MONOKOTE® MK-10HB

Product data and application instructions

Product Description

Monokote® MK-10 HB is single component, spray applied, mill-mixed fire resistive plasters. MK-10 HB has approval for use on structural steel members and fluted decking to provide up to four hours of fire protection, and on flat plate cellular decking for up to three hours with Spatterkote® SK-3.

It has been designed to obtain bond strengths in excess of 430 psf making it an attractive material for meeting the 2006 IBC building requirements for bond strength for buildings in excess of 75' tall but less than 420 feet tall. The capability of meeting the bond strength requirements with a high yielding spray applied fire resistant material makes Monokote MK-10 HB a cost effective option.

Features & Benefits

Monokote cementitious fireproofing offers many significant advantages to the architect, owner, applicator and building occupant. These include:

- Proven in-place performance
- Low in-place cost
- Fast, efficient application
- UL fire tested and factory inspected
- Building Code compliant

Delivery & Storage

a. All material to be used for fireproofing shall be delivered in original unopened packages bearing the name of the manufacturer, the brand and proper UL labels for fire hazard and fire resistance classifications.

b. The material shall be kept dry until ready for use. Packages of material shall be kept off the ground, under cover and away from sweating walls and other damp surfaces. All bags that have been exposed to water before use shall be discarded. Stock of material is to be rotated and used before its expiration date.

Steel & Concrete Surfaces

a. Prior to the application of Monokote MK-10 HB, an inspection shall be made to determine that all steel surfaces are acceptable to receive fireproofing. The steel shall be free of oil, grease, rolling compounds or lubricants, loose mill scale, excess rust, noncompatible primer, lock down agent or any other substance that will impair proper adhesion. Where necessary, the cleaning of steel surfaces to receive fireproofing shall be the responsibility of the general contractor.

b. The project architect shall determine if the painted/primed structural steel to receive fireproofing has been tested in accordance with ASTM E119, to provide the required fire resistance rating.

c. Many Fire Resistance Designs allow the use of painted metal floor or roof-deck in place of galvanized decking. Painted decking must be UL listed in the specific fire resistance designs and must carry the UL classification marking. Consult your local Grace sales representative for details.

d. Prior to application of Monokote MK-10 HB, a bonding agent, approved by the fireproofing manufacturer, shall be applied to all concrete substrates to receive MK-10 HB.

e. Fireproofing to the underside of roof deck assemblies shall be done only after roofing application is complete and roof traffic has ceased.

Performance Characteristics

Physical Properties	Recommended Specification	Laboratory Test* Values	Test Method
Dry density, minimum average	15 pcf (240 kg/m^3)	15 pcf (240 kg/m^3)	ASTM E605
Bond strength	600 psf (28.7 KPa)	1,337 psf (63.9 KPa)	ASTM E736
Compression, 10% deformation	4,500 psf (215 KPa)	5,601 psf (267.7 KPa)	ASTM E761
Air erosion	Max 0.000 g/ft^2 (0.00 g/m^2)	0.000 g/ft^2 (0.00 g/m^2)	ASTM E859
High velocity air erosion	No continued erosion after 4 hours	No continued erosion after 4 hours	ASTM E859
Corrosion	Does not contribute to corrosion	Does not contribute to corrosion	ASTM E937
Bond impact	No cracking, spalling or delamination	No cracking, spalling or delamination	ASTM E760
Deflection	No cracking, spalling or delamination	No cracking, spalling or delamination	ASTM E759
Resistance to mold growth	No growth after 28 days	No growth after 28 days	ASTM G21
Surface burning characteristics	Flame spread = 0 Smoke developed = 0	Flame spread = 0 Smoke developed = 0	ASTM E84
Combustibility	Less than 5 MJ/m^2 total, 20 kw/m^2 peak heat release	Less than 5 MJ/m^2 total, 20 kw/m^2 peak heat release	ASTM E1354

*Actual laboratory tested values meet or exceed Grace's recommended value. Test reports are available on request from your Grace sales representative.

f. No fireproofing shall be applied prior to completion of concrete work on steel decking.

g. Other trades shall not install ducts, piping, equipment, or other suspended items until the fireproofing is completed and inspected.

h. Other trades shall install clips, hangers, support sleeves, and other attachments that penetrate the fireproofing, prior to application of the fireproofing.

Mixing

a. Monokote Fireproofing shall be mixed by machine in a conventional, plaster-type mixer or a continuous mixer specifically modified for cementitious fireproofing. The mixer shall be kept clean and free of all previously mixed material. The mixer speed in a conventional mixer shall be adjusted to the lowest speed which gives adequate blending of the material and a mixer density of 40–45 pcf (640–720 kg/m^3) of material.

b. Using a suitable metering device and a conventional mixer, all water shall be first added to the mixer as the blades turn. Mixing shall continue until the mix is lump-free, with a creamy texture. All material is to be thoroughly wet. Target density of 43 ± 1 pcf (688 ± 16 kg/m^3) is most desirable. Overmixing Monokote will reduce pumping rate.

