APPROVAL REPORT

POLARA® POLYESTER ROOF FELT AND POLARALUME® ALUMINUM FOIL-BACKED POLYESTER FELT BASE SHEET FOR USE WITH CLASS 1 ROOF DECK ASSEMBLIES

Prepared For:

PALISADES ATLANTIC CORPORATION
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RIDGEFIELD PARK, NJ 07660

2B1A2.AM
Class 4470
Date: May 5, 1997

FACTORY MUTUAL | Factory Mutual System

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from

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I INTRODUCTION

1.1 Palisades Atlantic Corporation submitted their Polara® polyester roof felt and Polaralume® aluminum foil-backed polyester felt base sheet to determine if they meet Factory Mutual Research Corporation (FMRC) Standard No. 4470 (1986) for Class 1 Fire and 1-60 and 1-90 Windstorm Classifications in Class 1 roof deck assemblies.

1.2 Examination included testing for the potential interior fire spread below the roof deck, testing for the potential exterior fire spread above the roof deck, simulated wind uplift pressure testing, small scale comparison testing, water leakage testing and hail resistance testing.

1.3 Tests indicate that the Polara® polyester roof felt and Polaralume® aluminum foil-backed polyester felt base sheet meets the FMRC Standard 4470 (1986) Approval requirements when installed as specified in the CONCLUSIONS of this report.

II MATERIALS TESTED

2.1 Polara® polyester built-up roof felt is a flexible felt of nonwoven polyester fibers and a binder. It is used as the felt in built-up roofing membranes. The nominal thickness is 0.025 in. (0.64 mm). The felt is supplied in roll form and is white in color. Each roll contains 823.3 ft² (76.5 m²), the width is 40 in. (1.02 m) and the length is 247 ft (75.3 m).

2.2 Polaralume® aluminum foil-backed polyester felt base sheet consists of a flexible felt top layer of nonwoven polyester fibers and binder with an aluminum foil laminated to the bottom side with a water-based adhesive. It is used as the base sheet in built-up roof assemblies. The nominal thickness of the felt top later is 0.025 in. (0.64 mm) and the nominal thickness of the aluminum foil bottom layer is 0.002 in. (0.05 mm). The base sheet is supplied in roll form and is white on top with an aluminum bottom layer. Rolls are supplied in various lengths, and the width is 40 in. (1.02 m).

2.3 The proprietary formulations are on file at FMRC.

III TESTS AND PROCEDURES

3.1 Tests conducted were as required by FMRC Standard 4470 (1986) - Approval requirements for Class 1 Insulated Steel Deck Roofs.

3.2 FMRC Calorimeter Fire Test

A fire test from below the roof deck was conducted using the FMRC Construction Materials Calorimeter which measures the maximum rate of fuel contribution by the sample roof, also expressed as maximum heat release rate (HRR); e.g, for a Class 1 rating, the assembly must exhibit a HRR no greater than 410 Btu/ft^2/min (77.6 kW/m^2) in any 3 minute time frame during the 30 minute fire exposure.

3.3 ASTM E108 (93) Spread of Flame Tests

3.3.1 Fire tests from above the roof cover were conducted in accordance with ASTM E108 Spread of Flame Tests.

3.3.2 Each sample size was 3-1/3 by 8 ft. (1.0 by 2.4 m).

3.3.3 The wind velocity over the top of the standard panel was adjusted to 12±0.5 mph (5.3±0.2 m/s).

3.3.4 Flame exposure: The flame was adjusted to 1400±50 °F (760±28 °C) for Class A tests. The flame temperature was measured by a thermocouple located 1 in. (25.4 mm) above the surface of the standard panel and 1/2 in. (13 mm) toward the flame source from the lower edge of the standard panel. The flame was applied to each test panel for 10 minutes.

3.3.5 During and after the application of the flame, each panel was observed for the distance of maximum flame spread, glowing brands and other damage.

