APPROVAL REPORT

APPROVAL OF PYROCRETE 241
FIRE PROTECTIVE COATING
FOR STEEL PROCESS STRUCTURES

Prepared for:

CARBOLINE, INC.
350 HANLEY INDUSTRIAL COURT
ST. LOUIS, MO 63144

Project ID: 3024079
Class: 4971
Date of Approval: March 13, 2006
Authorized by: George A. Smith, Assistant Vice President
Director, Materials Group.
I  INTRODUCTION

1.1 Carboline, Inc. submitted their Pyrocrete 241 fire protective coating for an examination to determine if it meets the Approval requirements of the Standard listed below as a fire protective coating for steel process structures.

1.2 Items that were examined for conformance to the referenced Standard include:

1.2.1 Fire endurance and hose stream testing conducted in accordance with the standard referenced below.

1.2.2 Heat of Combustion testing.

1.3 The fire endurance testing was conducted at the Carboline, Inc. facility in St. Louis, MO with a representative of FM Approvals in attendance.

1.4 This Report may be reproduced only in its entirety and without modification.

1.5 Standard:

<table>
<thead>
<tr>
<th>Title</th>
<th>Class / Document Name</th>
<th>Date of Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Protective Coating for LP Gas Storage Vessels and Process Structures</td>
<td>4971</td>
<td>September 1981</td>
</tr>
</tbody>
</table>

1.6 Listings: This company’s products will be listed in the Approval Guide as follows:

1.6.1 Building Materials/Fire Protective Coatings – For Process Structures

Pyrocrete 241. A cementitious coating applied over a primed steel surface. Prior to application of the coating, a diamond mesh, galvanized steel lath [3.4 lb/yd² (1.3 kg/m²)] is pre-bent and tie wired into place. Smaller members (minimum size is W10x49) require lath only around the flanges. Larger members may also need to have lath applied over the member’s web. Coating is then spray or trowelled in layers until a minimum thickness of 1-7/16 in. (37 mm), as measured from the steel surface, is achieved.
II PRODUCT DESCRIPTION

2.1 Pyrocrete 241 is a cementitious fireproof coating that is spray or trowel applied to structural steel. It is applied to structural steel contours to a minimum thickness of 1-7/16 in. (37 mm) as measured from the face of the steel. Steel lath, 3.4 lb/yd² (1.3 kg/m²), is secured to the steel prior to application of the coating. The coating is prepared by mixing 4.5 gallons (16.5 l) of water per 50 lb (22.7 kg) bag of dry Pyrocrete 241 in a mixer and mixed to a wet density of 74 – 80 lbs/ft² (1185 – 1281 kg/m²).

2.2 The product is currently FM Approved for other purposes. The formulation is considered proprietary and is on file at FM Approvals.

III EXAMINATION AND TESTING

3.1 Two test specimens were prepared using 24 in. (610 mm) long sections of W10 x 49 steel. The steel was primed with Carboguard 893 to a 3 mil (0.076 mm) thickness. Five (5) 20 gage Type K, stainless steel thermocouples were peened into the center of each flange and the web of each sample. The ends of the steel were capped with concrete. Pre-bent steel lath, 3.4 lb/yd² (1.3 kg/m²), was placed over each flange and tie-wired into place. A lifting hook was also welded to the section.

3.2 The coating was mixed (50 lbs (22.7 kg) of dry weight powder to 4-1/2 gallons (16.5 l) of water and spray applied to the samples. It was then troweled into place until a thickness of approximately 7/8 in. (22 mm) was achieved. The 1st layer was allowed to partially set up and then a 2nd coat was applied in the same manner until the final thickness, as measured from the steel face, was approximately 1-7/16 in. (37 mm) thick. The surface was then troweled smooth. The coating of the samples was witnessed by a representative of FM Approvals.

3.3 The samples were allowed to cure for 31 days prior to testing.

IV TEST PROCEDURE

4.1 Fire Test

4.1.1 Two tests were conducted using Carboline’s fire endurance furnace located in St. Louis, MO. A representative of FM Approvals witnessed the tests.

4.1.2 Test Sample #1 was placed into the furnace and subjected to a two (2) hour exposure in accordance with the time-temperature shown in the Approval Standard. This requires that a temperature of 1800°F (982°C) be reached within 20 minutes and maintained for the duration of the test. After completion of the fire test, the sample was removed from the furnace and subjected to a hose stream test.
4.1.2.1 The hose stream test was applied using a 7/8 in. (22 mm) diameter nozzle adjusted to provide the most solid stream obtainable. The tip of the nozzle was located 20 ft (6.1 m) from the sample. The water stream pressure was 45 psi (310 kPa) as measured approximately 6 in. (152 mm) from the nozzle. The stream was moved slowly and continuously over as much of the fire exposed coating surface as possible for one (1) minute.