Application

a. Application of Monokote Fireproofing can be made in the following sequence:

1. For thicknesses of approximately ½ in. (13 mm) or less, apply in one pass.
2. For thicknesses of ⅝ in. (16 mm) or greater, apply subsequent passes after the first coat has set.

b. Spatterkote SK-3 shall be applied to all cellular steel floor units with flat plate on the bottom and to roof decking where required prior to application of Monokote. Spatterkote shall be applied in accordance with manufacturer's application instructions.

c. Monokote Fireproofing material shall not be used if it contains partially set, frozen or caked material.

d. The minimum average density shall be that required by the manufacturer, listed in the UL Fire Resistance Directory for each rating indicated, ICBO Evaluation Report, as required by the authority having jurisdiction, or minimum average 15 lbs/ft^3 (240 kg/m^3), whichever is greater.

e. Monokote shall be mixed with water at the job site.

f. Monokote Accelerator is to be used with Monokote Fireproofing to enhance set characteristics and product yield. The Monokote Accelerator is injected into the Monokote Fireproofing at the spray gun. Monokote Accelerator shall be mixed and used according to manufacturers recommendations.

g. Monokote is applied directly to the steel, at various rates of application which will be job dependent, using standard plastering type equipment or continuous mixer/pump units. A spray gun, with a properly sized orifice and spray shield and air pressure at the nozzle of approximately 20 psi (38 KPa), will provide the correct hangability, density and appearance. NOTE: If freshly sprayed Monokote does not adhere properly, it is probably due to a too wet mix, poor thickness control, or an improperly cleaned substrate.

Temperature & Ventilation

a. An air and substrate temperature of 40°F (4.4°C) minimum shall be maintained for 24 hours prior to application, during application and for a minimum of 24 hours after application of Monokote.

b. Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation, air circulation and ventilation must be provided to achieve a minimum total fresh air exchange rate of 4 times per hour until the material is substantially dry.

Field Tests

a. The architect will select an independent testing laboratory (for which the owner will pay) to sample and verify the thickness and density of the fireproofing in accordance with the provisions of ASTM E605, *Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members* or Uniform Building Code Standard No. 7-6 *Thickness and Density Determination for Spray Applied Fireproofing*.

b. The architect will select an independent testing laboratory (for which the owner will pay) to randomly sample and verify the bond strength of the fireproofing in accordance with the provisions of ASTM E736.

c. Results of the above tests will be made available to all parties at the completion of pre-designated areas which shall have been determined at a pre-job conference.

Safety

a. Monokote is slippery when wet. The general contractor and applicator shall be responsible for posting appropriate cautionary "SLIPPERY WHEN WET" signs. Signs should be posted in all areas in contact with wet fireproofing material. Anti-slip surfaces should be used on all working surfaces.

b. Material Safety Data Sheets for Monokote MK-10 HB is available on our web site at www.graceconstruction.com or by calling 866-333-3SBM.

www.graceconstruction.com

For technical assistance call toll free at 866-333-3SBM (3726)

W. R. Grace & Co.–Conn., 62 Whittemore Avenue, Cambridge, MA 02140.
In Canada, Grace Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

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GRACE

July 30, 2012

W. R. Grace & Co. - Conn
Construction Products Division
Mr. John Dalton
62 Whittemore Ave.
Cambridge, MA 02140

Our Reference: R4339 / 12CA41322

Dear Mr. Dalton:

At your request the following information is being provided and is verification of the Classification of your company's Type MK-10 HB and Type MK-10 HB Extended Set Cementitious Mixture, which has been tested in accordance with UL723 / ASTM E84.

The above mentioned product, is specified in our Follow-Up Service Procedure R4339, Vol. 4, Sec. 3 and is eligible to bear the below surface burning characteristics Classification Marking when produced in accordance with the mentioned Procedure:

CEMENTITIOUS MIXTURES
SURFACE BURNING CHARACTERISTICS
APPLIED TO INORGANIC REINFORCED CEMENTBOARD

FLAME SPREAD	0
SMOKE DEVELOPED	0

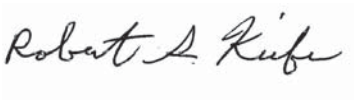
The Classification Marking of UL LLC on the product is the only method provided by UL to identify products, which have been produced under our Follow-Up Service Program.

Since the anticipated work has been completed, we have instructed our Accounting Department to terminate the investigation and invoice you for the charges incurred to date.

Please feel free to call if you have any questions.

UL LLC
333 Pfingsten Road, Northbrook, IL 60062-2096 USA
T: 847.272.8800 / F: 847.272.8129 / W: UL.com

Very truly yours,



Robert S. Kiefer (Ext. 42014)
Sr. Engineering Assoc
Fire Protection Division

Reviewed by,

James F Smith (Ext. 42666)
Staff Engineering Assoc
Fire Protection Division

COHESION/ADHESION

MONOKOTE TYPE MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W. R. GRACE & COMPANY

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

COHESION/ADHESION
ABSTRACT

Significance: This test measures the adhesive force required to separate the material from the base, or the cohesive force within the material and is an indication of the ability of sprayed fire-resistive material to remain in place and resist separation during anticipated service conditions.