3.4 FMRC Simulated Windstorm Classification Tests

3.4.1 The simulated wind uplift tests were conducted to evaluate the ability of the completed roof assemblies to resist simulated wind uplift forces as specified in FMRC Standard 4470 without failure of the assemblies.

3.4.2 Simulated wind uplift pressure test No. 1 utilized a 9 ft. (2.7 m) long by 5 ft. (1.5 m) wide by 2 in. (51 mm) deep steel pressure vessel arranged to apply air pressure at pre-established standard rates to the underside of the test panel which formed the top of the pressure vessel. The vessel was pressurized with compressed air.

3.4.3 Simulated wind uplift pressure test No. 2 and No. 3 utilized the 24 ft (7.3 m) long by 12 ft (3.6 m) wide by 2 in. (51 mm) deep steel pressure vessel arranged to apply air pressure at pre-established standard rates to the underside of the test panel which formed the top of the pressure vessel. The vessel was pressurized with compressed air.

3.4.4 For each test, a net pressure of 30 psf (1.4 kPa) was applied to the test sample and maintained for 1 minute. The pressure was increased to 45 psf (2.2 kPa), then to 60 psf (2.9 kPa) and held for 1 minute at each increment. The pressure was increased in increments of 15 psf (0.7 kPa) every minute until failure occurred.

3.5 Comparative Tensile Pull-Through Tests

3.5.1 Tensile pull-through tests were conducted with various fasteners in combination with the tested base sheet to determine the comparative performance of the base sheet in resisting pull-through of the selected fasteners. The results were compared and used as the basis for selection of the most critical fasteners to be used in the simulated wind uplift pressure tests.

3.5.2 Tests were conducted using a Tinius Olsen tensile testing machine. Each fastener and plate was placed through the center of the base sheet sample with the fastener held in the upper stationary jaws of the tester and the jig holding the base sheet attached to the moving head. Force was exerted in a direct line parallel to the shank of the fastener at a crosshead speed of 2 in./min (51 mm/min) until failure occurred.

3.6 FMRC Simulated Hail Damage Tests

3.6.1 The simulated hail damage tests were conducted using the FMRC simulated hail damage test apparatus to evaluate the ability of the roof cover to withstand a hailstorm without damage to the covering. The test criteria state that there must be no signs of cracking, splitting, internal separation, delamination or rupture of the roof cover.

3.6.2 Severe Hail Damage Test for Class 1-SH - A 1.75 in. (49 mm) diameter steel ball weighing 0.78 lbs. (0.3 kg) was dropped from a 17 ft 9.5 in. (5.4 m) height through a 2 in. (51 mm) ID PVC tube. This procedure was repeated several times on various sections of the sample. After each drop the sample was inspected for cracking, splitting, internal separation, delamination and rupture of the roof cover.

3.7 FMRC Susceptibility to Leakage Test

3.7.1 Tests were conducted in accordance with the FMRC Susceptibility to Leakage Test procedure.

3.7.2 The test apparatus consists of top and bottom sections which are bolted together with the specimen being evaluated placed as a diaphragm between the sections. The top and bottom sections consist of 9-1/4 in. (203 mm) diameter pipe. An 11-5/8 in. (295 mm) diameter pipe flange is cemented to the other end of each pipe section. Both top and bottom sections are bolted together at the flanges with the cover being evaluated placed between them. The apparatus is fabricated to allow both a standing head of water above and additional air pressure below the test sample. Each section is fabricated with two 1/2 in. (13 mm) diameter pipe outlets to allow connection of an air pressure inlet and pressure gauge.

3.7.3 The 10 in. (254 mm) diameter specimen is bolted in place between the flanges of the test apparatus. Water is placed over the sample to a depth of 6 in. (152 mm) and maintained for a period of 7 days. At the end of the 7 day period, air is introduced below the water to a 1 psig (6.3 kPa) level and cycled 25 times from 1 psig (6.3 kPa) to ambient. Test criteria state that there shall be no signs of water leakage during the 7 day period. In addition, there shall be no signs of water leakage during or after the pressure cycles.

