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TEST REPORT

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RENDERED TO

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PRODUCT EVALUATED:
Magerack Mounting System

EVALUATION PROPERTY:
Class 'A' System Fire Class Rating of Panel
with Mounting Systems in Combination with
Roof Coverings, For Steep Slope Applications

Report of Testing the photovoltaic module roof mount system by Magerack Corporation for evaluation with the applicable requirements of: UL 1703 (2014) Section 31.2 and UL 2703 (2012) Sections 15.2 and 15.3.

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2 Introduction

Intertek Testing Services NA (Intertek) Fire Testing Laboratory in Middleton, Wisconsin conducted an investigation of the external fire resistance characteristics of a photovoltaic module roof mount system supplied by Magerack Corporation for a class 'A' application. Samples were submitted to Intertek, Middleton and received in October, 2014 in good condition.

The tests were conducted in accordance with the fire resistance criteria of UL 1703 (2014) Section 31.2 and UL 2703 (2012) Sections 15.2 and 15.3 referencing UL 790 (2004) *"Standard Test Methods for Fire Tests of Roof Coverings"*. Testing was conducted with a Type 1 panel, for a steep slope application. The testing was conducted per the requirements of Table 31.2 in UL 1703 (2014).

3 Test Samples

The test decks were constructed by Intertek personnel.

1. The test samples were submitted by the client.
2. The test materials were applied by Intertek personnel at Middleton location.

The samples are described in more detail in the table below.

Deck#	Deck Type	System
1	Burning Brand Class 'A' Brand placed on Top of PV panel. 4" Interstitial space.	Sheathing: 15/32" AC plywood. Underlayment: 15# felt (ASTM D226 Type 1). Shingle: Listed Class A 3 Tab Asphalt shingles. Rack: Magerack mounting system. Photovoltaic Module: Solarworld, Type 1.
2	Spread of Flames Class 'A' 4" Interstitial space.	Sheathing: 15/32" AC plywood. Underlayment: 15# felt (ASTM D226 Type 1). Shingle: Listed Class A 3 Tab Asphalt shingles. Rack: Magerack mounting system. Photovoltaic Module: Solarworld, Type 1.
3	Spread of Flames Class 'A' 4" Interstitial space.	Sheathing: 15/32" AC plywood. Underlayment: 15# felt (ASTM D226 Type 1). Shingle: Listed Class A 3 Tab Asphalt shingles. Rack: Magerack mounting system. Photovoltaic Module: Solarworld, Type 1.
4	Burning Brand Class 'B' Brand placed in Interstitial Space. 4" Interstitial space.	Sheathing: 15/32" AC plywood. Underlayment: 15# felt (ASTM D226 Type 1). Shingle: Listed Class A 3 Tab Asphalt shingles. Rack: Magerack mounting system. Photovoltaic Module: Solarworld, Type 1.

5	Burning Brand Class 'A' Brand placed on Top of PV panel. 4" Interstitial space.	Sheathing: 15/32" AC plywood. Underlayment: 15# felt (ASTM D226 Type 1). Shingle: Listed Class A 3 Tab Asphalt shingles. Rack: Magerack mounting system. Photovoltaic Module: Solarworld, Type 1.
6	Burning Brand Class 'B' Brand placed in Interstitial Space. 4" Interstitial space.	Sheathing: 15/32" AC plywood. Underlayment: 15# felt (ASTM D226 Type 1). Shingle: Listed Class A 3 Tab Asphalt shingles. Rack: Magerack mounting system. Photovoltaic Module: Solarworld, Type 1.

The photovoltaic modules used in this testing were by SolarWorld. These modules were Type 1 panels.

Description of Magerack Mounting System, perimeter not guarded.

Component	Material	Notes
Roof Attachment	Aluminum	Installed with supplied hardware. L-foot. Rail nut. 5/16 x 1-1/4 ss bolt/washer. 5/16 x ¾" ss bolt/washer. L-foot flashing (9"x12" or 12"x12")
Rail	Extruded Aluminum	(5) different lengths available. 10'6", 12', 14', 17', and 20'
End Clamp	Aluminum or Stainless Steel	Installed with stainless steel supplied hardware.
Mid Clamp	Aluminum or Stainless Steel	Installed with stainless steel supplied hardware.
Grounding Lug	Aluminum or Stainless Steel	Not needed or installed for Fire Resistance test.
Wire Clip	Stainless Steel	Secondary component.
Bonding Clip	Stainless Steel	Secondary component.
End Clamp w/ Integrated Bonding	Aluminum and Stainless Steel	Secondary component.

The final connection of the rack to the roof was evaluated for the L-Foot and flashing. The Tile hook is an acceptable means of connection, for use with different roofing constructions. The interstitial space of 4" should be maintained.