The test was conducted using a modified ASTM E-736 "Cohesion/Adhesion of Sprayed Fire-Resistive Material Applied to Structural Members" test procedure.

Results: The average cohesive strength of Monokote Type MK-10 HB on galvanized steel was 970.7 pounds per square foot (psf).

REPORT DETAILS

Dates of Test: November 12, 2013 (mixing & spraying) ; January 13, 2014 (testing)

Identification of Specimen: Bags were selected at random of Monokote Type MK-1000 HB as produced by Construction Products Division, W. R. Grace & Company. Each bag contained the label of Underwriters' Laboratory, Inc. and was mixed with water in a mechanical mixer in accordance with published instructions. Mixing for four minutes produced a uniform slurry having a mixer density of 42.9 pounds per cubic foot (pcf) and a nozzle density of 28.2 pcf. The procedures represented typical field construction practices and complied with instructions printed on the Monokote Type MK-10 HB bags.

Description of Test:

I. Apparatus

A. Metal screw cap 3.25 inches [5.1 centimeters] in diameter and 0.4 inches deep [8.296 sq. in. area], with a hook attached at the center.

B. Pull Tester accurate to 0.1 lb. (45 grams) with a capacity of 200 lbs (91 kg).

C. Steel substrate 11.5" (29 cm) x 12.5" (31.8 cm) x 16 gauge to which Monokote Type MK-10 HB was spray applied and allowed to dry in laboratory conditions 72° F ± 3° F (22° C ± 1.6° C) for a period of 62 days.

II. Test Specimen:

A. 4 Galvanized steel sheets for bond strength determinations.

B. An additional steel sheet was sprayed at the same time for formal dry density determination of the sprayed material.

III. Procedure:

A. After allowing test specimens to cure for a minimum of 28 days under controlled laboratory conditions, the metal screw cap was attached to the surface of the Monokote MK-10 HB material using a two- part, fast setting epoxy. This epoxy attachment assembly was allowed to fully dry a period of two days prior to testing.

B. A digitally recording pull tester manufactured by Com-Ten Industries was used to apply the force required to remove the cap assembly from the test panel. A continuous load was applied to the cap assembly using the manually operated screw jacking system. The test was continued until failure occurred, and the maximum force was recorded.

IV. Calculations: The cohesive/adhesive force is calculated as:

$$CA = F/A$$

Where:

CA = Cohesive/adhesive strength, (lbs./ft^2)

F = Recorded force, (lb.)

A = Area of the cap assembly, (ft.^{2})

V. Test Data:

SPECIMEN	MAXIMUM APPLIED LOAD (lbs)	MAXIMUM STRENGTH (psf)	FAILURE TYPE
1	52.5	911.3	Cohesive
2	50.6	878.3	Cohesive
3	55.5	963.4	Cohesive
4	65.1	1130.0	Cohesive
AVERAGE	**55.9**	**970.7**	

Thickness Tested - 1.25" Monokote Type MK-10 HB Density – 14.9 pcf

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.

Doug Macy - W. R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Steve Ackerman, PE
Senior Engineer

DEFLECTION TEST – ASTM E759-11

MONOKOTE® MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY, INC.

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

DEFLECTION TEST
ABSTRACT

Significance: The Deflection Test measures the behavior of sprayed fire-resistive materials when the floor construction to which it is applied is subjected to deflection and evaluates such phenomena as spalling and delamination under bending stress. It is an indication of the ability of the sprayed fire-resistive material to remain in place and resist removal during anticipated service conditions.

The test was conducted in accordance with ASTM E-759-11 "Effect of Deflection on Sprayed Fire-Resistive Materials Applied to Structural Members."

Results: Monokote® MK-10 HB did not crack, spall, or delaminate and remained unchanged in every aspect when the backing to which it was applied was subjected to deflection of 1/120th of the span. The test density was 15.75 pounds per cubic foot (lbs./ft.^{3}).

REPORT DETAILS

Date of Test: January 9, 2014 (sample preparation); July 15, 2014 (testing)

Identification of Specimen: Bags of Monokote® MK-10 HB were selected at random as produced by Grace Construction Products, W.R. Grace & Company. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® MK-10 HB was mixed with water in a mechanical mixer for approximately 90 seconds in accordance with the noted instructions to produce a uniform slurry having a mixer density of 44.3 pounds per cubic foot (pcf) and a nozzle density of 31.8 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® MK-10 HB bags.

Description of Test:

I. Apparatus

A. Supports - A rigid base to provide 4 inches [101 mm] bearing and a clear span between supports of 10 feet.

B. Load - Pre-weighed bars of iron.

C. Deflection Gauge - a dial micrometer graduated to 0.001 inch.

II. Test Specimen:

The test specimen was a cellular steel deck of non-composite type, nominal 1.5 inches deep, 24 inches wide by 12 feet long, consisting of an 18 gauge galvanized steel fluted top section and a 20 gauge steel flat bottom section welded together to form four cells 6 inches on center. The fire-resistive material was then spray applied to the underside of the steel deck to a 3/4 inch thickness. The Monokote® MK-10 HB was not applied to an area 12 inches from each end of the specimen in order to permit the steel deck to bear directly on the supports of the test fixture.

