



QUALITY ASSURANCE SPECIFICATIONS™

SFI SPECIFICATION 54.1

EFFECTIVE: JANUARY 17, 2008*

PRODUCT: Non Flammable, Thermal Barrier / Fire Extinguishing Coatings

1.0 GENERAL INFORMATION

- 1.1 This SFI Specification establishes uniform test procedures and minimum standards for evaluating and determining performance capabilities for non flammable thermal barrier / fire extinguishing coatings used by individuals engaged in competitive motorsports.
- 1.2 The procedures, test evaluations and standards contained herein, are intended only as minimum guidelines for construction and evaluation of products. Certification that products meet such minimum standards is made by the product manufacturer and products are not certified, endorsed or approved by SFI under this program.
- 1.3 Use of the "This Manufacturer Certifies That This Product Meets SFI Specification 54.1" logo/designation, the authorized artwork style, or conventional lettering by a manufacturer, on a subject product, is intended only to indicate that the manufacturer of the product has represented that they have submitted the product to the recommended tests, with positive results, in compliance with the standards established herein.
- 1.4 This SFI Specification requires a demonstration that the product of a manufacturer meets or exceeds the requirements when the manufacturer enters the program; and on a periodic basis thereafter. Any manufacturer may participate in the program by providing Non Flammable, thermal barrier / fire extinguishing coatings that meet or exceed the SFI Specification 54.1 test standards, by complying with the requirements of the SFI Specification 54.1 program, and by signing a licensing agreement with the SFI Foundation, Inc.

- 1.5 Compliance with this specification is entirely voluntary. However, when a manufacturer provides Non Flammable, thermal barrier / fire extinguishing coatings in compliance with all requirements of the SFI Specification 54.1 and enters into the licensing agreement with the SFI Foundation, Inc., they may certify that compliance with such standards is in accordance with the guidelines established herein.
- 1.6 Manufacturers wishing to participate in the program, in addition to the other requirements of this specification, must label each of their products with the manufacturer's name, trademark or symbol as well as the date of manufacture of the product.
- 1.7 No manufacturer may display the SFI logo/designation on their product unless the manufacturer has signed a licensing agreement with SFI and has successfully complied with all the requirements of this specification and the self-certification program.

2.0 DEFINITIONS

- 2.1 A non flammable, thermal fire barrier / fire extinguishing coating is a liquid-based coating that shall provide fire protection and suppression within a racing vehicle to primarily protect the occupant(s) and secondarily to minimize damage to the vehicle itself.
- 2.2 Thermal Fire Barrier / Fire Extinguishing Coating: A thermal or fire barrier is a liquid based coating, applied over a substrate, designed to slow the temperature increase of the substrate during a fire, and to delay the substrate's involvement in a fire. Thermal barriers limit the temperature rise of the underlying substrate to not more than 250°F after specific time intervals of fire exposure complying with the standard time temperature curve of ASTM E 119.
- 2.3 Non Flammable: The inability of a substance to ignite, causing fire or combustion. Also known as incombustible or noncombustible. Materials that will not ignite at temperatures commonly encountered are considered non flammable, with various specific definitions giving a specific maximum temperature requirement. For discussion purposes, products which can pass ASTM E84 with zero flame spread and zero smoke generated are considered non flammable.
- 2.4 Heat Insulating: Heat (and thermal) insulation refers to materials used to reduce the rate of heat transfer, or the methods and processes used to reduce heat transfer. Heat is transferred from one material to another by

conduction, convection and/or radiation. Insulators minimize the transfer of heat energy.

