USDA United States Department of Agriculture
Food Safety and Inspection Service

January 1, 2016

FOR

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

FOOD SAFETY AND INSPECTION SERVICE
WASHINGTON, D.C. 20250

"FSIS DIRECTIVE 11,000.4"
APPROVAL OF PAINTS AND COATINGS USED IN OFFICIAL ESTABLISHMENTS

LETTER OF WRITTEN CERTIFICATION AS ACCEPTED BY USDA FROM MANUFACTURER

PRODUCT IDENTIFICATION: **HPC® COATING**
SUPPLIER'S NAME AND ADDRESS: SUPERIOR PRODUCTS
INTERNATIONAL II, INC.
10835 W. 78th Street
Shawnee, Kansas 66214 USA

STATEMENT FOR FINISHED PRODUCT:

- HPC® COATING will not result in adulteration of food products if used and applied as stated in the supplied instructions and label directions.
- HPC® COATING will perform well under a daily regimen of cleaning and cyclical temperature change.
- HPC® COATING is resistant to moisture.
- HPC® COATING is a white color that will not obscure detection of debris or unsanitary conditions.
- HPC® COATING contains no known categories of carcinogens, mutagen, or teratogens classified as hazardous substances, heavy metals, or other toxic substances.
- HPC® COATING is not considered a pesticide and does not have pesticidal characteristics.

Superior Products International II, Inc. will provide to FSIS, in a timely manner, the complete chemical composition of the materials used to manufacture HPC® COATING upon request.

SIGNED:

J.E. Pritchett
President
Superior Products International II, Inc.

United States Department of Agriculture
Food Safety and Inspection Service
Facilities, Equipment and Sanitation Division
Approval of Paints and Coatings

CERTIFICATE NUMBER	19-HS1923800-PDA
EFFECTIVE DATE	06-Dec-2019
EXPIRY DATE	05-Dec-2024
ABS TECHNICAL OFFICE	Houston Materials

CERTIFICATE OF

Product Design Assessment

This is to certify that a representative of this Bureau did, at the request of

SUPERIOR PRODUCTS INTERNATIONAL II, INC.

located at

10835 W. 78TH STREET, SHAWNEE, KS, United States, 66214.

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product **Coating, Fire Resistive**

Model **HPC® Coating**

This Product Design Assessment (PDA) Certificate remains valid until 05/Dec/2024 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

American Bureau Of Shipping

Tim Kimble,Engineer/Consultant

SUPERIOR PRODUCTS INTERNATIONAL II
10835 W. 78TH STREET
SHAWNEE KS
United States 66214.
Telephone: 913-669-2550
Fax:
Email: trcappel@spicoatings.com
Web: www.spicoatings.com

Tier: 3 - Type Approved, unit certification not required

Product: **Coating, Fire Resistive**
Model: **HPC® Coating**
Intended Service:
Bulkhead, Ceilings, Decks, and the outer surfaces of Hot Pipes in Marine Applications where compliance with IMO requirements for Smoke and Toxicity and Low Surface Flammability are indicated.

Description:
Unique water-borne and lightweight coating designed to provide a non-conductive block against heat transfer on surface temperatures up to 450ºF.
Performs as a primer and top coat over metal surfaces to prevent CUI and can be applied directly to hot pipes and vessels while operating to provide an insulation benefit and to block heat loss/transfer.
Offers a non-flammable and non-toxic formula for high heat situations.
Coating film thickness varies depending upon surface temperature.

Rating:
Parts 2 (Smoke & Toxicity) and 5 (Surface Flammability) of the IMO FTP Code, 2010

Service Restriction:
1) Unit Certification is not required for this product.
2) If the manufacturer or purchaser request an ABS Certificate for compliance with a specification or standard, the specification or standard, including inspection standards and tolerances, must be clearly defined.
3) General shipboard and offshore use.
4) This product may not be used solely in order to provide A-Class, B-Class or F-Class fire resistance to coated surfaces where such classification is required, unless further testing has been performed and approval has been achieved.
5) This product may not be used as a primary deck covering if
(a) required to be not readily ignitable, and
(b) it is placed underneath any other floor covering, without further testing.
6) This product may not be used in applications requiring intumescent coatings.

Comments:
1) The Manufacturer has provided a declaration about the control of, or the lack of Asbestos in this product.
2) Approval is not on behalf of any Flag Administration.
3) Application and use are to be to the manufacturer's instructions and the limitations set forth herein.
4) ABS assessment regarding performance is limited solely to the characteristics tested and for which the ratings are as stated above.

Notes/Drawing/Documentation:
Drawing No. L-ABS DECLARATION OF CONFORMITY-SIX COATINGS (08-26-19)-TKIMBLE, Declaration of Conformity_ 6 PDAs, Revision: -, Pages: 1
Drawing No. MSDS (SUN-11-00) - HPC (Hot Pipe Coating), MSDS (SUN-11-00) - HPC (Hot Pipe Coating), Revision: -, Pages: 1
Drawing No. PO #191002-ABS Recertification (10-2-19) (002), Purchase Order 191002, Revision: -, Pages: 1
Drawing No. Technical Data Sheet (06-14-19) - HPC Coating, Technical Data Sheet (06-14-19) - HPC Coating, Revision: -, Pages: 1

Supporting Documentation (previous task):
1) VTEC Labs.Inc. Report 100-1944-20, 19 May 04.
2) VTEC Labs.Inc. Report 100-1944-16, 12 May 04.
3) SPI Tech Info - HPC® Coating; April 04 & 09.
4) SwRI Report No. 01.12544.01.326 dated 12 May 2008 (10 shts).
5) Technical Data Sheet dated 22 March 2012.