4 Testing and Evaluation Methods

The tests were conducted in accordance with the fire resistance criteria of UL 1703 (2014) Section 31.2 and UL 2703 (2012) referencing UL 790 (2004) *"Standard Test Methods for Fire Tests of Roof Coverings".*

The following test equipment was used to conduct the test.

Roofing Lab Equipment	Inventory Number	Measurement Uncertainty	Calibration Date
ASTM E108 Test Apparatus (Shop)	204	NA	Daily
Davis Anemometer (A/2-4 BB)	221	±2% of max reading	1/15/14
Accusplit Timer	611	±0.001% (over 3hr. period)	9/8/14

5 Tests Results

5.1. Results and Observations

Calibration

Test Conditions (Class 'A')

Test Date	10/29/14
Air Velocity	1054 average fpm
Slope of Cal. Deck	5:12
Average flame temp	NA
Ambient air temp.	68ºF

Test Conditions (Class 'A')

Test Date	10/30/14
Air Velocity	1067 average fpm
Slope of Cal. Deck	5:12
Average flame temp	1394ºF
Ambient air temp.	80ºF

Spread of Flames Tests

Test Observations Deck 2

Test Date	10/30/14
Slope of Test Deck	5:12
Ambient Temperature	75°F
Panel/Rack Set-Back	3'1"

Time (min:sec)	Distance (feet-inches)	Observations/Comments
00:00		Burner ignited.
02:10		Ignition of asphalt shingles.
09:00	1'	
10:00		Test stop.

Results: Class "A". Maximum spread of flames is 1'7".

Test Observations Deck 3

Test Date	10/30/14
Slope of Test Deck	5:12
Ambient Temperature	72°F
Panel/Rack Set-Back	3'1"

Time (min:sec)	Distance (feet-inches)	Observations/Comments
00:00		Burner ignited.
01:40		Ignition of asphalt shingles.
05:20	1'	
10:00		Test stop.

Results: Class "A". Maximum spread of flames is 2'.

Burning Brand Tests

Test Observations Deck: 1

Test Date	10/29/14
Ambient Air Temperature	68ºF
Brand Type	Class A, 4.72 lbs
Slope of Test Deck	5:12

Brand#	Time (min:sec) Brand placed on deck	Observations
1	00:00	Brand placed on PV module.
	01:47	Back sheet blistering.
	02:25	Back sheet venting smoke.
	02:53	Back sheet ignites.
	04:02	Ignition of roof surface.
	05:27	Brand ¼ consumed.
	07:06	Glass cracks, brand falls onto roof deck.
	07:12	Smoke from horizontal joint, underside.
	08:26	Discoloration of horizontal joint, underside.
	14:08	Flame out, top side.
	26:42	Glow out, top side. Brand fully consumed.
	60:00	Test stop. No smoke, glow or flame. Deck cool to touch.

Acceptance Level: Class 'A' – No flaming of the underside of the deck.

Test Observations Deck: 4

Test Date	10/30/14
Ambient Air Temperature	74ºF
Brand Type	Class B, 1.21 lbs
Slope of Test Deck	5:12

Brand#	Time (min:sec) Brand placed on deck	Observations
1	00:00	Brand placed on roof, in interstitial space.
	01:56	Surface ignition of roof deck.
	02:30	Back sheet of panel is melting.
	03:50	Back sheet ignites.
	05:13	Brand ¼ consumed.
	06:24	Smoke from horizontal joint, underside.
	08:03	Asphalt is dripping from horizontal joint.
	08:22	Brand ½ consumed.
	09:50	Discoloration of plywood, underside of deck.
	11:00	Brand ¾ consumed.
	11:55	Flame out, top side.
	25:09	Glow on plywood, underside.
	36:30	Glow out, underside.
	60:00	Test stop. Deck cool to touch, no smoke, glow or flame.

Acceptance Level: Pass – No flaming of the underside of the deck.

Test Observations Deck: 5

Test Date	10/30/14
Ambient Air Temperature	65ºF
Brand Type	Class A, 4.68 lbs
Slope of Test Deck	5:12

Brand#	Time (min:sec) Brand placed on deck	Observations
1	00:00	Brand placed on roof, in interstitial space.
	01:45	Blistering of back sheet.
	02:00	Burn through of panel.
	02:15	Back sheet ignites.
	02:30	Shingles ignite.
	03:40	Brand ¼ consumed.
	04:50	Brand ½ consumed.
	05:30	Brand ¾ consumed.
	05:55	Top corners of rail fall to deck.
	06:50	Smoke from vertical and horizontal joint, underside.
	08:00	Discoloration of horizontal joint, underside.
	12:48	Flame out, top side.
	15:15	Discoloration of underside.
	26:30	Glow out, top side. Brand fully consumed.
	52:30	Stop test.

Acceptance Level: Class ‘A’ – No flaming of the underside of the deck.

