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EVALUATION OF THE EXTERNAL FIRE RESISTANCE CHARACTERISTICS OF ROOF COVERING SYSTEMS IN GENERAL ACCORDANCE WITH ASTM E 108-07a, *STANDARD TEST METHODS FOR FIRE TESTS OF ROOF COVERINGS: CLASS A TESTING*

SAMPLE ID: *SPF with a 60 mil EPDM membrane and
DensDeck substrate*

FINAL REPORT
Consisting of 21 Pages

SwRI® Project No. 01.14431.01.325b
Test Date: July 28, 2009, and November 13 and 23, 2009
Report Date: November 30, 2009

Prepared for:

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1.0 INTRODUCTION

This report presents the results of an investigation of the external fire resistance characteristics of the *SPF with a 60 mil EPDM membrane and DensDeck substrate* roof covering system in general accordance with Class A Spread of Flame requirements of ASTM E 108-07a, *Standard Test Methods for Fire Tests of Roof Coverings*. The objective of this standard is to measure the relative fire resistance characteristics of roof coverings under a simulated fire originating outside the building. This standard is used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment that takes into account all of the factors, pertinent to an assessment of the fire hazard of a particular end use. The results apply specifically to the specimens tested, in the manner tested, and not to the entire production of these or similar materials, nor to the performance when used in combination with other materials.

2.0 CLASSIFICATION CRITERIA

Class A tests are applicable to roof coverings that are effective against severe test exposure, afford a severe degree of fire protection to the roof deck, do not slip from position, and do not present a flying brand hazard. To be regarded as Class A, a roofing system shall meet the requirements of eight tests: four Burning Brand tests, two Spread of Flame tests, and two Intermittent Flame tests. Each Class A Burning Brand test requires a Class A burning brand to be placed on the test deck. The brand must be positioned at the location considered most vulnerable to fire penetration. Each Class A Intermittent Flame test requires fifteen 2-min exposures to a $1400\text{ }^{\circ}\text{F} \pm 50\text{ }^{\circ}\text{F}$ flame with a 2-min interval between each exposure. Each Class A Spread of Flame test requires a single 10-min exposure to a $1400\text{ }^{\circ}\text{F} \pm 50\text{ }^{\circ}\text{F}$ flame. All tests are performed in the presence of a $1056 \pm 44\text{-ft/min}$ air velocity.

In order to meet acceptance criteria in accordance with ASTM E 108-07a, a roof covering material shall meet the following conditions when subjected to the particular class of fire tests:

1. At no time during or after the Intermittent Flame, Spread of Flame, or Burning Brand tests shall:
 - Any portion of the roof covering material be blown or fall off the test deck in the form of flaming or glowing brands that continue to glow after reaching the floor,
 - The roof deck be exposed (except for roof coverings restricted to use over noncombustible deck), or

- Portions of the roof deck fall away in the form of particles that continue to glow after reaching the floor.
2. At no time during the Class A, B, or C Intermittent Flame or Burning Brand tests shall there be sustained flaming of the underside of the deck. If flaming does occur, conduct another series of tests, during which no sustained flaming shall occur.
 3. During the Spread of Flame tests, the flaming shall not spread beyond 6 ft (1.8 m) for Class A, 8 ft (2.4 m) for Class B, nor 13 ft (4.0 m, the top of the deck) for Class C. There shall be no significant lateral spread of flame from the path directly exposed to the test flame.

3.0 TEST INFORMATION

Client: TTR Roofing International Inc.

SwRI Project No.: 01.14431.01.325b

Test Specimen

Identification: *SPF with a 60 mil EPDM membrane and DensDeck substrate*

Date Received: July 28, 2009 and November 11, 2009

Description: TTR Roofing International Inc.'s SPF with 60 mil Firestone RubberGard non-reinforced EPDM membrane. The membrane was adhered to the SPF foam using a nominal 1/4-in. of spray applied adhesive. A 1/2-in. thick substrate of DensDeck was also used.

Dimensions: N/A

Nominal Weight: 2.75-lb/ft³ SPF

Construction Details: In ascending order, the *SPF with a 60 mil EPDM membrane and DensDeck substrate* roofing system consisted of:

1. 15/32-in., 5-ply, Douglas Fir A-C grade plywood decking.
2. 1/2-in. thick DensDeck roofing board.
3. 1-1/2 to 2-in. thickness of SPF.
4. 1/4-in. thickness of spray applied adhesive.
5. Firestone RubberGard non-reinforced EPDM membrane, white in color and 60 mils thick.

Surveillance: N/A

Color: Off-white foam and adhesive, White and Black Membrane

Storage Conditions: Ambient conditions

Test Details

Test Dates: July 28, 2009, and November 13 and 23, 2009

Test Location: Southwest Research Institute's (SwRI's) Fire Technology Department in San Antonio, Texas

Miami-Dade Approval: The Test Notification Number from Miami-Dade County Florida for this test program is SWRI 09036.