III. Procedure:

The prepared specimen was allowed to condition at atmospheric conditions for a period of 28 days prior to testing. The test specimen was placed on the test fixture supports to simulate field conditions of a floor construction with sprayed Monokote® MK-10 HB fire-resistive material as the lower surface. The specimen had a clear span between supports of 10 feet. A vertical load was applied to the upper face of the specimen to develop a deflection of 1/120 of the clear span, or 1.0 inch. To measure the deflection, the initial reading of the dial micrometer was recorded prior to the application of the load, and deformation monitored as the load was applied.

IV. Results:

The test specimen was examined upon completion of the test. No evidence of cracking, spalling, delamination, loss of bond or any other change in the Monokote® MK-10 HB was observed after being subjected to the above described test procedure.

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.
Michael Morgan - W. R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ross R. Deaver, PE
Senior Engineer

BOND IMPACT TEST – ASTM E760-11

MONOKOTE® MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY, INC.

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

BOND IMPACT TEST
ABSTRACT

Significance: The Bond Impact Test measures the behavior of sprayed fire-resistive materials when the floor construction to which it is applied is subjected to the impact of shock loading, and evaluates adhesion and resistance to spalling, cracking, and delamination. It is an indication of the ability of the sprayed fire-resistive material to remain in place and resist removal during anticipated service conditions.

The test was conducted in accordance with ASTM E-760-11 "Effect of Impact on Bonding of Sprayed Fire-Resistive Materials Applied to Structural Members."

Results: Monokote® MK-10 HB did not crack, spall, or delaminate and remained unchanged in every aspect when the floor construction to which it was applied was subjected to an impact shock loading of 240 foot-pounds (60 pounds dropped from 4 feet), or 33 Kilogram-meters (27.2 Kilograms dropped from 1.2 meters). The test density was 15.75 lbs./ft.^{3} [252 Kg/m^3].

REPORT DETAILS

Date of Test: January 9, 2014 (sample preparation); July 15, 2014 (testing)

Identification of Specimen: Bags of Monokote® MK-10 HB were selected at random as produced by Grace Construction Products, W.R. Grace & Company. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® MK-10 HB was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 44.3 pounds per cubic foot (pcf) and a nozzle density of 31.8 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® MK-10 HB bags.

Description of Test:

I. Apparatus

A. Supports – a rigid base to provide 4 inches [101 mm] bearing and a clear span between supports of 10 feet [3.05 meters].

B. Impact Instrument – a steel-shot filled leather bag weighing 60 lbs. (27.2 kg).

C. Measuring Stick – used to accurately measure the height of drop.

II. Test Specimen:

The test specimen consisted of a complete deck assembly of a cellular steel deck and a concrete topping. The cellular steel deck was of the non-composite type, nominal 1.5 inches deep, 24 inches wide by 12 feet long [38 mm x 610 mm x 3.66 meters], consisting of an 18

gauge galvanized steel fluted top section and a 20 gauge steel flat bottom section welded together to form four cells 6 inches [152 mm] on center. The concrete was nominal 3,000 psi [211 Kg/cm^2] mix, poured 2.5 inches deep [63 mm] as measured to the top plane of the steel decking. The Monokote® MK-10 HB fire-resistive material was then spray applied to the underside of the steel deck to a 3/4 inch [19 mm] thickness. The Monokote® MK-10 HB was not applied to an area 12 inches [305 mm] from each end of the specimen in order to permit the steel deck to bear directly on the supports of the test fixture.

III. Procedure:

The prepared specimen was allowed to condition at atmospheric conditions for a period of 28 days prior to testing. The test specimen was placed on the fixture supports to simulate field conditions of a floor construction with sprayed Monokote® MK-10 HB fire-resistive material as the lower surface and the concrete as the upper surface. The specimen had a clear span between supports of 10 feet [3.05 meters]. An impact load was applied to the upper face of the specimen by dropping the instrument from a height of 4 feet [1.22 meters]. The height of the bag was measured from the upper face of the specimen prior to release.

IV. Results:

The test specimen was examined upon completion of the test. No evidence of cracking, spalling, delamination, loss of bond or any other change in the Monokote® MK-10 HB was observed after being subjected to the above described test procedure

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.
Michael Morgan - W. R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ross R. Deaver, PE
Senior Engineer

COMPRESSIVE STRENGTH – ASTM E761-11

MONOKOTE TYPE MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY, INC.

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

COMPRESSIVE STRENGTH
ABSTRACT

Significance: This test measures the compressive strength of sprayed fire - resistive materials and is a measure of the resistance to deformation under a compressive load.

The test was conducted in general accordance with ASTM E761-11 "Compressive Strength of Sprayed Fire - Resistive Materials Applied to Structural Members."

Results: The samples of Monokote MK-10 HB required an average uniform compressive load of 35.7 pounds per square inch (psi) to compress them to 10 percent deformation.

REPORT DETAILS

Date of Test: November 12, 2013 (sample preparation); January 13, 2014 (testing)

Identification of Specimen: Bags of Monokote Type MK-10 HB were selected at random as produced by Grace Construction Products, W.R. Grace & Company. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote Type MK-10 HB was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having an average mixer density of 42.9 pounds per cubic foot (pcf) and a nozzle density of 28.2 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote Type MK-10 HB bags.