IV TEST SAMPLES

4.1 FMRC Calorimeter Test Panel

4.1.1 One 4-1/2 by 5 ft. (1.4 by 1.5 m) panel was constructed. The components and sequence of installation were as follows:

Sample No. 1: 18 gauge FMRC Approved steel deck.
ACFoam II 1.5 in. thick roof insulation loose laid on deck.
One layer of foil-backed polyester felt (Polaralum®) mechanically fastened to the ACFoam II through the 6 in. (152 mm) laps.
Two layers of Polara® polyester felt applied "phased" with 6 in. (152 mm) laps and adhered to the Polaralum® with asphalt applied at 40 lb/sq.
Flood coat asphalt applied at 75 lb/sq.

4.2 ASTM E108 Spread of Flame Test Panels

4.2.1 Two 3-1/3 by 8 ft. (1.0 by 2.4 m) panels were constructed. The components and sequence of installation were as follows:

Sample No. 1: 3/8 in. (9.5 mm) plywood.
ACFoam II 1.5 in. (38 mm) thick insulation loose laid.
Polaralum® foil-backed polyester felt base sheet mechanically attached.
Two layers of Polara® polyester felt applied "phased" with 6 in. (152 mm) laps and adhered to the Polaralum® with asphalt applied at 40 lb/sq.
Flood coat asphalt applied at 75 lb/sq.
Karnak 97 AF coating applied at 1-1/2 gal/sq.(0.60 L/m²).

Sample No. 2: Same as sample No. 1.

4.3 FMRC Simulated Windstorm Classification Test Panels

4.3.1 One 5 ft x 9 ft (1.5 m x 2.7 m) test sample was constructed. The components and sequence of installation were as follows:

Sample No. 1: FMRC Approved 22 gauge steel deck.
ACFoam II 1.5 in. (38 mm) thick insulation loose laid.
Polaralum® foil-backed polyester felt base sheet mechanically attached with Dekfast Hex Plate and #14 Dekfast fasteners secured within the 6 in. (152 mm) laps 18 in. (457 mm) o.c. in rows 17 in. (432 mm) apart.
Each row was staggered 6 in. (152 mm).
Two layers of Polara® polyester felt applied "phased" with 6 in. (152 mm) laps and adhered to the Polaralum® with asphalt applied at 40 lb/sq.
Flood coat asphalt applied at 75 lb/sq.

4.3.2 Two 12 ft x 24 ft (3.7 m x 7.3 m) test samples were constructed. The components and sequence of installation were as follows:

Sample No. 1: 22 gauge (MSG) [0.0295 in. (0.7493 mm)] thick, 1.5 in. (38 mm) deep, Wheeling Corrugating Company BW series steel roof deck meeting ASTM Designation A611 Grade E or ASTM Designation A446 Grade E placed over 0.25 in. (6 mm) thick structural steel supports having a maximum 6 ft (1.8 m) o.c. span. Deck anchored to the minimum .25 in. (6 mm) thick steel supports with ITW Buildex Traxx/4 or Traxx/5 fasteners spaced at maximum 6 in. (152 mm) o.c. at the supports. The deck side laps secured with ITW Buildex Traxx/1 fasteners spaced at a maximum 30 in. (762 mm) o.c.
ACFoam II 1.5 in. (38 mm) thick insulation loose laid.
Polaralum® foil-backed polyester felt base sheet mechanically attached with SFS Stadler IF-3"-S Type II Bore 3 in. (76 mm) diameter steel plates and #14-10 Insul-Fixx fasteners secured within the 6 in. (152 mm) laps 18 in. (457 mm) o.c. in rows 17 in. (432 mm) apart. Each row was staggered 6 in. (152 mm).
Two layers of Polara® polyester felt applied "phased" with 6 in. (152 mm) laps and adhered to the Polaralum® with asphalt applied at 40 lb/sq.
Flood coat asphalt applied at 75 lb/sq.