Witnesses: Mr. Barry L. Badders Jr., P.E. No. 61907, Florida

Calibration Details: See Appendix A

Tests Conducted: ASTM E 108-07a Class A

Slope: 1/2:12

Observations: Selected photos taken during the test are presented in Appendix B. Observations made during each test can be found in Appendix C.

Other Details: Testing was also performed on a similar roofing system in which the white 60 mil membrane was replaced with a black 45 mil membrane. Based on previous testing conducted July 28, 2009 by SwRI, it was determined that the roofing system with the black membrane was the more critical system. Classification was sought for both systems; and therefore, SwRI performed Burning Brand testing on both the black and white membrane systems. SwRI performed Intermittent Flame testing only on the black membrane system. These test results are outlined in the results section.

Deviations: For the Intermittent Flame test, a Class A Burning Brand test deck was used in lieu of a Class A Intermittent Flame deck. However, the deck was placed onto the test apparatus backwards, such that the vertical plywood seam on the Burning Brand deck was located at the front of the apparatus closer to the burner location. This was done in order to more accurately represent the Intermittent Flame test deck.

4.0 RESULTS

TTR Roofing International Inc.'s *SPF with a 60 mil EPDM membrane and DensDeck substrate* roof covering system met the Class A Spread of Flame requirements of ASTM E 108-07a. Five additional tests were performed on the roofing systems provided by TTR Roofing International Inc. A summary of these test results are outlined in Table 1.

Table 1. Test Results.

Test No.	Type of Test	Membrane Used	Result
1	Class A BB	Black 45 mil	Pass
2	Class A BB	Black 45 mil	Pass
3	Class A BB	White 60 mil	Pass
4	Class A BB	White 60 mil	Pass
5	Class A IF	Black 45 mil	Pass

5.0 CONCLUSION

SwRI's Fire Technology Department performed testing in general accordance with the Class A requirements of ASTM E 108-07a for TTR Roofing International Inc. on July 28, 2009, and November 13 and 23, 2009. Mr. Barry L. Badders Jr. (Professional Engineer, License No. 61907, registered in the State of Florida) of SwRI was present to witness the testing. Messrs. Stan Cox, John Justice, and Angel Morales representing TTR Roofing International Inc. were present to witness the testing on July 28, 2009 only. The Test Notification Number from Miami-Dade County Florida for this test program is SWRI 09036. Based on the test results and the classification criteria, the *SPF with a 60 mil EPDM membrane and DensDeck substrate* roof covering system, manufactured by TTR Roofing International Inc. and described herein, met the ASTM E 108-07a Class A Spread of Flame requirements for roof coverings.

This system also passed two Class A Burning Brand tests. The SPF with a 45 mil EPDM membrane and DensDeck substrate roof covering system passed two additional Class A Burning Brand tests and a Class A Intermittent Flame test. Based on these test results, it is in the opinion of SwRI that the *SPF with a 60 mil EPDM membrane and DensDeck substrate* roof covering system would meet the full Class A requirements of ASTM E 108-07a.

APPENDIX A
CALIBRATION DATA
(Consisting of 1 Page)

Calibration Data

Calibration Date: July 28, 2009

Air Velocity (ft/min):	Right	1100	
	Center	1099	
	Left	1035	
Flame Temperature (°F):	2-min Average	1400	(760 °C)

Calibration Data

Calibration Date: November 13, 2009

Air Velocity (ft/min):	Right	1098	
	Center	1054	
	Left	1092	
Flame Temperature (°F):	2-min Average	N/A	

Calibration Data

Calibration Date: November 23, 2009

Air Velocity (ft/min):	Right	1086	
	Center	1075	
	Left	1086	
Flame Temperature (°F):	2-min Average	1416	(769 °C)

APPENDIX B
SELECTED TEST PHOTOGRAPHS
(Consisting of 5 Pages)



Figure B-1. Application of SPF.



Figure B-2. Side View of Assembly.



Figure B-3. Test ID SoF-1. Sample at beginning of Test.



Figure B-4. Test ID SoF-1. Sample at end of Test.



Figure B-5. Test ID SoF-2. Sample at end of Test.



Figure B-6. Test ID BB-1. Sample at end of Test.



Figure B-7. Test ID BB-1. Underside of Deck at end of Test.



Figure B-8. Test ID BB-4. Sample at end of Test.



Figure B-9. Test ID IF-1. Sample at end of Test.