SUPERIOR PRODUCTS INTERNATIONAL II
10835 W. 78TH STREET
SHAWNEE KS
United States 66214.
Telephone: 913-669-2550
Fax:
Email: trcappel@spicoatings.com
Web: www.spicoatings.com

Tier: 3 - Type Approved, unit certification not required

Terms of Validity:
This Product Design Assessment (PDA) Certificate remains valid until 05/Dec/2024 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

STANDARDS

ABS Rules:
Rules for Conditions of Classification, Part 1 - 2014 Steel Vessel Rules 1-1-4/7.7, 1-1/A3, 1-1-A4, which covers the following:
- Steel Vessels;
- Steel Vessels Under 90 Meters (295 feet) in Length;
- Offshore Support Vessels;

Rules for Conditions of Classification, Part 1 - 2014 Offshore Units and Structures 1-1-4/9.7, 1-1-A2, 1-1-A3, which covers the following:
- Mobile Offshore Drilling Units;

National:
NA

International:
IMO FTP Code, 2010, Parts 2 and 5

Government:
NA

EUMED:
NA

OTHERS:
NA

CRADLE TO CRADLE PRODUCTS INNOVATION INSTITUTE

Material Health

SILVER

Industrial Coatings

ISSUED TO Superior Products International II, Inc

STANDARD 3.1 **EXPIRES** 29 May 2020

LEAD ASSESSMENT BODY
MBDC

ASSESSED APPLICATIONS
Manufacture, use as a surface coating in residential and commercial settings, intended reutilization through recycling of substrate, unintended disposal of substrate.

PRODUCTS COVERED
Superior Products International II, Inc. Industrial Coatings, including the following:

HSC® Coating, HPC® Coating, SP Ceramic Stucco, SP Seal Coat, Sunshield, Super Base /HS, Super Therm ®

PRODUCT OPTIMIZATION SUMMARY

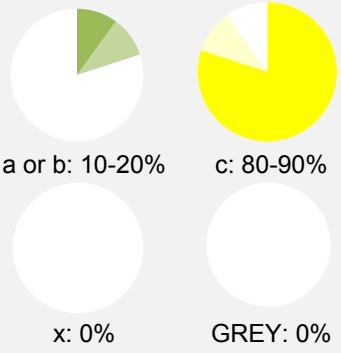
- ☑ *Cradle to Cradle Certified*™ Banned List compliant
- ☑ Material Health optimization strategy not required
- ☑ No exposure from carcinogens, mutagens, or reproductive toxicants
- ☐ Meets VOC emissions testing requirements
- ☑ Product is fully optimized - does not contain any GREY or x-assessed chemicals
- ☐ Process chemicals have been identified and none are GREY or x-assessed

PERCENTAGE OF CHEMICAL SUBSTANCES ASSESSED BY WEIGHT

100%

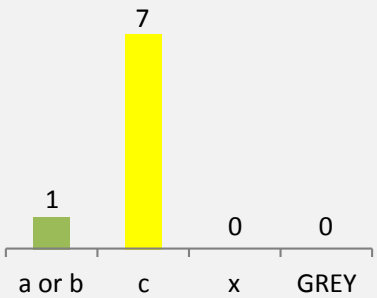
Inventory threshold for chemicals in each material = 100 ppm

ASSESSMENT RATINGS BY WEIGHT



% CHEMICAL SUBSTANCES

PRODUCT OPTIMIZATION



8 CHEMICAL SUBSTANCES

Material Health Certificate Guide

The Material Health Certificate is awarded to products assessed against the requirements in the Material Health category of the *Cradle to Cradle Certified*™ Product Standard. The Material Health achievement level (Basic, Bronze, Silver, Gold, or Platinum) is shown in the certificate's upper right corner. A Material Health Certificate does not indicate that a product is *Cradle to Cradle Certified*™, which requires assessment against all five Standard categories.

The *Cradle to Cradle Certified*™ Material Health Assessment Methodology is a contextual assessment based on chemical hazard identification and qualitative exposure considerations during a product's final manufacture, use, and end-of-use. The exposure assessment is highly simplified and more conservative compared to a conventional, quantitative risk assessment.

Definitions of Administrative Fields

Field	Definition
Issued To	Company that sells the assessed product(s).
Assessed By	Accredited Assessment Body responsible for conducting the product assessment.
Expires	Date the certificate expires. Certificate renewal is required biennially.
Standard	Version of the Standard (Material Health subsection only) the product was assessed against.
Assessed Scenarios	Use and end-of-use scenarios that the assessor considered in the exposure portion of the Material Health assessment. Assessment results are only valid for these scenarios.
Products Covered	Products included in the scope of the certificate. Certificates may cover multiple product variations.

Definitions of Product Optimization Summary Fields

***Cradle to Cradle Certified*™ Banned List compliant**

The product's materials are not known to contain chemicals on the Banned Lists of Chemicals above permitted thresholds.