Description of Test:

I. Apparatus

A. Tinius-Olsen universal testing machine with loading and crosshead travel distance recorder.

B. Spherical bearing block assembly having a plane bearing surface 6" x 6"square. A steel plate measuring 4" x 4" was used to center loading on the fireproofing material.

II. Test Specimen: Specimens consisted of nominal 7" x 24" x 1.3" Monokote MK-10 HB applied to a galvanized steel sheet approximately 0.25" in thickness. This resulted in an actual MK-10 HB thickness of approximately 1.05". Two individual specimens of the prepared panels were tested.

III. Procedure:

A. After initial room temperature curing for 72 hours, the specimens were force dried in a drying oven maintaining a temperature of 110 ± 10 °F and a relative humidity less than 60% in order to reach constant weight.

B. The compressive load was applied perpendicular to the face of the test specimen, with the bearing block on top of the specimen. The initial thickness for the deformation calculation was measured between the bearing surface and the steel substrate after the initial load of 0.1 psi had been applied.

C. The crosshead speed of the testing machine was set at 0.05 inches per minute during compression to 10 percent deformation.

IV. Calculations: The compressive strength is calculated as:

$$CS = L/A$$

Where:

CS = Compressive strength at 10% deformation, (lbs./in^2)

L = Recorded compressive load at 10% deformation (lb.)

A = Area of load bearing surface, (in.^{2})

V. Test Data:

SPECIMEN	MAXIMUM APPLIED LOAD (lbs)	MAXIMUM STRENGTH (psi)
1	549.0	34.3
2	592.6	37.0
AVERAGE	**570.8**	**35.7**

Thickness Tested – 1.3" (incl. galvanized sheet) Density – 14.9 pcf

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.

Doug Macy - W. R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Steve Ackerman, PE
Senior Engineer

AIR EROSION – ASTM E859-11

MONOKOTE® MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY, INC.

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

AIR EROSION TEST
ABSTRACT

Significance: The Air Erosion Test measures the effect of a high speed air stream upon fire-resistive materials in plenums during normal service conditions, and evaluates the resistance to dusting, flaking, spalling and delamination of the fire-resistive material.

The test was conducted in accordance with ASTM E-859 "Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members."

Results: Monokote® MK-10 HB, when subjected to tangential air stream of a velocity of 20.8 ft./sec [6m/s], resulted in a weight loss of 0.000 grams at one hour, 0.000 grams during the next 5 hours, and 0.000 grams during the next 18 hours (24 hours test time), for a total weight loss of 0.000 grams over the 24 hour test period. **The loss per area of test section for the total test period was 0.000 grams per square foot.** The test density was 17.7 lbs./ft.^{3} [284 Kg/m^3].

REPORT DETAILS

Date of Test: January 9, 2014 (sample preparation); July 15, 2014 (testing)

Identification of Specimen: Bags of Monokote® MK-10 HB were selected at random as produced by Grace Construction Products, W.R. Grace & Company. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® MK-10 HB was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 46.0 pounds per cubic foot (pcf) and a nozzle density of 37.9 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® MK-10 HB bags.

Description of Test:

I. Apparatus

A. Application Base – 16 gauge galvanized sheet steel 14.5" x 67.5" [368 mm x 1715 mm].

B. Duct System – A duct made of 12 gauge galvanized steel 8.7 feet long [2.64 meters], rectangular in cross section, with a 10.5" x 63.5" [267 mm x 1613 mm] opening in the top to accept the test sample (4.63 ft^2 or 0.430 m^2 exposed area).

C. Blower – capable of moving air through the entire cross section of the duct at a velocity of 20.8 ft./sec [6 m/s].

D. Pitot Tube – used in conjunction with a manometer to measure air velocity in the duct.

E. Filters – one at the intake end of the duct (blower end) and a collecting filter at the exhaust end of the duct. Filter fabric was 30 denier nylon constructed with 94 ends per inch and 82 picks per inch.

II. Test Specimen:

The test specimen was a 16 gauge galvanized steel sheet 14.5" x 67.5" [368 mm x 1715 mm] onto which the Monokote® MK-10 HB was spray applied at 0.75" in thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions for a minimum period of 28 days prior to testing.

III. Procedure:

A. The collecting filter was dried for one hour at 120 °F [49 °C], weighed, and placed in the apparatus.
B. The specimen was placed in the duct opening so that its face and the inside face of the duct opening were flush in the same plane. The specimen was sealed in place using silicone rubber adhesive. The edges overlapped the duct opening by 2 inches [50 mm].
C. The pitot tube was positioned 4 inches [101 mm] from the upstream edge of the specimen at the center line of the duct, and 2 inches [50 mm] below the test specimen.
D. With both filters in place, the blower was maintained at an average velocity of 20.8 ft./sec [6 m/s] throughout the duration of the test. The blower was stopped at intervals of 1, 6, and 24 hours. During this stoppage, the filter was removed, dried, and re-weighed to determine the mass gain.

