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APPROVAL REPORT

PROTAN SE ROOF COVER IN MECHANICALLY ATTACHED CLASS 1 STEEL AND CONCRETE DECK ROOF CONSTRUCTIONS

Prepared for:

**PROTAN AS
POSTBOKS 420, N-3002 DRAMMEN
NORWAY**

Project ID: 3013587

Class: 4470

Date of Approval:

6/11/04

Authorized by:

[Signature]
George A. Smith, Group Manager

FM Approvals
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062

**PROTAN SE ROOF COVER IN MECHANICALLY ATTACHED CLASS 1 STEEL AND
CONCRETE DECK ROOF CONSTRUCTIONS**

from

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I INTRODUCTION

- 1.1 Protan AS submitted their SE roof cover to determine if it meets the Approval requirements of the **Standard** listed below for Class 1 roof covers in selected roof constructions.
- 1.2 This Report may be reproduced only in its entirety and without modification.
- 1.3 **Standard:**

Title	Class Number	Date
Class 1 Roof Covers	4470	April, 1989

- 1.4 Examination included ASTM E108 tests, Simulated Wind Uplift tests, Simulated Hail Damage testing, Resistance to Foot Traffic testing and Susceptibility to Leakage testing.
- 1.5 Tests show that the submitted assemblies as tested, meet the Approval requirements of the **Standard** listed above for use in Class 1 insulated roof constructions, when installed as described in the conclusions.
- 1.6 **Listings:** The tested constructions meet the Approval criteria of FM Approvals when installed as specified in the **CONCLUSIONS** of this report and will be listed in the FM Approval Guide.

II DESCRIPTION

- 2.1 Protan SE is a polyester reinforced PVC sheet, with a textured non-slip top surface produced with a light gray top surface, and a dark grey bottom surface. The membrane is produced in two widths 39.4 in. (1 m) wide or 78.8 in. (2 m) wide by 0.047 in. (1.2 mm) thick.. There are two roof systems: the Standard Overlap System and the Secret Fix Strip System which has factory welded fastening Strips transverse to the roll length at various intervals. Both systems have heat welded seams.
- 2.2 All other components are as described in the current edition of the FM Approval Guide. Proprietary formulations, specifications, and drawings are on file at FM Approvals.

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III EXAMINATIONS AND TESTS

- 3.1 Samples were submitted for examination and testing as follows:
- 3.1.1 Tests conducted were as required by the **Standard** listed in paragraph 1.3 above. FM Approvals corrosion resistance testing was waived because of previous satisfactory performance of the fasteners in prior Approval programs sponsored by the fastener manufacturer. FM Approvals calorimeter testing was waived due to previous satisfactory performance of the currently Approved insulations in more combustible constructions.
- 3.1.2 The fasteners, plates and insulation samples were produced under the FM Approvals Facilities and Procedures Audit program as indicated by FM Approvals labels. All samples were considered to be representative of standard production and were examined and tested as indicated below.
- 3.1.3 Roof covers, insulations, fasteners and plates incorporated into test samples were selected by FM Approvals personnel. Test samples were prepared by, or under the supervision of, FM Approvals personnel.
- 3.1.4 All data is on file at FM Approvals under J.I 3013587 along with other documents and correspondence applicable to this program.

3.2 FM Approvals 5 x 9 ft (1.5 x 2.7 m) Simulated Wind Uplift Pressure Test

- 3.2.1 The test was conducted using the FM Approvals Uplift Pressure Test Apparatus to evaluate the ability of the above deck components of the roofing system to resist a minimum simulated wind uplift pressure of 60 psf (2.9 kPa) without failure of the assemblies.
- 3.2.2 The simulated wind uplift pressure test 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 a pre-established standard rates to the underside of the test sample which formed the top of the pressure vessel. The vessel was pressurized with compressed air.
- 3.2.3 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.
- 3.2.4 One 5 by 9 ft (1.5 by 2.7 m) sample was prepared. The components, sequence of installation and test results were as follows:

Sample No.1: - 22 gauge steel deck Approved by FM Approvals
- 1.5 in. (38 mm) thick Polyisocyanurate roof insulation was presecured to the deck.
- Protan SE 0.047 in. (1.2 m) roof cover was secured to the deck with Olympic XHD screws and Olympic XHD 2 3/8 in. (60 mm) round barbed plates spaced 12 in. (300 mm) o.c. within the 5.0 in. (125 mm) wide laps. Laps were spaced 34 1/2 in. (875 mm) o.c. and sealed with a 1 1/2 - 1 3/4 in. (38 - 44 mm) wide heat weld.