- 2.5 VOC: Volatile organic compounds (VOCs) are organic chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize and enter the atmosphere. A wide range of carbon-based molecules, such as aldehydes, ketones, and hydrocarbons are VOC's.
- 2.6 Applied non flammable, thermal barrier / fire extinguishing coatings shall be recoated or replaced as described in the product instructions or as specified by the certifying manufacturer. Coatings shall also be replaced when a car sustains any occurrence of fire. When coatings are replaced, a new or updated SFI conformance label marked with the reapplication date shall be used (thus recertification). Manufacturer shall provide as part of the product instructions that end user should inspect coatings whenever modifications, cleanup, or rework has been done to the racing component that has been coated. Product instructions shall also provide that recoating is required whenever minimum coating thickness has been breached.
- 2.7 Any non flammable, thermal barrier / fire extinguishing coatings pertaining to this specification shall remain as formulated and tested by the original manufacturer and not modified by the end user. The tested coating identification must be controlled by recording coating lot number(s).
- 2.8 Marking of product containers: It is required that non flammable, thermal barrier / fire extinguishing coatings are manufactured and tested in accordance with good manufacturing practices (GMP's). Containers must also include proper SFI certification information and provide product label installation directions as outlined by the specific race sanctioning body rules
- 2.9 After-Flame Time: The time an object continues to flame after the thermal load is removed.

3.0 CONSTRUCTION - PRE APPROVAL TESTING

The non flammable, thermal barrier / fire extinguishing coating shall be capable of extending the protection time period of a substrate (thermoset plastics, composite materials, foams, hoses, grommets, panels, etc.) when introduced to a controlled fire source, as defined by this specification and other identified test methods. Any non flammable, thermal barrier / fire extinguishing coating submitted for approval will need to be submitted with the following PRE APPROVALS from 3rd party sources attached to the submittal for initial design validation only:

3.1 ACCEPTABLE INGREDIENTS - ENVIRONMENTAL

Acceptable coatings should be made up of ultra low (<50g/l) or no VOC as determined by ASTM D2369: Volatile Organic Compounds (VOC's).

3.2 WATER RESISTANCE AND DURABILITY

It is required that all non flammable, thermal barrier / fire extinguishing coatings be designed, manufactured and tested in accordance with the following standards:

Test:		Requirement:
ASTM D522	Flexibility	32% min
ASTM D2486	Scrub Resistance	350cy min
ASTM D968	Abrasion Resistance	>1000L min
ASTM D2794	Impact Resistance	160in-lb min
ASTM D4541	Adhesion	90 psi min
ASTM D2243	Freeze Thaw Resistance	2 cycles minimum
ASTM G153	Accelerated Weathering-1000hr	no change
ASTM D412	Tensile Strength/% Elongation	45psi min/55% min
ASTM D6904	Wind Driven Rain	0.2lb max absorption
ASTM D3273	Mold Resistance	no growth allowed
ASTM D4585	Moisture Resistance-100hr	no adhesion loss
ASTM D1729	Visual Color Change	no change
ASTM D4214	Degree of Chalking	no change
ASTM D661	Degree of Cracking	no change
ASTM D96	Vapor Barrier Requirements	<1 perm

3.3 FLAME SPREAD & SMOKE GENERATION PERFORMANCE

3.3.1 ASTM E84 (Standard Test Method for Surface Burning Characteristics)

It is required that all non flammable, thermal barrier / fire extinguishing coatings meet zero flame spread and zero smoke generation at a minimum coating thickness of .015" thick.

3.4 THERMAL BARRIER PERFORMANCE

3.4.1 ASTM E119 (Standard Test Methods for Fire Tests of Building Construction and Materials)

It is required that all non flammable, thermal barrier / fire extinguishing coatings comply with a minimum 1 hour thermal barrier performance at a coating maximum of .012" thickness per side on a 2x4" wood studded, 1/2" gypsum wall assembly.

4.0 MODEL CLASSIFICATION

Any variation in the coating formulation is considered a model change and must be tested to initial design criteria.

5.0 TESTING

5.1 THERMAL AND FLAME BARRIER PERFORMANCE OVER COMPOSITES

5.1.1 SAMPLES

Test samples shall be made from coating currently produced or to be produced. All necessary instructions shall be supplied by the certifying manufacturer and used/followed by the test lab for installation/mounting to the test fixture. Coated samples shall be tested in a cured state as per the manufacturer's requirements. Test samples shall be preconditioned at 70°F ± 5°F for twenty-four (24) hours prior to testing.

Test Panel Size: 0.050" (+/-0.010") thickness carbon fiber panel, approximate size, 6" x 6".