Material Health optimization strategy developed

Plan developed to phase out x assessed chemicals and assess GREY content.

No exposure from carcinogens, mutagens, or reproductive toxicants

Assessed materials do not contain carcinogens, mutagens, or reproductive toxicants with plausible exposure routes.

Meets VOC emissions testing requirements

The product meets the volatile organic compound (VOC) emissions testing requirements described in the Standard.

Does not contain any GREY or x-assessed chemicals; product is fully optimized

The product's materials contain chemicals with only a, b, or c risk ratings (no GREY or x). (Note: In the *Cradle to Cradle Certified*™ Material Health Assessment Methodology, chemicals in each material are assigned a, b, c, x, or GREY risk ratings. Each material is then assigned an A, B, C, X, or GREY final assessment rating based on the risk ratings of its constituent chemicals. The following table explains the rating system.)

a or b (A or B)	Optimal
c (C)	Moderately problematic, but acceptable for use
x (X)	Highly problematic; targeted for phase out
GREY	Considered unassessed due to unknown identity or lack of toxicity information

Process chemicals have been identified and none are GREY or x-assessed

All process chemicals have been assessed and received an a, b, or c risk rating (no x-assessed or GREY).

Percentage Assessed by Weight

For single-material products, the cumulative percentage of assessed chemicals (a, b, c, and x). For other products, the cumulative percentage of assessed materials (A, B, C, and X). When a certificate represents a group of products, a percent range is shown.

Assessment Ratings by Weight

For single-material products, the percentage of a or b (shown in green), c (shown in yellow), and x (shown in red) assessed chemicals. For other products, the percentage of A or B (shown in green), C (shown in yellow), and X (shown in red) assessed materials. When a certificate represents a group of products, percent ranges are shown.

Product Optimization

Number of materials (or chemical substances for single-material products and multi-material product groups with uncountable color variations) assigned each assessment rating.

Momentum Technologies, inc.
1507 Boettler Road
Uniontown, OH 44685
P: 330/896-5900 F: 330/896-9943
www.momentumtech.net

Date: January 27, 2009
MTi Project No.: CX27A9A
Phone No.: 913-962-4848
Fax No.: 913-962-6767

Accreditations

ISO 17025

ACCREDITED LABORATORY

Associations

TECHNICAL SERVICE REPORT

Superior Products International

ATTN: Craig Smith
10835 West 78th Street
Shawnee, KS 66214
crsmith@spicoatings.com

Project ID: **CX27A9A** Date: **January 27, 2009**

Abstract:	Analysis of one sample for Reflectance per ASTM C1549 and Thermal Emittance per ASTM C1371.
Samples:	**1** sample labeled as: yellow colored HPC® Coating (MTi-090009) received on 1-13-09.

Test Results:

Procedure	HPC® Coating
Reflectance	64.83%
Thermal Emittance	0.66

Conclusion:	Three panels were tested and the average of the three panels was reported above.

Momentum Technologies, inc.
1507 Boettler Road
Uniontown, OH 44685
P: 330/896-5900 F: 330/896-9943
www.momentumtech.net

If you should have any questions or require any additional information, please call us at 330/896-5900.

Tested by,

Cindy L. Campbell
Laboratory Engineer

Reviewed by,

Richard P. Lee
Director of Tech. & Lab Services

ASTM C 177 TESTING
FOR
SUPERIOR PRODUCTS INTERNATIONAL II, INC.
ON
HOT PIPE COATING
VTEC #100-1888
TESTED: FEBRUARY 26, 2004

VTEC Laboratories Inc.

March 4, 2004

Client: Superior Products International II, Inc.
10835 W. 78th Street
Shawnee, KS 66214

Attention: Mr. J.E. Pritchett

Subject: Standard Test Method For Thermal Conductivity According to ASTM C 177.

Sample Description: Hot Pipe Coating Batch #121703

RESULTS:

THERMAL CONDUCTIVITY(k) (Btu-in/h-sq. ft.-deg F)

SAMPLE THK. (mils)	HOT FACE TEMP DEG F	COLD FACE TEMP DEG F	AVERAGE TEMP DEG F	THERMAL CONDUCTIVITY(k)	HR FT2 °F/BTU RESISTANCE(R)
361	217.2	186.5	201.9	0.640	0.564
611	219.5	184.0	201.8	0.525	1.160
918	216.8	185.6	201.2	0.528	1.740

Neil Schultz
Executive Director

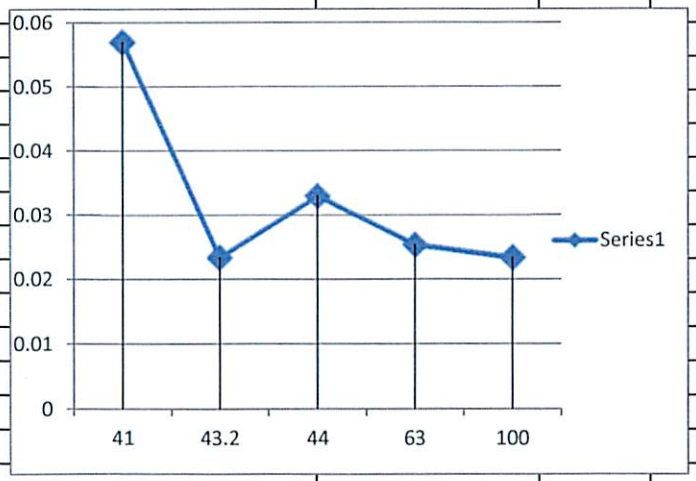
A. Rahim
Amirudin Rahim
Technical Director