4.1.3 Test Sample #2 was placed into the furnace and subjected to a one (1) hour exposure, a hose stream test and then an additional one (1) hour fire exposure in accordance with the time-temperature shown in the Approval Standard. This requires that a temperature of 1800°F (982°C) be reached within 20 minutes and maintained for the duration of the test. After one (1) hour of exposure, the sample was removed from the furnace and subjected to a hose stream test and placed back into the furnace for an additional one (1) hour exposure.

4.1.3.1 The hose stream test on this sample was conducted as described in 4.1.2.1 above.

4.2 Heat of Combustion

4.2.1 The Heat of Combustion of a sample of Pyrocrete 241 was determined in accordance with ASTM E711-87(2004), Standard Test Method for Gross Calorific Value of Refuse Derived Fuel by the Bomb Calorimeter.

V CONDITIONS OF ACCEPTANCE

5.1 The coating shall be considered acceptable as long as the following criteria are met.

5.1.1 The coating remains attached to the steel member during all phases of the testing.

5.1.2 The temperature of the steel member does not exceed 800°F (427°C) as measured by any individual thermocouple for the duration of each test.

5.1.3 The sample shall not spall or develop fissures during any portion of the test such that it exposes bare steel.

VI TEST RESULTS

6.1 The coating remained securely attached to each specimen during the fire endurance and hose stream tests.

6.2 The maximum temperatures reached during the tests were 400°F (204°C) and 454°F (234°C) respectively.

6.3 The samples did not exhibit any spalling or develop any fissures during the test that extended through the full depth of the coating.

6.4 The sample could not be ignited from the ignition source when trying to determine the material’s Heat of Combustion.
VII  MARKING

7.1 The manufacturer shall mark each bag or container with the manufacturer’s name, product trade name and the Approval mark of FM Approvals.

7.2 Markings denoting Approval shall be attached only to products manufactured in accordance with this report.

7.3 Markings denoting Approval 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.

VIII  MANUFACTURER’S RESPONSIBILITIES

8.1 FM Approval is based upon the manufacture of Pyrocrete 241 in accordance with this Approval Report, satisfactory field experience and continued use of acceptable quality control procedures as determined by Facilities and Procedures Audits.

8.2 The manufacturer shall be responsible for the continuous high quality and shall notify FM Approvals of intended changes to the product examined in this report.

8.2.1 All requests for changes shall be made and agreed to in writing utilizing FM Approvals Form 797, "Approved Product-Revision Report", prior to distribution for sale.

8.3 The manufacturer shall supply all the necessary instructions and other assistance to the installer to ensure proper installation and maintenance.

8.4 The manufacturer shall establish and adhere to sufficient quality controls to ensure that markings denoting Approval shall only be applied to products conforming to the requirements set forth in this report.

IX  FACILITIES AND PROCEDURES AUDITS

9.1 Ongoing Facilities and Procedures Audits of the Carboline facilities located in Calgary, Alberta, Canada; Edison, NJ; Pasadena, TX and New Eagle, PA have indicated that Carboline has the necessary equipment, facilities, personnel and quality controls to manufacture the coating examined in this report.

9.2 Periodic, unannounced Facilities and Procedures Audits will be conducted to determine that the quality and uniformity of the coating is being maintained and that they are providing a level of quality equivalent to that originally Approved.

9.3 Approval recognition is contingent upon satisfactory results of the follow-up Facilities and Procedures Audits.
9.3.1 Unsatisfactory results of Facilities and Procedures Audits may result in additional Facilities and Procedures Audits as deemed necessary by FM Approvals or forfeiture of Approval recognition.

X CONCLUSIONS

10.1 Pyocrete 241, manufactured by Carboline, Inc., meets the Approval requirements of FM Approvals for use as a fire protective coating for steel process structures as described in this report.

10.2 The fireproof coating is spray or trowel applied to structural steel. It is applied to structural steel contours to a minimum thickness of 1-7/16 in. (37 mm) as measured from the face of the steel. Steel lath, 3.4 lb/yd² (1.3 kg/m²) is secured to the steel prior to application of the coating. The coating is prepared by mixing 4.5 gallons (16.5 l) of water per 50 lb (22.7 kg) bag of dry Pyocrete 241 in a mixer and mixed to a wet density of 74 – 80 lbs/ft³ (1185 – 1281 kg/m³).

10.3 Continued Approval is dependent upon the manufacture of Pyocrete 241 in accordance with this report, satisfactory field experience, and acceptable quality control procedures as determined by follow-up Facilities and Procedures Audits.

10.3.1 Since this product was previously Approved for other uses, there is no change to their follow-up audits based on this program.

10.4 Since a duly signed Master Agreement is on file for this customer, Approval is effective as of the date of this report.

PROJECT DATA RECORD: 3024079

ATTACHMENTS: None

EXAMINATION AND REPORT BY:  

J. E. Gould, P.E.  
Senior Engineering Specialist

REPORT REVIEWED BY:  

L.N. D’Angelo  
Technical Team Manager - Materials Group