Coating thickness: 0.020" (+/-0.002) coating thickness on one side of the test panel.

5.1.2 APPARATUS

A. THERMAL LOAD

The thermal load shall be a propane flame with a standard flame nozzle.

B. TIMING DEVICE

A timing device with an accuracy of ±0.5 seconds shall be used to measure the after-flame times.

C. FIXTURE

A fixture shall be used to support the sample panel in a vertical position.

5.1.3 PROCEDURE

- A. Confirm the coating thickness by removing a small piece of coating and measuring thickness.
- B. Place the conditioned, coated panel vertically against a flat surface, coated side toward the fire source.
- C. Set the propane torch flame length such that it exhibits a 2" blue flame.
- D. The flame shall be positioned perpendicular to the center of the panel surface and so that the tip of the 2" flame is just in contact with the sample. The sample shall be subjected to the thermal load for a period of 30 ± 1 seconds.
- D. Record any changes in the flame bloom during the 30 seconds.
- E. Simultaneous with the removal of the flame, the timing device shall be activated. Record the time of any after-flame until it extinguishes or 15 seconds has passed.
- F. Inspect the carbon fiber panel backside for burn through. Burn through will be seen by loss of gloss, whitish char, etc. See figure below for example of acceptable backside of panel:

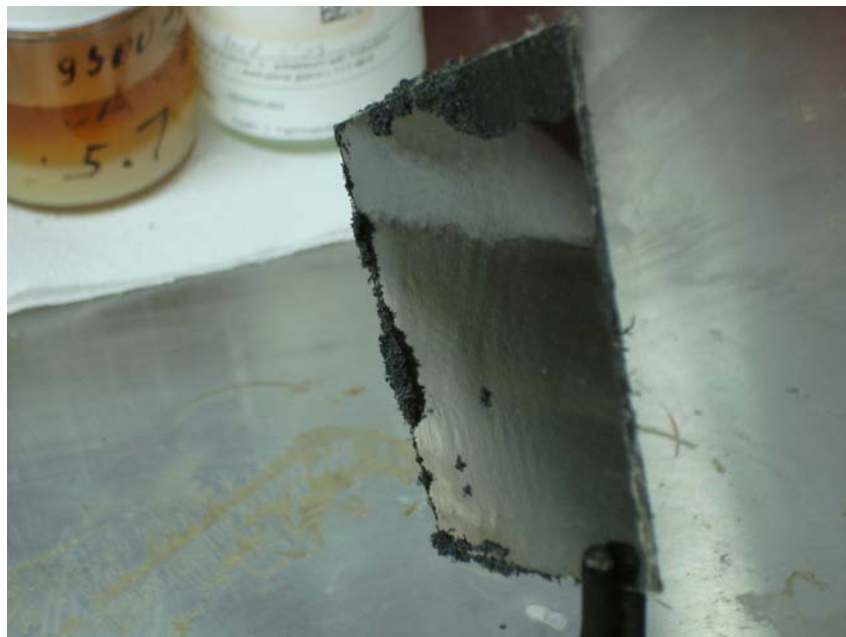


Figure 1

5.2 FIRE EXTINGUISHING PERFORMANCE SPECIFICALLY OVER COMPOSITES

5.2.1 SAMPLES

Test samples shall be made from coating currently produced or to be produced. All necessary instructions shall be supplied by the certifying manufacturer and used/followed by the test lab for installation/mounting to the test fixture. Coated samples shall be tested in a cured state as per the manufacturer's requirements. Test samples shall be preconditioned at 70°F ± 5°F for twenty-four (24) hours prior to testing.

Test Panel Size: 0.050" (+/-0.0010") thickness carbon fiber panel, approximate size, 8" x 8".

Coating thickness: 0.020" (+/-0.002) coating thickness on one side of the test panel.

5.2.2 APPARATUS

A. TIMING DEVICE

A timing device with an accuracy of ±0.5 seconds shall be used to measure the after-flame times.

B. FIXTURE

A simulated elevated heat environment shall be used as illustrated in Figures 2 and 3 below. The apparatus shall be capable of generating a heat source of at least 400°F. A steel cup oil reservoir is required to dump the burning boiling motor oil onto the hot plate and sample. See Figure 2.