Test Result: The test sample met the 90 psf (4.3 kPa) minimum FM Approvals requirements for Class 1-90 windstorm classification. The sample held the 135 psf (6.4 kPa) limit of the test equipment. Roof constructions tested using this test method are limited by FM Approvals to a maximum windstorm classification of Class 1-90.

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3.3 FM Approvals 12 x 24 ft (3.7 x 7.3 m) Simulated Wind Uplift Pressure Test

- 3.3.1 The test was conducted using the FM Approvals Uplift Pressure Test Apparatus to evaluate the ability of the above deck components of the roofing system to resist a minimum simulated wind uplift pressure of 60 psf (2.9 kPa) without failure of the assemblies.
- 3.3.2 The simulated wind uplift pressure test utilized a 12 ft. (3.7 m) long by 24 ft. (7.3 m) wide by 5 in. (127 mm) deep steel pressure vessel arranged to apply air pressure at a pre-established standard rates to the underside of the test sample which formed the top of the pressure vessel. The vessel was pressurized with compressed air.
- 3.3.3 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.
- 3.3.4 One 12 by 24 ft. (3.7 x 7.3 m) sample was prepared. The components, sequence of installation and test result is as follows:

Sample No.1:

- 12 ft 3 in. (3.7 m) sections of ASTM A1008/A1008M SS Grade 80 FM Approvals Approved 22 gauge steel deck were installed parallel to the 24 ft (7.3 m) test frame dimension and secured to 1/4 in. (6.4 mm) thick steel structural supports spaced 6 ft (1830 mm) on center with TRAXX/5 fasteners 6 in. (152 mm) on center at each bearing and 24 in. (305 mm) on center at the perimeter of the test frame. Deck side laps were secured 24 in. (610 mm) on center with TRAXX/1 fasteners.
- 3.5 in. (90 mm) Kingspan TR26 FM insulation secured using FM Approvals preliminary fastening requirements.
- 0.047 in. (1.2 mm) thick Protan SE Secret Fix roof cover secured with # 14 Olympic Heavy Duty screws and Olympic XHD 2 3/8 in. (60 mm) round barbed plates spaced 12 in, (300 mm) o.c. along the membrane Secret Fix tabs. The Secret Fix tabs were spaced 39.4 in. (1 m) o.c.

Test Results: The test sample met the 60 psf (2.9 kPa) minimum FM Approvals requirements for Class 1-60 windstorm classification. The construction failed after maintaining a pressure of 75 psf (3.6 kPa) for 5 seconds. Fastener pull out from deck was the mode of failure.

3.4 ASTM E108-00 Spread of Flame Tests

- 3.4.1 The fire tests from above the roof cover were conducted in accordance with ASTM E108-00 Spread of Flame Tests.
- 3.4.2 Sample size was 3 – 1/3 by 8 ft. (1.0 by 2.4m)
- 3.4.3 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 ½ 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.

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- 3.4.4 During and after the application of the flame, each panel was observed for the distance of maximum flame spread, glowing brands and other damage.
- 3.4.5 Two 3-1/3 by 8 ft. (1.0 by 2.4 m) test samples were prepared. The components and sequence of installation were as follows:

Test Sample No.1 & 2:

- ½ in. (13 mm) plywood deck
- Single layer of 3.5 in. (90 mm) thick Kingspan TR26 FM Polyisocyanurate insulation board mechanically attached.
- .047 in. (1.2 mm) thick Protan SE membrane mechanically attached.

- 3.4.6 Results of the ASTM E108 Spread of Flame tests were as follows:

<u>Sample No.</u>	<u>Slope</u>	<u>Max. Flame Spread</u>	<u>Rating</u>
1	2 in 12	4 ft 4 in. (1.30 m)	A
2	2 in 12	4 ft 5 in. (1.32 m)	A

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

3.5 FM Approvals Simulated Hail Damage Tests

- 3.5.1 Tests were conducted using the FM Approvals Simulated Hail Damage Test Apparatus to evaluate the ability of the roof cover to withstand a hailstorm without damage to the membrane.

