Fail	Fail	4 of 5 shall pass

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Table 5 – ASTM D 3462 “Weight of Displaced Granules” for Roof Maxx Treated 3-Tab Asphalt Shingles

Property	Test Method	Results				Requirement
Weight of Displaced Granules, (g) 2” x 9” specimens; Cond. 30min @ 73.4±3.6°F; Test 50 complete cycles	ASTM D 3462	1	2	Avg.		
		1.18	1.35	**1.27**		≤ 1.0

Table 6 – ASTM D 3462 “Weight of Displaced Granules” for Untreated 3-Tab Asphalt Shingles

Property	Test Method	Results				Requirement
Weight of Displaced Granules, (g) 2” x 9” specimens; Cond. 30min @ 73.4±3.6°F; Test 50 complete cycles	ASTM D 3462	1	2	Avg.		
		1.79	2.90	**2.35**		≤ 1.0

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Table 7 – UL 2218 for Roof Maxx Treated 3-Tab Asphalt Shingles

Property	Test Method	Results						Requirement
Hail Impact Resistance, 1 specimen; 3ft x 3ft test deck Test for Class 4 compliance 2.00±0.01in steel ball diameter 1.15±0.04lb steel ball mass 20.0ft steel ball drop 23.71ft-lb impact kinetic energy 2 drops per impact location 6 impact locations	UL 2218	1	2	3	4	5	6	
Visual Inspection *[Pass/Fail]*		Fail	Fail	Fail	Fail	Fail	Fail	The prepared roof covering material exposed surface, back surface and underneath layers shall show no evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other evidence of opening through any prepared roof covering layer.
Depression (in.)		0.060	0.175	0.127	0.118	0.125	0.115	Report.

Table 8 – UL 2218 for Untreated 3-Tab Asphalt Shingles

Property	Test Method	Results						Requirement
Hail Impact Resistance, 1 specimen; 3ft x 3ft test deck Test for Class 4 compliance 2.00±0.01in steel ball diameter 1.15±0.04lb steel ball mass 20.0ft steel ball drop 23.71ft-lb impact kinetic energy 2 drops per impact location 6 impact locations	UL 2218	1	2	3	4	5	6	
Visual Inspection *[Pass/Fail]*		Fail	Fail	Fail	Fail	Fail	Fail	The prepared roof covering material exposed surface, back surface and underneath layers shall show no evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other evidence of opening through any prepared roof covering layer.
Depression (in.)		0.196	0.142	0.143	0.137	0.154	0.170	Report.

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Table 9 – Results from Proprietary “Spread of Flame” Test

Photos after 10 minute flame exposure at 5:12 slope and a sustained 1056 ft/min air flow	
Untreated 3-Tab Asphalt Shingle	**Roof Maxx Treated 3-Tab Asphalt Shingles**

Remarks: Initial flame was more intense with the Roof Maxx treated specimen even though the resultant flame spread was not appreciably different from the untreated specimen. Post-testing, the plywood deck of the Roof Maxx treated sample sustained a flame, whereas the untreated flame extinguished quickly upon removing the gas torches.

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PRI Construction Materials Technologies LLC 6412 Badger Drive Tampa, FL 33610 Tel: 813-621-5777 Fax: 813-621-5840 e-mail: materialstesting@pricmt.com WebSite: http://www.pricmt.com

Table 1- – ASTM D 93 for Roof Maxx

Property	Test Method	Results
Flash Point, Pensky-Martens Closed Cup; Procedure A; Water removed from material prior to testing;	ASTM D 93	250°F / 121°C

Statement of Attestation:

The performance evaluation of named single-ply membranes was determined in accordance with methods described herein. The laboratory test results presented in this report are representative of the material supplied.

Signed: _____

Zachary Priest, P.E.
Director

Date: December 15, 2017

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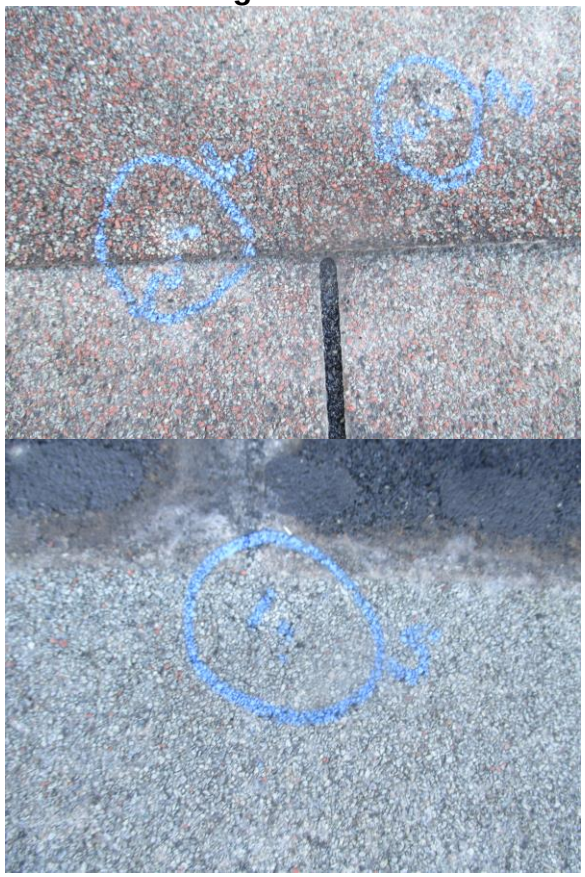
Untreated Shingles