Figure 2



Figure 3

5.2.3 PROCEDURE

- A. Confirm the coating thickness by removing a small piece of coating and measuring thickness.
- B. Using a propane torch, heat 20 grams of 10w30 motor oil in the steel cup until it burns under its own energy and is boiling. Upon removal of the torch the oil should sustain combustion.

- C. Confirm the hot plate is at $400^{\circ}\text{F} \pm 25^{\circ}\text{F}$.
- D. Place the conditioned, coated (1 side only) panel on the heated surface, coated side toward the oil source. The panel should be in place for approximately 15 seconds before the burning oil is poured.
- E. Initiate the test by activating the timing device at the same time as introducing the burning oil to the center of the sample.
- F. Record the time in seconds it takes for the oil on the panel to extinguish.

5.3 VAPOR FIRE - THERMAL AND FLAME RESISTANCE

5.3.1 SAMPLES

Test samples shall be made from coating currently produced or to be produced. All necessary instructions shall be supplied by the certifying manufacturer and used/followed by the test lab for installation/mounting to the test fixture. Coated samples shall be tested in a cured state as per the manufacturer's requirements. Test samples shall be preconditioned at $70^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for twenty-four (24) hours prior to testing.

Test Panel Size: 0.050" (+/-0.0010") thickness carbon fiber panel, 12" x 12" minimum.

Coating thickness: 0.020" (+/-0.002) coating thickness on both sides and edges of the test panel.

5.3.2 APPARATUS

A. FIXTURE

A steel or similar surface with fire hood shall be used to support the sample panel in a horizontal position.

5.3.3 PROCEDURE

- A. Confirm the coating thickness by removing a small piece of coating and measuring thickness.

- B. Weigh out 5 grams of methanol fuel (98%+pure).
- C. Place the conditioned, coated pane (both sides and edges) on the steel or similar surface.
- D. Pour the methanol onto center of the panel.
- E. Using a lighter, ignite the methanol. Upon removal of the lighter the methanol should sustain combustion.
- F. Allow the methanol to burn off.
- G. Inspect the panel at test completion.

6.0 PROOF OF COMPLIANCE

Non Flammable, thermal barrier / fire extinguishing coatings manufacturers are required to provide the following information to enroll in this program:

6.1 TEST RESULTS

Test results shall be documented in one or multiple test report and meet the requirements outlined in the 'pre approval' and 'testing' sections defined above.

6.1.1 THERMAL AND FLAME BARRIER PERFORMANCE OVER COMPOSITES

The after-flame time shall be fifteen (15) seconds or less. Additionally, no flare up in the presence of the torch, no reigniting and no burn-through of the panel may occur. Any one such occurrence shall be considered a failure.

6.1.2 FIRE EXTINGUISHING PERFORMANCE SPECIFICALLY OVER COMPOSITES

The burning oil shall extinguish within 15 seconds of being poured onto the panel. After 30 seconds any remaining oil shall not reignite on the panel nor should the panel surface ignite. Any one such occurrence shall be considered a failure.

6.1.3 VAPOR FIRE - THERMAL AND FLAME RESISTANCE

During the test, the sample panel shall not ignite. Immediately after the methanol burns off, the coating shall still be intact on the panel surface. Upon cool down of the panel (at least 10 minutes), the

coating shall still be intact on the panel surface. Any one such occurrence shall be considered a failure.

7.0 TEST REPORTS

A separate test report, or set of test reports if required, shall be submitted for each product model. If more than one test facility is required to complete all necessary tests, then a separate test report shall be submitted from each one. A test report shall be submitted for each component, if tested separately. The test facility shall assign a unique number to each test report. This number along with the report date and page number shall appear on each page. Each test report shall include:

7.1 RELEVANT INFORMATION

- 7.1.1 Manufacturer's name, contact name, address and telephone number.
- 7.1.2 Name, address and telephone number of the test facility.
- 7.1.3 Name and signature of the responsible test supervisor.
- 7.1.4 Actual date of the test.
- 7.1.5 Specification number and effective date.
- 7.1.6 Product name, description and model designation

7.2 TESTS

Each test conducted shall be listed showing the test name, apparatus used, procedure used and test results obtained along with any other appropriate information.