IV. Results:

WEIGHING TIME	FILTER WEIGHT (g)	WEIGHT LOSS (g)	WEIGHT LOSS (g per ft^2)
1 HR (initial)	1.260	0.000	0.000
1 HR (final)	1.260		
6 HR (initial)	1.215	0.000	0.000
6 HR (final)	1.215		
24 HR (initial)	1.248	0.000	0.000
24 HR (final)	1.248		

Monokote® MK-10 HB Density – 17.7 pcf

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.
Jordan Merritt - W. R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ross R. Deaver, PE
Senior Engineer

HIGH VELOCITY AIR EROSION – ASTM E859-11

MONOKOTE® MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY, INC.

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

AIR EROSION TEST
ABSTRACT

Significance: The High Velocity Air Erosion Test measures the effect of a very high speed air stream upon fire-resistive materials in plenums during extreme service conditions, and evaluates the resistance to dusting, flaking, spalling and delamination of the fire-resistive material.

The test was conducted in accordance with ASTM E-859 "Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members." The tested velocity was more than twice that specified in ASTM E-859.

Results: Monokote® MK-10 HB, when subjected to tangential air stream of a velocity of 45.8 ft./sec [13.7 m/s], resulted in a weight loss of 0.000 grams at one hour, 0.000 grams during the next 5 hours, and 0.000 grams during the next 18 hours (24 hours test time), for a total weight loss of 0.000 grams over the 24 hour test period. **The loss per area of test section for the total test period was 0.000 grams per square foot.** The test density was 17.7 lbs./ft.^{3} [284 Kg/m^3].

REPORT DETAILS

Date of Test: January 9, 2014 (sample preparation); July 15, 2014 (testing)

Identification of Specimen: Bags of Monokote® MK-10 HB were selected at random as produced by Grace Construction Products, W.R. Grace & Company. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® MK-10 HB was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 46.0 pounds per cubic foot (pcf) and a nozzle density of 37.9 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® MK-10 HB bags.

Description of Test:

I. Apparatus

A. Application Base – 16 gauge galvanized sheet steel 14.5" x 67.5" [368 mm x 1715 mm].

B. Duct System – A duct made of 12 gauge galvanized steel 8.7 feet long [2.64 meters], rectangular in cross section, with a 10.5" x 63.5" [267 mm x 1613 mm] opening in the top to accept the test sample (4.63 ft^2 or 0.430 m^2 exposed area).

C. Blower – capable of moving air through the entire cross section of the duct at a velocity of 45.8 ft./sec [13.7 m/s].

D. Pitot Tube – used in conjunction with a manometer to measure air velocity in the duct.

E. Filters – one at the intake end of the duct (blower end) and a collecting filter at the exhaust end of the duct. Filter fabric was 30 denier nylon constructed with 94 ends per inch and 82 picks per inch.

II. Test Specimen:

The test specimen was a 16 gauge galvanized steel sheet 14.5" x 67.5" [368 mm x 1715 mm] onto which the Monokote® MK-10 HB was spray applied at 0.75" in thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions for a minimum period of 28 days prior to testing.

III. Procedure:

A. The collecting filter was dried for one hour at 120 °F [49 °C], weighed, and placed in the apparatus.
B. The specimen was placed in the duct opening so that its face and the inside face of the duct opening were flush in the same plane. The specimen was sealed in place using silicone rubber adhesive. The edges overlapped the duct opening by 2 inches [50 mm].
C. The pitot tube was positioned 4 inches [101 mm] from the upstream edge of the specimen at the center line of the duct, and 2 inches [50 mm] below the test specimen.
D. With both filters in place, the blower was maintained at an average velocity of 45.8 ft./sec [13.7 m/s] throughout the duration of the test. The blower was stopped at intervals of 1, 6, and 24 hours. During this stoppage, the filter was removed, dried, and re-weighed to determine the mass gain.

IV. Results:

WEIGHING TIME	FILTER WEIGHT (g)	WEIGHT LOSS (g)	WEIGHT LOSS (g per ft^2)
1 HR (initial)	2.174	0.000	0.000
1 HR (final)	2.174		
6 HR (initial)	2.299	0.000	0.000
6 HR (final)	2.299		
24 HR (initial)	2.122	0.000	0.000
24 HR (final)	2.122		

Monokote® MK-10 HB Density – 17.7 pcf

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.
Jordan Merritt - W. R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,
FROEHLING & ROBERTSON, INC.

Ross R. Deaver, PE
Senior Engineer

CORROSION TEST

MONOKOTE® TYPE MK-10 HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

CORROSION

ABSTRACT

Significance: This test evaluates the corrosion to steel induced by sprayed fire-resistive materials and determines whether the presence of these materials increases, decreases, or had no effect on the corrosion characteristics of steel. The test was conducted in accordance with ASTM E-937 "Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members".

Results: Monokote® Type MK-10 HB did not excessively contribute to corrosion of steel when exposed to higher temperature and humidity. Test density was 16.1 pounds per cubic foot (pcf).