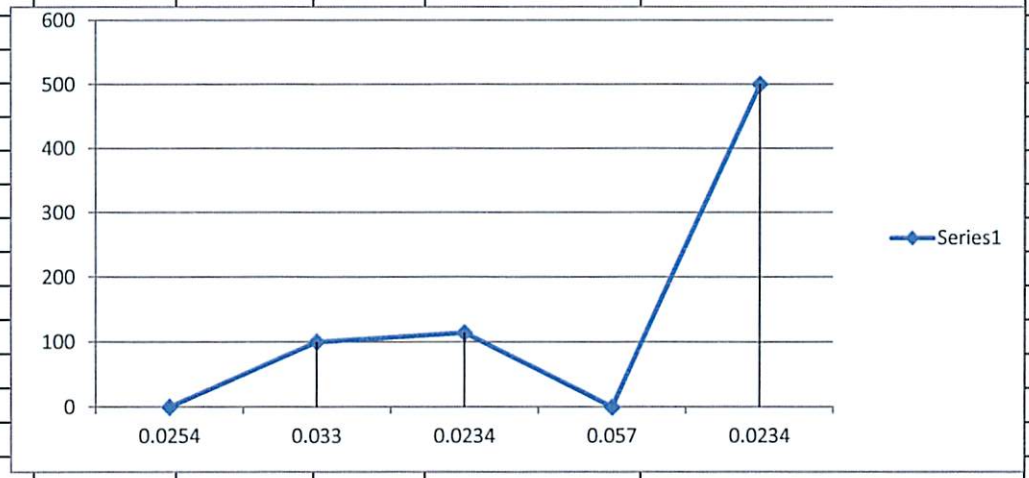
212 Manida Street • Bronx, New York 10474 • (718) 542-8248 • Fax: (718) 542-8759 • www.vteclabs.com

Russian Scientific Lab Results

Коэффициент теплопроводности материалов SPI по результатам применения в России.

Наименование объекта	Предмет изоляции	Материал	Ду, мм	Токр.ср.	Тнеизол.	Тиз.,°C	δиз.,мм	λ, (Вт/(м°C)) W/mK	ΔT, °C
Name of company and city	Object of insulation	Ins. Mat.	OD., mm	T amb., °C	T no ins. °C	T ins., °C	Ins. Thickness, mm	Ins. Conductivity, W/mm K	ΔT, °C
Магнитогорск, МП "Трест Теплофикация", котельная	Трубопровод / pipe	HSC	500	20	97.3	54.1	3	0.0234	43.2
ОАО "УралХимМаш", котельная	Трубопровод / pipe	HSC	114	19.5	164	64	5	0.0234	100
Тепловой узел Кагальницкого молзавода, Ростов	Трубопровод / pipe	HSC	32(50)	26.9	125	62	4	0.0254	63
Новошахтинск, ГБ № 1	Трубопровод / pipe	HSC	100	0	59	15	4	0.033	44
Газпром добыча Ямбург	Фасонные части	HPC	-	25	151	71	7.5	0.0376	80
Газпром Трансгаз Самара	Фасонные часть	HPC	-	98	394.4	140	7	0.011	254.4
Газпром Трансгаз Самара	Фасонные часть	HPC	-	98	394.4	110	20	0.0075	284.4
Астрахань	Трубопровод /pipe	HSC	159(5)	3	68	27	5	0.057	41





Diameter | Amb. Temp | Surf. Temp No Insul. °C | Surf. Temp with Insul. °C | Thickness of Ins | Conductivity W/m. °C | ΔT

Коэффициент теплопроводности материалов SPI по результатам применения в России.