7.3 AUTHENTICATION

Test reports shall be authenticated and stamped by a Professional Engineer who is registered in the state in which the testing is conducted. If necessary, SFI may allow an equivalent entity to provide authentication.

8.0 INITIAL DESIGN VALIDATION

To receive initial recognition from SFI as a participant in the SFI Specification 54.1 Program, the manufacturer must submit to SFI all information delineated in the CONSTRUCTION PRE APPROVAL TESTING section of this specification and provide samples or test results for the TESTING and Proof of Compliance sections. This information shall be provided for each Non Flammable, thermal barrier / fire extinguishing

coating offered by the applicant that is to be included in the program. Any change in design, materials and/or methods of manufacturing not specifically excluded is considered a model change and, therefore, requires initial design validation.

9.0 PERIODIC REVALIDATION

Test reports with successful test results must be submitted to or performed by SFI for the TESTING section only at least once every 24 month period following the date of the initial design validation test for each model of coating manufactured by the participant. If multiple test reports are required to obtain all test results, then the earliest test date shall be used to determine when the periodic revalidation reports are due.

10.0 CERTIFICATION OF COMPLIANCE

Upon demonstration of successful compliance with all the requirements of the specification and the self-certification program and upon entering the licensing agreement with SFI, the manufacturer may advertise, present and offer Non Flammable, thermal barrier / fire extinguishing coatings for sale with the representation that their product meets the SFI Specification 54.1. Continuing certification is contingent upon the following additional considerations: (1) the product shall be resubmitted for testing following any change in design, materials and/or methods of manufacturing not specifically excluded, and (2) periodic revalidation test reports are submitted when due to SFI.

11.0 CONFORMANCE LABELS AND "IN SERVICE" LIFE – END USE APPLICATION

The conformance label is a punch out sticker which may be incorporated into a manufacturer's sticker. A sticker shall be placed on each vehicle using the coating. Holes (1/8" (3.2mm) diameter) shall be punched in each sticker indicating the month and year of the 'in service' date. The invoice and 'in service' date should appear on the manufacturer sticker as well as the SFI serial number to aid in identification and tracking. The coating will be replaced or recoated annually on the end use application, with new labels issued as a method of recertification in the field. Coating removal and replacement and affixing a new certification label must be done for any fire related event, whether entire vehicle or coated component. Where the specific coated component or vehicle is modified, repaired or replaced, the component or vehicle must be recoated and relabeled.

12.0 DECERTIFICATION

Participating manufacturers are subject to decertification when not in compliance with the requirements of this program or when their products are not in compliance with the requirements of this specification. Decertification will provide SFI the right to effect any and all remedies which are available to SFI in the licensing agreement.

13.0 APPEAL PROCEDURE

In the event of decertification, the manufacturer is entitled to an appeal of the decision of SFI. Requests for appeal must be received by SFI no later than thirty days following receipt of the notice of decertification. Appeals of such decisions will be heard at the next meeting of the Board of Directors of SFI.

14.0 STATEMENT OF LIMITATIONS

Testing procedures and/or standards contained in this specification are intended for use only as a guide in determining compliance with the minimum performance requirements as defined herein. The granting and assignment of the "This Manufacturer Certifies That This Product Meets SFI Specification 54.1" logo/designation is in no way an endorsement or certification of product performance or reliability by SFI. SFI, its officers, directors and/or members assume no responsibility, legal or otherwise, for failure or malfunctions of a product under this program.

15.0 COSTS

All costs involved in this program will be absorbed by the submitting manufacturer.

16.0 COMPLIANCE PERIOD

As this specification is revised to reflect changes in technology and/or field conditions, to remain current, participating manufacturers in the SFI Specification 54.1 non flammable, thermal barrier / fire extinguishing coatings must demonstrate full compliance with the requirements of this specification within ninety (90) days of the latest effective date.

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