Sample No. 2: 22 gauge (MSG) [0.0295 in. (0.7493 mm)] thick, 1.5 in. (38 mm) deep, Wheeling Corrugating Company BW series steel roof deck meeting ASTM Designation A611 Grade E or ASTM Designation A446 Grade E placed over 0.25 in. (6 mm) thick structural steel supports having a maximum 6 ft (1.8 m) o.c. span. Deck anchored to the minimum .25 in. (6 mm) thick steel supports with ITW Buildex Traxx/4 or Traxx/5 fasteners spaced at maximum 6 in. (152 mm) o.c. at the supports. The deck side laps secured with ITW Buildex Traxx/1 fasteners spaced at a maximum 30 in. (762 mm) o.c.
ACFoam II 1.5 in. (38 mm) thick insulation loose laid.
Polaralum® foil-backed polyester felt base sheet mechanically attached with SFS Stadler IF-3"-S Type II Bore 3 in. (76 mm) diameter steel plates and #14-10 Insul-Fixx fasteners secured within the 6 in. (152 mm) laps 18 in. (457 mm) o.c. in rows 17 in. (432 mm) apart. Each row was staggered 6 in. (152 mm).
3 ply BUR (organic felts).

4.4 Tensile Pull-Through Test Samples

Fifteen samples (three for each fastener/base sheet combination) were prepared by inserting a sample of the indicated base sheet into a 12 by 12 in. (300 by 300 mm) jig with a 3 in. (75 mm) diameter opening in the center. The indicated fastener was then placed through the indicated base sheet in the center of the opening in the jig.

Fastener	Base Sheet
Olympic Standard metal 3 in. (76 mm) diameter plate	Polaralum® base sheet
Trufast MP-3 - 3 in. (76 mm) diameter plate	"
Dekfast Hex Plate	"
ITW Buildex 3 in. (76 mm) Round Metal Plate	"
SFS Metal IF-3"S metal 3 in. (76 mm) diameter plate	"

4.5 FMRC Simulated Hail Damage Test Sample

One 2 x 4 ft (1.2 x 2.4 m) test sample was constructed. The components and sequence of installation were as follows:

Sample No. 1: Polaralum® foil-backed polyester felt base sheet.
Two layers of Polara® polyester felt applied "phased" with 6 in. (152 mm) laps and adhered to the Polaralum® with asphalt applied at 40 lb/sq.
Flood coat asphalt applied at 75 lb/sq.

4.6 FMRC Susceptibility to Leakage Test

One 2 x 4 ft (1.2 x 2.4 m) test sample was constructed. The components and sequence of installation were as follows:

Sample No. 1: Polaralum® foil-backed polyester felt base sheet.
Two layers of Polara® polyester felt applied "phased" with 6 in. (152 mm) laps and adhered to the Polaralum® with asphalt applied at 40 lb/sq.
Flood coat asphalt applied at 75 lb/sq.

V RESULTS

5.1 FMRC Calorimeter Tests

The calorimeter test showed the test sample to have fuel contribution rates below the maximum permissible rates for Class 1 Insulated Steel Deck Roof Construction. These rates and the Class 1 limits are given below:

Maximum Average Rate of Fuel Contribution
BTU/ft²/min. (kW/m²) for
Various Intervals of Time

	3 min.	5 min.	10 min.	Avg.
Class I Standard	410 (77.6)	390 (73.8)	360 (68.1)	285 (53.0)
Test Sample No. 1	149 (28.2)	149 (28.2)	132 (25.0)	102 (19.0)

5.2 ASTM E108 (96) Spread of Flame Tests

5.2.1 The results of the ASTM E108 Spread of Flame tests were as follows:

Sample No.	Slope	Max. Flame Spread	Rating
1	1/2"/12" (4.2%)	1 ft 10 in. (0.6 m)	Class A
2	1/2"/12" (4.2.)	4 ft 0 in. (1.2 m)	Class A