Conductivity by Field Experience

Наименование объекта	Предмет изоляции	Материал	Ду, мм	Токр.ср.	Тнеизол.	Тиз.,°С	δиз.,мм	λ, (Вт/(м°С))	
Магнитогорск, МП "Трест Теплофикация", котельная	Трубопровод	HSC	500	20	97.3	54.1	3	0.0234	43.2
ОАО "УралХимМаш", котельная	Трубопровод	HSC	114	19.5	164	64	5	0.0234	100
Тепловой узел Кагальницкого молзавода, Ростов	Трубопровод	HSC	32(50)	26.9	125	62	4	0.0254	63
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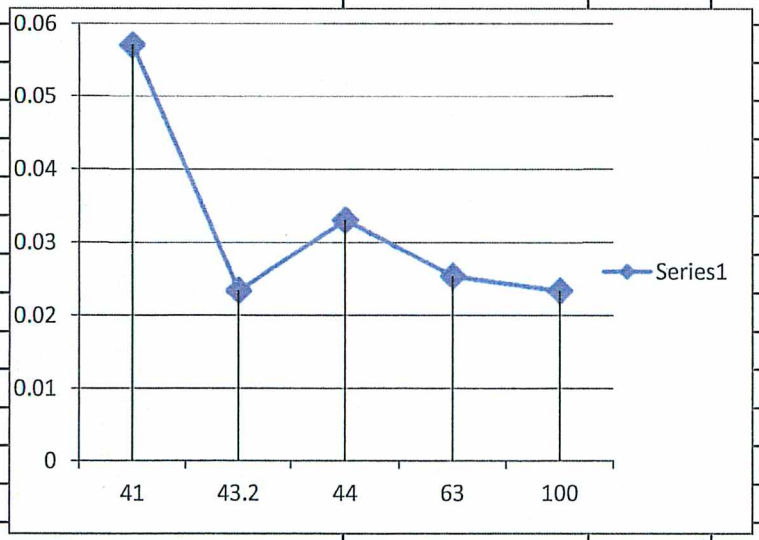
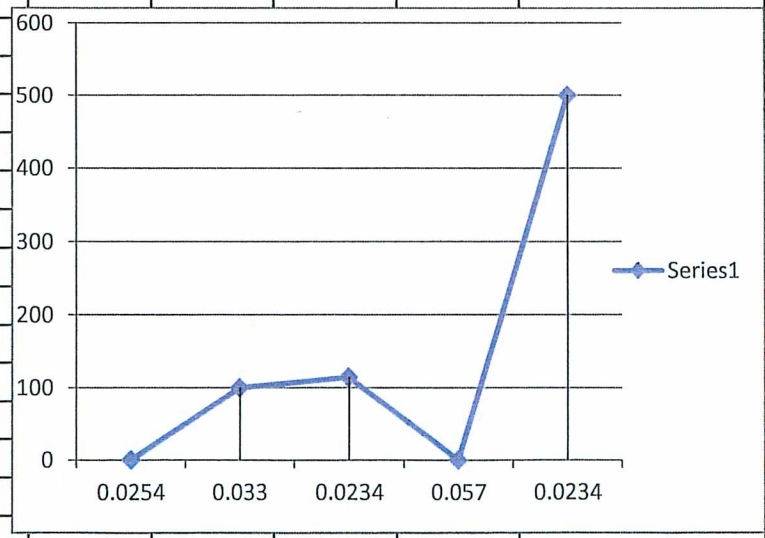
Газпром добыча Ямбург	Фасонные части	HPC	-	25	151	71	7.5	0.0376	80
Газпром Трансгаз Самара	Фасонные часть	HPC	-	98	394.4	140	7	0.011	254.4
Газпром Трансгаз Самара	Фасонные часть	HPC	-	98	394.4	110	20	0.0075	284.4
Астрахань	Трубопровод	HSC	159(5)	3	68	27	5	0.057	41





IMO A.653(16) TESTING
FOR
SUPERIOR PRODUCTS INTERNATIONAL II, INC.
ON
HOT PIPE COATING
VTEC #100-1944-16
TESTED: MAY 12, 2004

VTEC Laboratories Inc.

May 13, 2004

Client: Superior Products International II, Inc.
10835 W.78th Street
Shawnee Mission, KS 66214

Attention: Mr. J.E. Pritchett

Scope: This report contains the reference to the test method, preparation and conditioning of sample, observation of material, test and post test observation data test results.

Test Method: This test was conducted in accordance with IMO A.653(16) specification.

This standard should be 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 which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

SUPERIOR PRODUCTS INTERNATIONAL II, INC.
IMO A.653(16) FLAME SPREAD DATA

PRODUCT: Hot Pipe Coating (batch 022304) applied at a thickness of 115 mils wet (95 mils dry) to 1" gage steel panel.

SOURCE: SUPERIOR PRODUCTS INTERNATIONAL II, INC.
DIMENSIONS: 156 mm X 800 mm
SPECIMEN THICKNESS: 95 mils dry Hot Pipe Coating on 11 Ga. Steel plate.
ORIENTATION: Vertical
EXPOSED SURFACE: Coated Surface

VTEC # 100-1944-16
COLOR: White
AL FOIL ? Yes
DATE: 5/12/2004

OBSERVATIONS: There was no unusual behavior or dripping during the test

TIME TO: Sample #	150 mm sec.	200 mm. sec.	250 mm. sec.	300 mm. sec.	350 mm. sec.	400 mm. sec.
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-

	SAMPLE 1	SAMPLE 2	SAMPLE 3	AVERAGE
Nonimpinging Pilot flame used?	YES	YES	YES	
Test Duration (min.)	10.00	10.00	10.00	10.00
Heat of Ignition (MJ/m^2)	N/A	N/A	N/A	N/A
Heat of Sustained Burning at (MJ/m^2):				
150 mm	N/A	N/A	N/A	N/A
200 mm	N/A	N/A	N/A	N/A
250 mm	N/A	N/A	N/A	N/A
300 mm	N/A	N/A	N/A	N/A
350 mm	N/A	N/A	N/A	N/A
400 mm	N/A	N/A	N/A	N/A
Sample Average:	N/A	N/A	N/A	N/A
Time of Extinguishment (min.)	N/A	N/A	N/A	N/A
Distance burned (mm)	N/A	N/A	N/A	N/A
Critical Flux at Extinguishment (kW/m^2)	N/A	N/A	N/A	N/A
Total Heat Release (MJ)	0.22	0.46	0.40	0.36
Peak Heat Release (kW)	0.65	1.05	0.82	0.84
Heat for Sustained Burning (MJ/m^2)	N/A	N/A	N/A	N/A

CONCLUSIONS: The specimens provided met all requirements per IMO Resolution A.653(16) for bulkhead, wall and ceiling linings.