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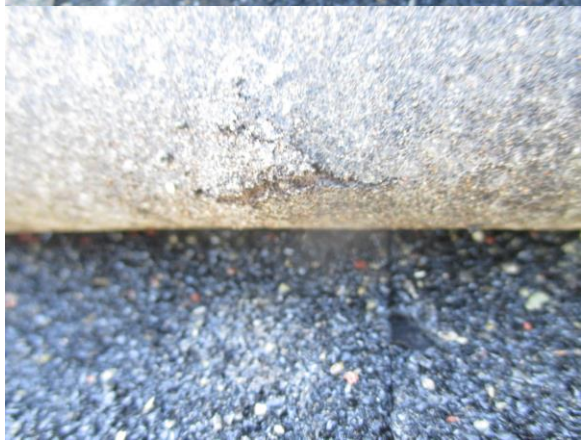

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Roof Maxx Treated Shingles

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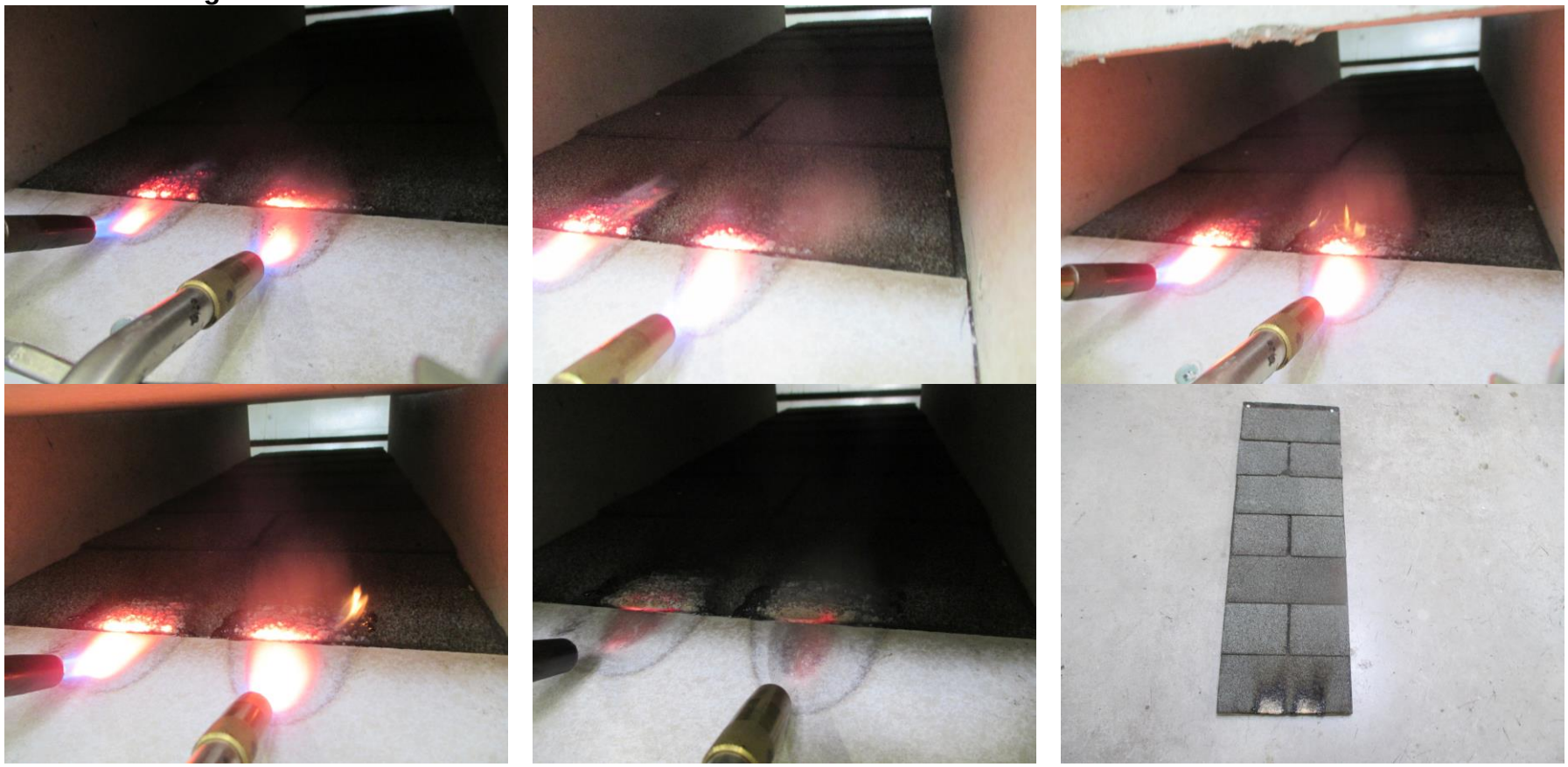
Untreated Shingles