REPORT DETAILS

Dates of Testing: June 2, 2014 (mixing & spraying) ; June 12, 2014 (testing)

Identification of Specimen: Bags of Monokote® Type MK-10 HB were selected at random as produced by Grace Construction Products, W.R. Grace & Co. Each bag contained the label of Underwriters' Laboratories, Inc. The Monokote® Type MK-10 HB was mixed with water in a mechanical mixer in accordance with the instructions on each bag to produce a uniform slurry having an average mixer density of 41.4 pcf and a nozzle density of 31.1 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Type MK-10 HB bags.

Description of Test:

(1) Apparatus

(a) An environmental chamber equipped to maintain the temperature at 95 ± 3 °F and a relative humidity of 95 ± 3 %.

(b) Scale with a capacity of 5000 Kg and a sensitivity of ± 0.1 g.

(c) Wire brush described as "cement mold brush" with brass wire bristles.

(2) Test Specimen:

Duplicate sets of 8" x 8" x 12 gauge sheets of galvanized (G60 grade), bare (A36 grade), and shop-coated steel (A36 grade) to which Monokote® Type MK-10 HB fire-resistive material was spray applied. The steel sheets were cleaned with Acetone to remove any oil or grease prior to material application. Two such sets of samples were prepared and tested on each type of steel and the results were averaged. The shop coating was accomplished with a red iron oxide alkyd metal primer.

(3) Procedures:

(a) Prior to the application of Monokote® Type MK-10 HB, the duplicate sheets were weighed to the nearest 0.1 gram and identified as I_a and II_a. The backs (unsprayed sides) of the plates were coated with wax.

(b) After the application of Monokote® Type MK-10 HB, specimens marked I_a were dried to constant weight at laboratory conditions [68 $\pm$ 9 °F with relative humidity not greater than 60%].

(c) Specimens marked II_a were placed into the chamber and kept at 95 $\pm$ 3°F and 95% $\pm$ 3% relative humidity for 240 hours.

(d) After this exposure, the fire-resistive material and protective wax were removed. All surface rust was removed with the wire brush. The cleaned sheets were then weighed to the nearest 0.1 gram and identified as II_b.

(e) The control specimens (those not exposed to higher temperature and humidity) were then cleaned and weighed in the same manner as the conditioned specimens and marked as I_b.

(4) Calculations: The difference in weight loss between the Control and the Conditioned specimens is expressed in grams per square millimeters of surface area as follows:

$$L_{II} = (II_a - II_b)/A_{II} \qquad L_I = (I_a - I_b)/A_I \qquad \text{and} \qquad D = L_{II} - L_I$$

Where:

L_I = loss at end of initial (Control) aging period in g/mm^2

L_{II} = loss at end of the Conditioned (240 hr) period in g/mm^2

D = difference in weight loss in g/mm^2

I_a = original weight of steel plate I in grams

I_b = weight of steel plate I in grams after cleaning off SFRM and any rust

II_a = original weight of steel plate II in grams

II_b = weight of steel plate II in grams after cleaning off SFRM and any rust

A_I = area of steel plate I in mm^2

A_{II} = area of steel plate II in mm^2

TEST DATA:

STEEL TYPE	CONTROL		Diff.	CONDITIONED		Diff.
	I_a	I_b	I_a-I_b	II_a	II_b	II_a-II_b
Bare (1)	1609.5	1608.5	1.0	1609.8	1607.4	2.4
Bare (2)	1598.4	1597.1	1.3	1613.9	1611.8	2.1
Shop Coated (1)	1023.8	1023.7	0.1	967.8	967.8	0.0
Shop Coated (2)	1086.8	1086.6	0.2	967.6	967.5	0.1
Galvanized (1)	936.3	936.1	0.2	943.5	943.3	0.2
Galvanized (2)	936.2	936.0	0.2	942.2	942.0	0.2

Monokote® Type MK-10 HB Thickness = 0.75 inches Density = 16.1 pcf

RESULTS: (Average of two tests)

Weight loss of control specimens : (I_a-I_b)

Bare Steel = 1.2 grams Shop Coated Steel = 0.2 grams
Galvanized Steel = 0.2 grams

Weight loss of conditioned specimens: (II_a - II_b)

Bare Steel = 2.2 grams Shop Coated Steel = 0.0 grams
Galvanized Steel = 0.2 grams

Difference in weight loss: (II_a - II_b) - (I_a - I_b)			Grams/mm^2
Bare Steel	=	1.0 grams	2.4×10^{-5}
Shop Coated Steel	=	-0.2 grams	-4.8×10^{-6}
Galvanized Steel	=	0.0 grams	0

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.
Doug Macy - W.R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,
FROEHLING & ROBERTSON, INC.

Ross R. Deaver, PE
Senior Engineer

ASTM E 1354
CONE CALORIMETER TESTING
FOR
W.R. GRACE
ON
MK-10HB
VTEC #100-4538-1
TEST DATE: JANUARY 29, 2014

VTEC Laboratories Inc.

January 29, 2014

Client: W.R. Grace
62 Whitemore Ave.
Cambridge, MA 02140

Attn: John A. Dalton

Subject: Cone Calorimeter Testing. Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter per Modified ASTM E1354.