Test Observations Deck: 6

Test Date	10/30/14
Ambient Air Temperature	64ºF
Brand Type	Class B, 1.20 lbs
Slope of Test Deck	5:12

Brand#	Time (min:sec) Brand placed on deck	Observations
1	00:00	Brand placed on PV module.
	02:00	Shingles ignite.
	02:30	Blistering of back sheet.
	04:30	Back sheet ignites.
	05:20	Brand ¼ consumed.
	05:55	Top edge of panel is bowing.
	06:39	Smoke from horizontal joint, underside.
	07:20	Brand ½ consumed.
	08:20	Discoloration of horizontal joint, underside.
	09:25	Brand ¾ consumed.
	11:40	Flame out, top side.
	12:35	Discoloration of underside plywood.
	20:10	Glow out, top side. Brand fully consumed.
	45:07	Test stop.

Acceptance Level: Pass – No flaming of the underside of the deck.

6 Conclusion

The results of the Class 'A' System Fire Class Rating of Photovoltaic Panels with Mounting Systems in Combination with Roof Coverings, For Steep Slope Applications is stated in the following table. The Magerack mounting system was provided by Magerack Corporation and testing included the use of Type 1 photovoltaic panels. Testing was conducted per UL 1703 (2014) Section 31.2 and UL 2703 (2012) Sections 15.2 and 15.3 referencing UL 790 (2004) *"Standard Test Methods for Fire Tests of Roof Coverings"*..

Sample	Surface Material	Test	Rating
1	Magerack mounting system with Type 1 panel	Burning Brand	Class A
2	Magerack mounting system with Type 1 panel	Spread of Flame	Pass
3	Magerack mounting system with Type 1 panel	Spread of Flame	Pass
4	Magerack mounting system with Type 1 panel	Burning Brand	Pass
5	Magerack mounting system with Type 1 panel	Burning Brand	Pass
6	Magerack mounting system with Type 1 panel	Burning Brand	Class A

The Magerack mounting system with Type 1 photovoltaic panel met the requirement for a Class A fire application in accordance with UL 1703 (2014) Section 31.2 and UL 2703 (2012) in compliance with UL 790 (2004) *"Standard Test Methods for Fire Tests of Roof Covering"* at for steep slope applications.

This report does not automatically imply product certification. Products must be under a certification program and bear the Warnock Hersey registered certification mark to demonstrate compliance.

INTERTEK TESTING SERVICES NA

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Intertek, Building Products

Reviewed by: _____
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Engineering Team Leader, Openings
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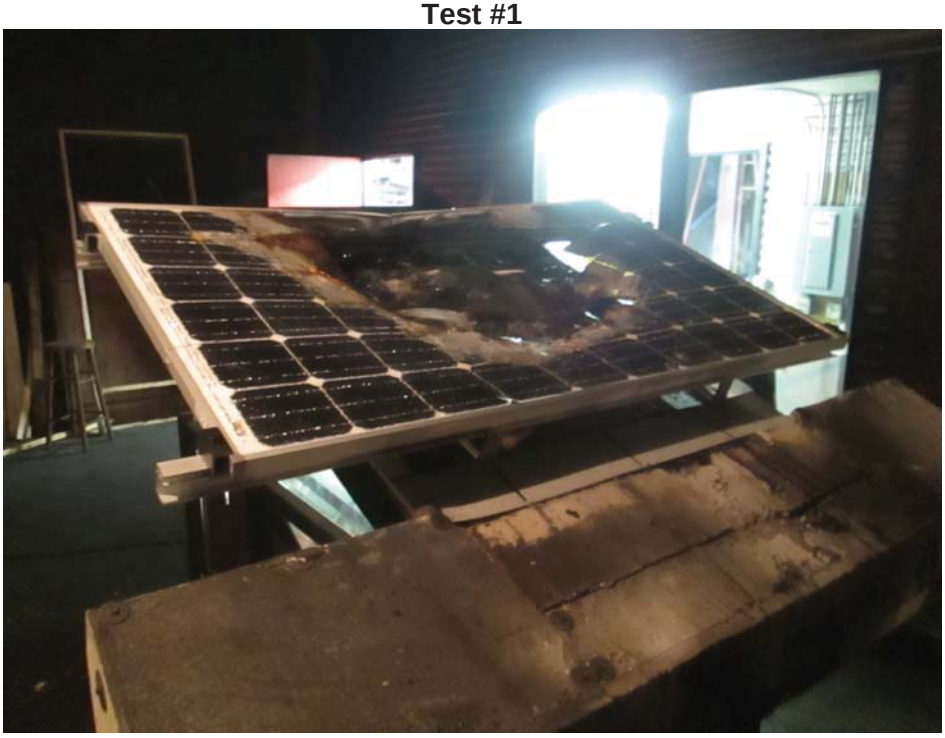
Photographs

Test #1



Test #1

Test #3

Test #6

Test #6

REVISION SUMMARY

DATE	SUMMARY
October 31, 2014	Initial report