5.2.2 Deck exposure, flying brands and significant lateral flame spread were not observed during the tests.

5.3 FMRC Simulated Windstorm Classification Tests

5.3.1 The 5 ft x 9 ft (1.5 m x 2.7 m) simulated wind uplift pressure test sample No. 1 described in paragraph 4.3.1 above exceeded the 60 psf (2.9 kPa) minimum FMRC requirements for Class 1-60 Windstorm Classifications, and also exceeded the 90 psf (4.3 KPa) minimum FMRC requirements for Class 1-90 Windstorm Classifications.

5.3.2 The 12 ft x 24 ft (3.7 m x 7.3 m) simulated wind uplift pressure test samples No. 1 and No. 2 described in paragraph 4.3.2 above exceeded the 60 psf (2.9 KPa) minimum FMRC requirements for Class 1-60 Windstorm Classifications, and also exceeded the 90 psf (4.3 KPa) minimum FMRC requirements for Class 1-90 Windstorm Classifications. In addition, the sample exceeded the 120 psf (5.8 kPa) minimum FMRC requirement for Class 1-120 Windstorm Classification, and also exceeded the 150 psf (7.3 KPa) minimum FMRC requirements for Class 1-150 Windstorm Classifications.

5.4 Comparative Tensile Pull-Through Tests

The results (average of three) of the tensile pull-through tests were as follows:

Fastener	lbf (N)
Olympic Standard metal 3 in. (76 mm) diameter plate	298 (1328)
Trufast MP-3 - 3 in. (76 mm) diameter plate	296 (1319)
Dekfast Hex Plate	264 (1176)
ITW Buildex 3 in. (76 mm) Round Metal Plate	292 (1301)
SFS Metal IF-3"S metal 3 in. (76 mm) diameter plate	318 (1417)

5.5 FMRC Simulated Hail Damage Test

After each drop of the impactor the sample was observed for cracking, splitting, internal separation, delamination and rupture of the roof cover. After 10 drops of the impactor, the sample showed no sign of cracking, splitting, internal separation, delamination or rupture of the roof cover.

5.6 FMRC Susceptibility to Leakage Test

The leakage test sample showed no signs of water leakage during the 7 day period.

VI CONCLUSIONS

6.1 Test results indicate that Polara® polyester roof felt and Polaralume® aluminum foil-backed polyester felt base sheet manufactured by Palisades Atlantic Corporation meets Factory Mutual Research Corporation (FMRC) Standard No. 4470 (1986) for Class 1 Fire and 1-60 and 1-90 Windstorm Classifications in Class 1 roof deck assemblies as summarized below:

Roof Cover:	Polara® roof felt
Deck:	Steel, Concrete, Recover (max 1 in. [25 mm] insulation for steel deck), as indicated below.
Coating:	Karnak 97 AF coating applied at 1-1/2 gal/sq.(0.60 L/m²).
Roof Cover Laps:	6 in. (152 mm) wide
Roof Cover Application:	Two layers applied "phased" with 6 in. (152 mm) laps and adhered to the base sheet with asphalt applied at 40 lb/sq and a flood coat of asphalt applied at 75 lb/sq.
Base Sheet:	Polaralum® foil-backed polyester felt base sheet
Base Sheet Laps:	6 in. (152 mm) wide
Base Sheet Application:	Mechanically attached within the laps 18 in. (457 mm) o.c. in rows 17 in. (432 mm) apart. Each row is staggered 6 in. (152 mm).
Hail Rating:	Class 1-SH
ASTM E 108:	Class A noncombustible deck at 1/2 in 12 slope

Construction #1: Steel, Concrete, Recover. ACFoam II, ACFoam III, E"NRG"Y-2, Hytherm AP, ISO95+GL, Multi-Max insulation presecured to the deck. Base sheet, roof cover and coating applied as above. Meets Class 1-90.