APPENDIX C
TEST OBSERVATIONS
(Consisting of 7 Pages)

Class A Burning Brand Test
November 13, 2009

Test ID No.: BB 1 of 4
Specimen ID: *SPF with a 45 mil EPDM membrane and DensDeck substrate*
Ambient Air Temperature: 70 °F (21.1 °C)
Deck EMC: 7.3 %
Brand Weight: 4.46 lb (2,021 g)

TIME MIN:S	OBSERVATIONS
00:00	Start of test; brand placed on deck.
02:00	Flame spread to end of deck.
04:00	Flames spreading toward front of deck.
14:45	Flaming ceased. Brand 90% consumed.
22:00	Light smoking observed on underside.
39:30	Test stopped. No failure conditions present. PASS

Class A Burning Brand Test
November 13, 2009

Test ID No.: BB 2 of 4
Specimen ID: *SPF with a 45 mil EPDM membrane and DensDeck substrate*
Ambient Air Temperature: 73 °F (22.8 °C)
Deck EMC: 8.5 %
Brand Weight: 4.52 lb (2,053 g)

TIME MIN:S	OBSERVATIONS
00:00	Start of test; brand placed on deck.
02:00	Flame spread to end of deck.
20:00	Flaming ceased. Minimal glowing near brand remains.
44:00	Test stopped. No failure conditions present. PASS

Class A Burning Brand Test
November 13, 2009

Test ID No.: BB 3 of 4
Specimen ID: *SPF with a 60 mil EPDM membrane and DensDeck substrate*
Ambient Air Temperature: 74 °F (23.3 °C)
Deck EMC: 8.3 %
Brand Weight: 4.71 lb (2,137 g)

TIME MIN:S	OBSERVATIONS
00:00	Start of test; brand placed on deck.
02:30	Flame spread to end of deck.
16:30	Minimal flaming remains.
51:00	Test stopped. No failure conditions present. PASS

Class A Burning Brand Test
November 13, 2009

Test ID No.: BB 4 of 4
Specimen ID: *SPF with a 60 mil EPDM membrane and DensDeck substrate*
Ambient Air Temperature: 74 °F (23.3 °C)
Deck EMC: 8.6 %
Brand Weight: 4.39 lb (1,992 g)

TIME MIN:S	OBSERVATIONS
00:00	Start of test; brand placed on deck.
03:00	Flame spread to end of deck.
50:00	Smoking observed on underside of deck.
56:20	Test stopped. No failure conditions present. PASS

Class A Intermittent Flame Test
November 23, 2009

Test ID No.: IF 1 of 1
Specimen ID: *SPF with a 45 mil EPDM membrane and DensDeck substrate*
Ambient Air Temperature: 61 °F (16.1 °C)
Deck EMC: 16.0%

TIME MIN:S	OBSERVATIONS
00:00	Start of test; Cycle #1 start. Blistering at leading edge after 30 s. Ignition at leading edge after 40 s.
02:00	Cycle #1 complete. Flames spreading toward end of deck.
04:00	Cycle #2 start. Flames spread to end of deck.
06:00	Cycle #2 complete.
08:00	Cycle #3 start. Flaming ceased at end of deck at 8 min 20 s.
10:00	Cycle #3 complete. Flaming ceased at leading edge of deck.
12:00	Cycle #4 start.
14:00	Cycle #4 complete. No ignition.
16:00	Cycle #5 start.
18:00	Cycle #5 complete. No ignition.
20:00	Cycle #6 start.
22:00	Cycle #6 complete. No ignition.
24:00	Cycle #7 start.
26:00	Cycle #7 complete. No ignition.
28:00	Cycle #8 start.
30:00	Cycle #8 complete. No ignition.
32:00	Cycle #9 start.
34:00	Cycle #9 complete. No ignition.
36:00	Cycle #10 start.
38:00	Cycle #10 complete. No ignition.
40:00	Cycle #11 start.
42:00	Cycle #11 complete. No ignition.
44:00	Cycle #12 start.
46:00	Cycle #12 complete. No ignition.
48:00	Cycle #13 start.
50:00	Cycle #13 complete. No ignition.
52:00	Cycle #14 start.
54:00	Cycle #14 complete. No ignition.
56:00	Cycle #15 start.
58:00	Cycle #15 complete. No ignition. Test stopped. No failure conditions present. PASS

Class A Spread of Flame Test
July 28, 2009

Test ID No.: SoF 1 of 2
 Specimen ID: *SPF with a 60 mil EPDM membrane*
 Ambient Air Temperature: 88 °F (31.1 °C)

TIME MIN:S	OBSERVATIONS
00:00	Start of test; burner on.
00:45	Bubbling and ignition at leading edge of sample.
10:00	Test stopped. Flame-spread to 4-1/4 ft. No failure conditions present. PASS

Flame-Spread Distance and Time.

Distance	1 ft	2 ft	3 ft	4 ft	5 ft	6 ft	7 ft	8 ft
Time (min:s)	1:50	3:45	5:45	9:30	-	-	-	-

**Class A Spread of Flame Test
July 28, 2009**

Test ID No.: SoF 2 of 2
 Specimen ID: SPF with a 60 mil EPDM membrane
 Ambient Air Temperature: 90 °F (32.2 °C)

TIME MIN:S	OBSERVATIONS
00:00	Start of test; burner on.
01:00	Bubbling at leading edge.
03:25	Ignition at leading edge.
04:30	Flame-spread to 1 ft.
10:00	Test stopped. Flame-spread to 2-3/4 ft. No failure conditions present. PASS

Flame-Spread Distance and Time.

Distance	1 ft	2 ft	3 ft	4 ft	5 ft	6 ft	7 ft	8 ft
Time (min:s)	4:30	7:45	-	-	-	-	-	-