Neil Schultz
Executive Director

A. Rahim
Amirudin Rahim
Technical Director

MSC.41(64) TESTING
FOR
SUPERIOR PRODUCTS INTERNATIONAL II
ON
HOT PIPE COATING
BATCH #022304
VTEC #100-1944-20
TESTED: MAY 19, 2004

VTEC Laboratories Inc.

May 29, 2004

Client: Superior Products International II
10835 W. 78th Street
Shawnee, KS 66214

Attention: J.E. Pritchett

I. INTRODUCTION:

The following Scope, Summary of Method, Test Specimens, and Classification Criteria sections are abridged from the MSC.41(64) Standard Test Method for Measuring Smoke and Toxic Products of Combustion.

II. SCOPE:

The smoke generation test is conducted in accordance with ISO 5659 Part 2, with additional test procedures as described in the MSC.41(64) standard. The method of test covers a procedure for measuring the smoke generated by materials and assemblies in thickness up to and including one inch. The test is based on the attenuation of a light beam by smoke accumulating within a closed chamber. Specimens are mounted horizontally within the chamber and exposed to thermal radiation on their upper surfaces at a constant irradiance of 25 kW/m^2, in both the flaming and non-flaming modes, and at 50 kW/m^2 in only the non-flaming mode.

Additionally, the gas concentrations measured at each test condition. Colorimetric gas detector tubes for each specific gas are used in the toxic gas analysis.

212 Manida Street • Bronx, New York 10474 • (718) 542-8248 • Fax: (718) 542-8759 • www.vteclabs.com

III. SUMMARY OF METHOD:

This method employs an electrically-heated radiant energy source mounted within an insulated ceramic tube and positioned so as to produce the irradiance levels mentioned above. This exposure provides the non-flaming exposures of the test.

For the flaming condition, a six-tube burner is used to apply a row of air-propane flamelets across the lower edge of the exposed specimen area and into the specimen holder trough. The application of flame in addition to the specified irradiance level from the heating element constitutes the flaming combustion exposure.

The test specimens are exposed to the flaming and non-flaming conditions within a closed 18 cubic foot chamber. A photometric system with a 36″ vertical light path measure the continuous decrease in light transmission as smoke accumulates.

When the toxicity measurements are performed, the gases are sampled during the smoke testing of either the second or third specimen at each test condition, from the geometrical center of the chamber within 3 minutes of the time when a maximum specific optical density of smoke is reached. The concentration of each toxic gas is determined as ppm in the chamber volume.

IV. TEST SPECIMENS:

The test sample is comprised of nine specimens; six specimens are tested at 25 kW/m^2 (three in the non-flaming mode and three in the flaming mode), and three specimens are tested at 50 kW/m^2 in the non-flaming mode. A nominal 3″ X 3″ specimen is mounted within a holder, which exposes an area 2-9/16″ X 2-9/16″. The holder can accommodate specimens up to one inch thick, depending on the particular sample thickness. When coating substrates or cores as used in normal practice, including coating items such as paints and adhesives, the number of coats and type of substrate is included in the test report.

V. CLASSIFICATION CRITERIA:

For a material to classify as passing, all smoke and toxicity requirements, per the MSC.41(64) standard, must be met.

Smoke:
For materials used as surface of bulkheads, linings, or ceilings, D_m should not exceed 200 in any test condition.

For materials used as primary deck coverings, D_m should not exceed 400 in any test condition.

For materials used as floor coverings, D_m should not exceed 500 in any test condition.

Toxicity:
The gas concentration measured at each test condition should not exceed the following limits, regardless of whether the material is to be used for bulkheads, linings, ceilings, primary deck coverings, or the surface of floors:

CO	1,450 ppm	HBr	600 ppm
HCl	600 ppm	HCN	140 ppm
HF	600 ppm	SO_2	120 ppm
No_x	350 ppm		

VI RESULTS:

Client: Superior Products International II, Inc.
Sample: Hot Pipe Coating, BATCH #022304,
Date: May 19, 2004

Based upon the test data (found on the following pages), the sample met all the passing criteria as specified by the MSC.41(64) test standard.

DATE: 5/19/2004
PROJECT #: 100-1944-20
SUPPLIED BY: Superior Products Inter. II
CONDITIONING TEMP: 73 deg. F
BURNER FUEL: 500 cc/min air; 50 cc/min. propane
SPECIAL PREPARATION: NONE
IRRADIANCE: 25 Kw/sq. m
DESCRIPTION OF MATERIAL: Hot Pipe Coating, batch 022304, applied at a thickness of 115 mils wet (100 mils dry) to an 11 gage steel panel.

	FLAMING			
SAMPLE #:	**1**	**2**	**3**	**Average D_m**
Type of Holder:	no trough	no trough	no trough	
Thickness (in):	0.23	0.23	0.23	
Weight (g):	154.7	153.8	151.5	
T 100%:	1.006	1.004	0.997	
Tmin:	0.458	0.501	0.458	
Tmin (%):	45.56	49.91	45.97	
D_m:	45.06	39.84	44.56	
T (clear):	0.889	0.841	0.941	
T% (clear):	88.37%	83.74%	94.35%	
D_c (clear):	7.4	10.4	3.2	
D_m (corr):	37.63	29.43	41.38	
D_m:	**45.06**	**39.84**	**44.56**	**43.15**
Color of Smoke:	Gray	Gray	Gray	

OBSERVATIONS:
The sample ignited at approximately 12 seconds and self extinguished at approximatey 1 minute and 30 seconds.