Fasteners: 1) Olympic #12 & #14, Olympic Standard metal 3 in. round plate, 2) Trufast #12-DP & #14 HD, Trufast MP-3 metal 3 in. round plate 3) Dekfast #12, #14, #15 Heavy, Dekfast Hex Plate, 4) ITW Buildex #12, #14, metal 3 in. round plate, 5) SFS #12-11 InsulFixx, #14-10 InsulFixx, IF-3"S metal 3 in. round plate.

Construction #2: Steel. Insulation, same as construction # 1 above, is presecured to either 18, 20 or 22 gauge (MSG) [0.0474, 0.0358 or 0.0295 in. (1.2040, 0.9093 or 0.7493 mm)] thick, 1.5 in. (38 mm) deep, Wheeling Corrugating Company BW series steel roof deck meeting ASTM Designation A611 Grade E or ASTM Designation A446 Grade E placed over 0.25 in. (6 mm) thick structural steel supports having a maximum 6 ft (1.8 m) o.c. span. Deck anchored to the minimum .25 in. (6 mm) thick steel supports with ITW Buildex Traxx/4 or Traxx/5 fasteners spaced at maximum 6 in. (152 mm) o.c. at the supports. The deck side laps secured with ITW Buildex Traxx/1 fasteners spaced at a maximum 30 in. (762 mm) o.c. Mill certification stating that the steel deck meets one of the above ASTM grade designations is required. The certification shall be provided to the building owner or his designated representative. Base sheet, roof cover and coating applied as above. Meets Class 1-150.

Fasteners: 1) SFS #14-10 InsulFixx, IF-3"S metal 3 in. round plate.

6.2 The roof cover must be installed using a FMRC Approved Roof Perimeter Flashing system (see FMRC Approval Guide).

6.3 The fastener density must be increased at the roof corners and perimeter. See FMRC Loss Prevention Data Sheets 1-28 and 1-29 for details.

6.4 Test results show that the above roof constructions, in and of themselves alone, would not create a need for automatic sprinkler protection.

6.5 The tested roof felt and base sheet, when installed as described above, meets the Factory Mutual Research Corporation Approval Standards and when Approval is effective, will be listed in the Factory Mutual Research Corporation Approval Guide, Description of Approved Combinations and Assemblies for use in Approved Combinations.

6.6 Approval is effective when the Approval Agreement is signed and received by Factory Mutual Research Corporation.

6.7 Continued Approval depends on satisfactory field experience and periodic Quality Audit Inspections.

VII MARKING

7.1 The manufacturer shall mark each roll with the manufacturer's name and product trade name. In addition, the roll shall be marked with the FMRC Approval Mark and the words "Subject to the conditions of Approval as a Roof Covering when installed as described in the current edition of the FMRC Approval Guide".

7.2 Markings denoting FMRC Approval shall by applied by the manufacturer only within and on the premises of manufacturing locations that are under the FMRC Facilities and Procedures Audit Program.

7.3 The manufacturer agrees that use of the FMRC name or Approval Mark is subject to the conditions and limitations of the FMRC Approval. Such conditions and limitations must be included in all references to FMRC Approval.

VIII MANUFACTURER'S RESPONSIBILITIES

8.1 To assure compliance with his procedures in the field, the manufacturer shall supply to the roofer such necessary instruction or assistance required to produce the desired performance achieved in the tests.

8.2 The manufacturer shall notify FMRC of any planned change in the Approved product, prior to general sale or distribution, using Form 797, Approved Product-Revision Report.

IX QUALITY AUDIT INSPECTION AND REEXAMINATION

9.1 Re-examination and manufacturing inspections will be conducted periodically on the approved products at the Palisades Atlantic Corporation manufacturing location in Ridgefield Park, NJ to determine that the quality and uniformity of the materials have been maintained and will provide the same level of performance as originally Approved.

TESTS AND REPORT BY:

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Engineer

REPORT APPROVED BY:

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