- 3.5.2 For the severe hail damage tests, a 1¾ in. (49 mm) diameter steel ball weighing 0.79 lbs. (0.359 kg) was dropped on the test sample from a 17 ft 9½ in. (5.42 m) height through a 3¾ in. (0.86 m) length of PVC pipe with a 2 in. (51 mm) inside diameter. This procedure was repeated several times on various sections of the sample. After each drop the sample was inspected for damage to the weatherproof membrane. Following initial testing, the sample was conditioned (weathered) for 1000 hours in the FM Approvals Ultraviolet Weatherometer. The initial procedure was then repeated on the conditioned sample.

- 3.5.3 After each, drop the sample is inspected and there must be no evidence of splitting, delamination or rupture of the roof cover.

- 3.5.4 One 2 by 4 ft. (0.6 by 1.2 m) sample was prepared. The components and sequence of installation were as follows:

- Sample No.1:
- 3.5 in.(90 mm) Kingspan TR26 FM insulation
 - Protan SE roof cover loose laid with center seam.

- 3.5.5 No damage to the roof cover on the test panel described in 3.5.4 above was observed after each drop of the simulated hail impactor before or after conditioning (weathering).

3.6 FM Approvals Susceptibility to Leakage Test

- 3.6.1 A test was conducted in accordance with the FM Approvals Susceptibility to Leakage Test Procedure to evaluate the ability of the roof cover to resist leakage of water under the conditions of the test.

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- 3.6.2 The test apparatus consists of top and bottom sections which are bolted or clamped together with the specimen being evaluated placed as a diaphragm between the sections. The top and bottom sections consist of 9-1/4 in. (235 mm) diameter cap cemented to 7-3/4 in. (197 mm) clear acrylic 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 or clamped 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 source and a pressure gauge.
- 3.6.3 After conditioning (weathering) for 1000 hours in the FM Approvals Ultraviolet Weatherometer a 10 in. (254 mm) diameter specimen was cut from the sample and bolted or clamped in place between the flanges of the test apparatus. Water was 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 was introduced below the sample at a pressure of 1 psi (6.3 kpa) and cycled 25 times from 1 psi (6.3 kpa) to ambient.
- 3.6.4 There must be no signs of water leakage during the 7 day period or during or after the pressure cycles following the exposure.
- 3.6.5 One 18 in. (460 mm) diameter panel of Protan SE roof cover with center seam was prepared.
- 3.6.6 No signs of water leakage through the test panel were observed during the 7 day exposure to a head of water or during or after the pressure cycles following the exposure.
- 3.7 FM Approvals Resistance to Foot Traffic Test
- 3.7.1 The test was conducted using the FM Approvals Resistance to Foot Traffic Test Apparatus to evaluate the ability of the roof cover/insulation combination to resist simulated foot traffic without damage.
- 3.7.2 A 3 in. (76 mm) square steel plate with rounded corners was centered on the centerline of the 12 in. (305 mm) square horizontal test panel and positioned along the butt edge and the side joint of the insulation boards. A 200 lb. (91 kg) load was imposed on the plate and then removed. This cycle was repeated four additional times. Penetration and residual readings were taken after each cycle without removing the plate. The roof covers were inspected for damage after the last cycle at the steel plate interface.
- 3.7.3 There must be no tearing or cracking of the roof cover causing exposure of plastic, glass fiber, foam or other compressible core materials.
- 3.7.4 One sample was prepared. The components and sequence of installation were as follows:
- Sample No.1: - 3.5 in. (90 mm) Kingspan TR26 FM insulation
- Protan SE roof cover loose laid with center seam
- 3.7.5 No damage to the roof cover on the test sample was observed after the tests.