Neil Schultz
Executive Director

A. Rahim
Amirudin Rahim
Technical Director

DATE: 5/19/2004
PROJECT #: 100-1944-20
SUPPLIED BY: Superior Products Inter. II
CONDITIONING TEMP: 73 deg. F
BURNER FUEL: 500 cc/min air; 50 cc/min. propane
SPECIAL PREPARATION: NONE
IRRADIANCE: **25 Kw/sq. m**
DESCRIPTION OF MATERIAL: Hot Pipe Coating, batch 022304, applied at a thickness of 115 mils wet (100 mils dry) to an 11 gage steel panel.

	NON-FLAMING			
SAMPLE #:	**1**	**2**	**3**	**Average D_m**
Type of Holder:	no trough	no trough	no trough	
Thickness (in):	0.23	0.23	0.23	
Weight (g):	154.2	155.9	154.4	
T 100%:	1.002	1.001	1.005	
Tmin:	0.125	0.160	0.090	
Tmin (%):	12.46	16.02	8.95	
D_m:	119.40	104.99	138.34	
T (clear):	0.917	0.905	0.985	
T% (clear):	91.54%	90.41%	97.99%	
D_c (clear):	5.2	5.8	1.5	
D_m (corr):	114.24	99.15	136.88	
D_m:	**119.40**	**104.99**	**138.34**	**120.91**
Color of Smoke:	Gray	Gray	Gray	

OBSERVATIONS:
The samples did not ignite.

Neil Schultz
Executive Director

Amirudin Rahim
Technical Director

DATE: 5/19/2004
PROJECT #: 100-1944-20
SUPPLIED BY: Superior Products Inter. II
CONDITIONING TEMP: 73 deg. F
BURNER FUEL: 500 cc/min air; 50 cc/min. propane
SPECIAL PREPARATION: NONE
IRRADIANCE: 50 Kw/sq. m
DESCRIPTION OF MATERIAL: Hot Pipe Coating, batch 022304, applied at a thickness of 115 mils wet (100 mils dry) to an 11 gage steel panel.

	NON-FLAMING			
SAMPLE #:	**1**	**2**	**3**	**Average D_m**
Type of Holder:	no trough	no trough	no trough	
Thickness (in):	0.23	0.23	0.23	
Weight (g):	152.3	153.0	153.8	
T 100%:	0.995	1.000	0.998	
Tmin:	0.285	0.261	0.294	
Tmin (%):	28.63	26.06	29.51	
D_m:	71.70	77.09	69.97	
T (clear):	0.881	0.789	0.830	
T% (clear):	88.56%	78.92%	83.18%	
D_c (clear):	6.7	13.6	10.4	
D_m (corr):	65.04	63.53	59.53	
D_m:	**71.70**	**77.09**	**69.97**	**72.92**
Color of Smoke:	Gray	Gray	Gray	

OBSERVATIONS:
The sample ignited at approximately 9 seconds and self extinguished at approximatey 1 minute and 39 seconds.

Neil Schultz
Executive Director

A. Rahim
Amirudin Rahim
Technical Director

TOXICITY

DATE:	5/19/2004
PROJECT #:	100-1944-20
SUPPLIED BY:	Superior Products Inter. II
CONDITIONING TEMP:	73 deg. F
BURNER FUEL:	500 cc/min air; 50 cc/min. propane
SPECIAL PREPARATION:	NONE
DESCRIPTION OF MATERIAL:	Hot Pipe Coating, batch 022304, applied at a thickness of 115 mils wet (100 mils dry) to an 11 gage steel panel.

TOXICITY RESULTS

	25 Kw Non-Flaming	25 Kw Flaming	50 Kw Non-Flaming	
WEIGHT (g):	155.9	153.8	153.0	
GAS	**CORRECTED PPM**	**CORRECTED PPM**	**CORRECTED PPM**	**REQUIRED CONCENTRATION LIMITS (PPM)**
CO	70	150	250	1,450
HCN	10	2	10	140
SO_2	19	18	20	120
HCL	0	0	0	310
HF	0	0	0	590
NO_X	0	16	0	350
CO_2	2,000	20,000	4,000	60,000
Formaldehyde	2	2	3	3.2
HBr	0	0	0	50

AMBIENT TEMPERATURE:	74.7° F
RELATIVE HUMIDITY:	69%
BAROMETRIC PRESSURE:	29.57 inches of mercury

Neil Schultz
Executive Director

A. Rahim
Amirudin Rahim
Technical Director

Measurement of Thermal Expansion Coefficients for HPC and HSC at 350 °C

Prepared for

Superior Products International II, Inc.
10835 W. 78th Street
Shawnee, Kansas 66214

Prepared by

Southwest Research Institute®
6220 Culebra Road
San Antonio, Texas 78238-5166

December 2014

Contents

Figure

1 Introduction

This report documents measurement of the thermal expansion coefficients of HPC and HSC coating materials. Three coated coupons of the two coating materials (HPC and HSC) were provided to Southwest Research Institute® (SwRI®) by Superior Products International. The average dry film thickness of the coating on the coupons was 500 mils (1.27 cm). The coating was applied on the carbon steel base plates. One can determine thermal expansion coefficient by measuring change in thickness and surface area coverage when the coupons are placed at 350 °C. This test procedure is expected to provide the coefficient of linear and volumetric thermal expansion coefficient. The coefficient of linear thermal expansion coefficient is generally 1/3 of the coefficient of volumetric thermal expansion coefficient for isotropic material. The coating material is considered homogeneous enough for it to be isotropic.