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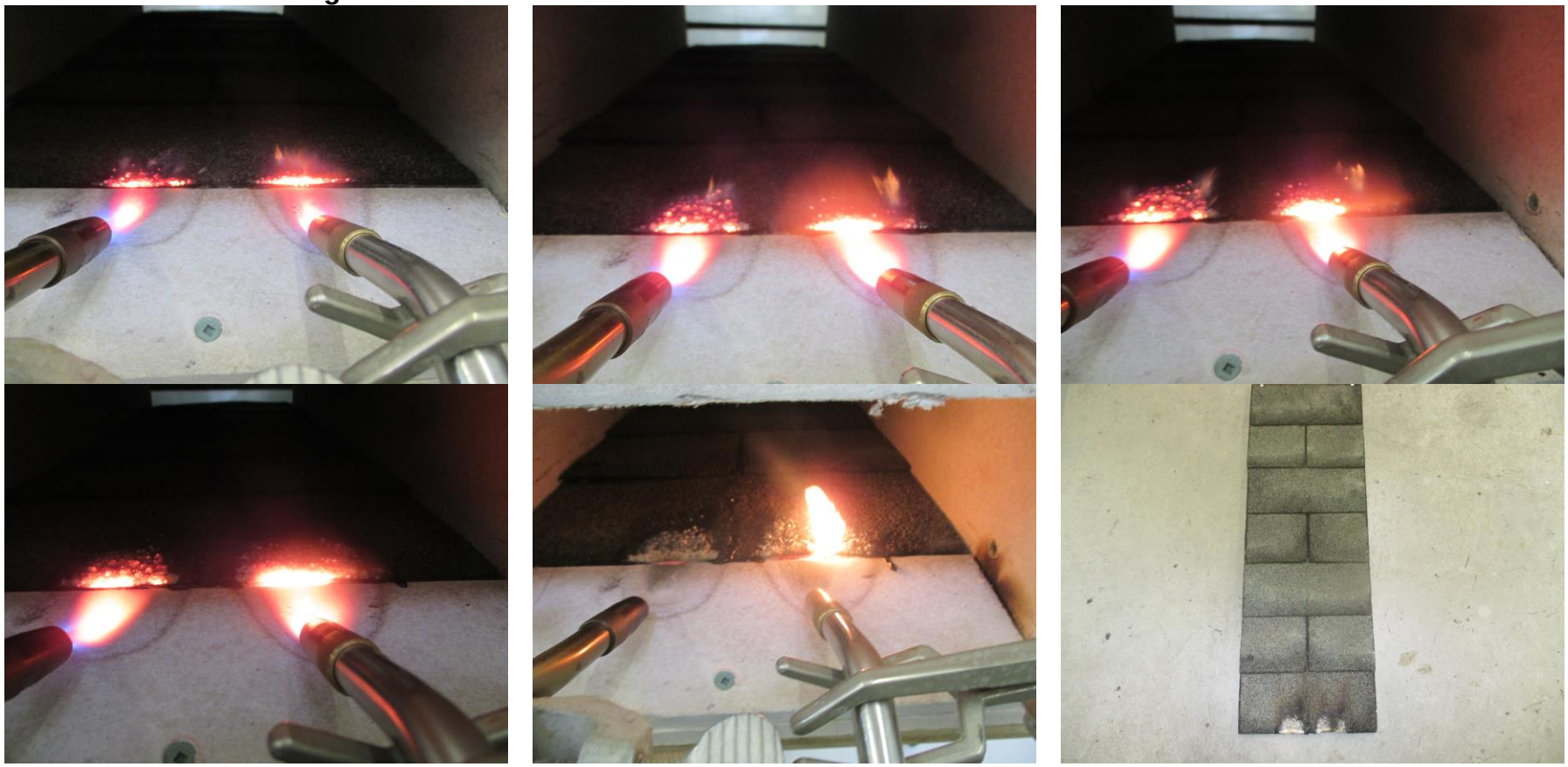
Roof Maxx Treated Shingles



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