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IV MARKING

- 4.1 The manufacturer shall mark each roll or wrapping with the manufacturer's name and product trade name. In addition, the roll or wrapping must be marked with the Approval Mark of FM Approvals and the words "Subject to the conditions of Approval as a roof cover as described in the current edition of the FM Approval Guide.
- 4.2 Markings denoting Approval by FM Approvals shall be applied by the manufacturer only within and on the premises of manufacturing locations that are under the FM Approvals Facilities and Procedures Audit program.
- 4.3 The manufacturer agrees that use of the FM Approvals name or Approval Mark is subject to the conditions and limitations of the Approval by FM Approvals. Such conditions and limitations must be included in all references to Approval by FM Approvals.

V REMARKS

- 5.1 The securement of the roof system must be enhanced at the building corners and perimeter as outlined in FM Global Property Loss Prevention Data Sheet 1-29.
- 5.2 The roof cover must be installed using a roof perimeter flashing system Approved by FM Approvals. See the current edition of the FM Approval Guide.

VI FACILITIES AND PROCEDURES AUDITS

The Protan A/S manufacturing location in Drammen, Norway is subject to periodic audit inspections to determine that the quality and uniformity of the materials have been maintained and will provide the same level of performance as originally Approved. The facility and quality control procedures in place have been found to be satisfactory to manufacture product identical to that examined and tested as described in this report.

VII MANUFACTURER'S RESPONSIBILITIES

- 7.1 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.
- 7.2 The manufacturer shall notify FM Approvals of any planned change in the Approved products, prior to general sale or distribution, using Form 797, Approved Product Revision Report.

VIII DOCUMENTATION

The following documents describe the Protan SE roof cover and are filed under J.I. 3013587.

Document	Issue or Revision	Description
Quality control information regarding application for FM Approval of the product Protan SE	Dec.18,2001	Protan SE Quality Control Information

IX CONCLUSIONS

- 9.1 Test results from this program indicate Protan SE roof cover meets the FM Approvals Standard 4470 (1986) Approval requirements for Class 1 Fire and various windstorm classifications when installed as follows:
 - 9.1.1 Steel (new) Kingspan TR26 FM or TR27 FM roof insulation secured to the deck per preliminary fastening requirements. The Protan SE Standard Overlap System is secured along the 4 ½ in. seams with Olympic XHD screws and Olympic XHD 2 3/8 in. (60 mm) round barbed plates spaced 12 in. (300 mm) o.c. within the 4 ½ in. (114 mm) wide laps. Laps are spaced 34 ½ in. (875 mm) o.c. and sealed with a 1 ½ - 1 ¾ in. (38 - 44 mm) wide heat weld. Meets Class 1-90 Windstorm Classification.
 - 9.1.2 Steel (new) FM Approvals Approved 22 gauge steel deck meeting ASTM A1008/A1008M-01a SS Grade 80 or A653/A653M-01a Grade 80 is secured per Approval requirements. Kingspan TR26 FM or TR27 FM roof insulation secured to the deck per preliminary fastening requirements. The Protan Secret Fix roof cover is secured along the 5 ½ in. (144 mm) Secret Fix tabs with Olympic # 14 Heavy Duty screws and 2 3/8 (60 mm) XHD barbed plates spaced 12 in. (305 mm) o.c. The tabs are spaced 39 in. (1 m) o.c. The roof cover's membrane laps sealed with a 1 ½ - 1 ¾ in. (38-44 mm) wide heat weld. Meets 1-60 Windstorm Classification.
- 9.2 The above constructions meets ASTM E108 Class A fire rating at a maximum slope of 2 in 12 and the SH Hail rating.
- 9.3 Tests show that the tested roof constructions in and of themselves would not create a need for automatic sprinklers.
- 9.4 Since a duly signed Master Agreement is on file for this customer, Approval is effective as of the date of this report.
- 9.5 Continued Approval will depend upon satisfactory field experience and periodic Facilities and Procedures Audits.

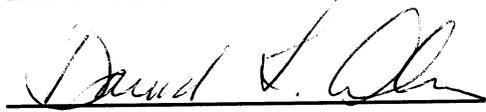
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TESTING SUPERVISED BY: D.L. Alves

PROJECT DATA RECORD: 3013587

ATTACHMENTS: None

REPORT BY:



D. L. Alves
Senior Engineer - Materials Group

REPORT REVIEWED BY:



P. J. Smith, PE
Technical Team Manager - Materials Group