The coupons were placed in an oven for 6 hours at 350 °C. It was determined that 6 hours were sufficient for the coupons and coating material to reach steady state values of the expanded dimensions. The coupons were removed from the over after exposure. The coupons were examined for the coating dimensional changes. Specifically, length and width of the coating material and that of carbon steel base plates were measured. Any cracks developed in the coating materials were also measured. This data was used to estimate the linear thermal expansion coefficients of the coating materials.

2 Testing Data and Results

The testing data is presented in form of coupons images.

2.1 HPC: Images of the two of the three HPC coupon before and after exposure to 350 °C is presented in Figure 1. The image of the third coupon before and after exposure cannot be presented as coating material got damaged during the handling of the coupon after testing. As seen in Figure 1, only hairline cracks developed on the coating. This indicates that thermal expansion coefficient of the HPC is very close to that carbon steel at 350 °C.

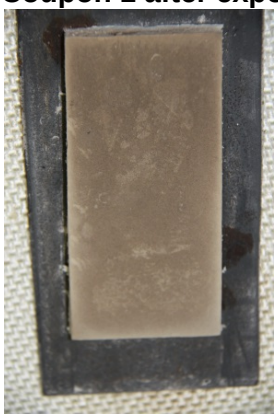
2.2 HSC: Images of the one of the three HSC coupon before and after exposure to 350 °C is presented in Figure 2. The image of the remaining two coupons before and after exposure cannot be presented as coating material got damaged during the handling of the coupon after testing. However, we were able to make measurements before the damage occurred. As seen in Figure 2, wide cracks developed on the coating materials. The cracks appeared both along the length and width of the coating material. This indicates that the thermal expansion of the coating material is less than that of carbon steel. The cracks occurred because the coating was not able to expand to the same dimensions as the carbon steel. The width of the cracks was 0.3 to 0.6 mm. This data was used to estimate the thermal expansion coefficient of the HSC coating material.

The thermal expansion coefficient of carbon steel is $7.6 \times 10^{-6} \frac{in}{in\,^{\circ}\mathrm{F}}$ at 350 °C [662 °F]. The average length and width of the coated area on the coupon surface is 155 and 75 mm, respectively. The following equation was developed to estimate the thermal expansion coefficient of the coating material:

HPC Coupon 1 before exposure

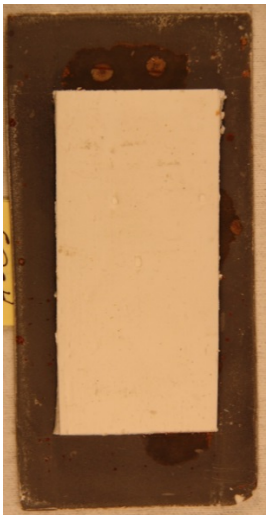
HPC Coupon 1 after exposure

HPC Coupon 2 before exposure



HPC Coupon 2 after exposure

Figure 1. Images of the two HPC coupons before and after exposure to heat at 350 °C for 6 Hours



HSC Coupon 1 before exposure

HSC Coupon 1 after exposure

Figure 2. Images of the one HSC coupon before and after exposure to heat at 350 °C for 6 hours

$$7.6 \times 10^{-6} \frac{in}{in\ °\mathrm{F}} \times \frac{155\ mm}{25.4} \times 662\ °\mathrm{F} - x \times \frac{155\ mm}{25.4} \times 662\ °\mathrm{F} = \frac{\Delta L}{25.4}\, in \qquad (1)$$

where

x — linear thermal expansion coefficient of the coating material $\left(\frac{in}{in\ °\mathrm{F}}\right)$

ΔL — crack width in the coating material (mm)

The value of x in Eq. (1) is $4.5 \times 10^{-6} \frac{in}{in\ °\mathrm{F}}$ for ΔL equal to 0.3 mm. Similarly, x is equal to $1.6 \times 10^{-6} \frac{in}{in\ °\mathrm{F}}$ for ΔL equal to 0.6 mm.

It is noted that the standard test is for 350 °C which applies to HPC but the design of HSC is limited to 160 °C and the results should be considered with this limitation. Although the coating film did not show burn out, the brittle texture of the HSC with the resulting cracking would be expected due to the formulation hardness in which HSC is made.

3 Conclusions

The linear thermal expansion coefficient of the HPC is close to that of the carbon steel, and is approximately equal to $7.6 \times 10^{-6} \frac{in}{in\ °\mathrm{F}}$. The linear thermal expansion coefficient of the HSC is in the range of $1.6 \times 10^{-6} \frac{in}{in\ °\mathrm{F}}$ to $4.5 \times 10^{-6} \frac{in}{in\ °\mathrm{F}}$.