RESULTS

The specimens did not ignite during the required 10 minutes exposure at 50kw/m^2 and therefore no data was generated. Because the specimens did not smolder or ignite, the heat release is zero. The smoke release was too minimal to be detected by the system.

Neil Schultz
Executive Director

Amirudin Rahim
Technical Director

DISCLAIMER 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.

NOTICE VTEC Laboratories Inc. will not be liable for any loss or damage resulting from the use of the data in this report, in excess of the invoice. This report pertains to the sample tested only. Such report shall not be interpreted to be a warranty, either expressed or implied as to the suitability of fitness of said sample for such uses or applications, as the party contracting for the report may apply such sample.

Accugen Laboratories, Inc.

FINAL REPORT
ASTM G21

ASTM Designation: G21-09 "Standard Practice for determining Resistance of Synthetic polymeric materials to Fungi"

TEST AGENT
Monokote MK-10 HB Lot# B

TESTING LABORATORY
Accugen Laboratories, Inc.
50 West 75th street, Ste 209
Willowbrook, IL 60527
Tel: 630-789-8105
Toll free: 800-282-7102
Fax: 630-789-8104
Web address: www.accugenlabs.com
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DATE RECEIVED
10-17-12

DATE REPORTED
11-27-12

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TEST: Fungus resistance test as per ASTM G21-09

METHOD REFERENCE: ASTM Designation: G21-09 "Standard Practice for determining Resistance of Synthetic polymeric materials to Fungi"

INTRODUCTION: The purpose of this study is to assess the potential for mold growth on products and to evaluate that the products do not provide a food source to support the mold growth.

SUMMARY: Test samples were inoculated with composite of five different mold suspensions and were incubated under conditions favorable to mold growth. Samples were examined and rated for visual growth.

TEST MATERIALS: Monokote MK-10 HB Lot# B

TEST CONDITIONS:

Challenge Organisms:	Aspergillus niger	ATCC # 9642
	Penicillium pinophilum	ATCC # 11797
	Chaetomium globosum	ATCC # 6205
	Trichoderma virens	ATCC # 9645
	Aureobasidium pullulans	ATCC # 15233

Contact temperature: Room temperature (28 to 30℃)
Humidity 85% +

Media and reagents:

- Sabauroud's dextrose agar
- Nutrient Salt solutions and agar
- Sterile deionized water

STUDY DATES AND FACILITIES:

The laboratory phase of this test was performed at ACCUGEN LABORATORIES, INC, 50 West 75th Street, Willowbrook, Il 60527 from. Study was initiated on 10/17/12.The study completion date is the date the study director signed the final report which is 11/27/12.

RECORDS TO BE MAINTAINED:

All testing data, test material records, the final report, and correspondence will be stored in the archives.

TEST PROCEDURE:

Nutrient-salts agar was poured into suitable sterile dishes to provide a solidified agar layer. 2x2 inches pieces of test samples were placed on the surface of nutrient salts agar (pH 6.5). Testing was carried out in triplicate. The surface, including the surface of the test specimens, were inoculated with the composite spore suspension by spraying the suspension so that the entire surface is moistened with the spore suspension. Fungal suspension was composed of equal volume of five mold suspensions at a concentration of 1,000,000 spores ± 200,000 per ml

Negative Control:

- Three pieces of test sample were placed on Nutrient salt agar without inoculating any fungal suspension.
- Three plates of Nutrient salt agar were placed along the test as media negative control.

Viability Control:

Three Sabouraud dextrose agar plates were inoculated by spraying the suspension to cover the entire surface with the spore suspension.

There was copious growth on all three of the growth media plates to confirm the viability of the inoculums.

Positive Control:

Sterilized Wood spatula,1 x 2 in were placed on hardened nutrient-salts agar in separate Petri dishes. Each of them was inoculated with the spore suspension by spraying the suspension to cover the entire surface with the spore suspension.

There was copious growth on control specimens.

INCUBATION CONDITIONS:

Incubation—The inoculated test specimens and controls were covered and incubated at 28 to 30℃ and 85 % relative humidity for 28 days & 60 days.

Observation for Visible Effects—Visible effects were recorded and rated.

Growth observed was scored by amount of growth on Specimens as follows:

Observation	Rating
None	0
Traces of growth (less than 10 %)	1
Light growth (10 to 30 %)	2
Medium growth (30 to 60 %)	3
Heavy growth (60 % to complete overage)	4

TEST RESULTS: See Table 1 and figures.

Sample was tested in triplicate. All three replicates of the sample showed no growth in 28 days & 60 days.

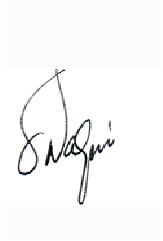
Table 1: Visual Rating of Fungal growth Observed

Sample	7 days			14 days			21 days			28 days			60 days		
Lab# 96689 Monokote MK-10 HB Lot# B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Negative Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viability Control	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Positive Control (Wood Spatula)	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4

Controls were satisfactory. Positive control and Viability control showed heavy growth. No unusual changes in the physical appearance of the sample were observed.

CONCLUSION:

Test sample do not provide food source that support mold growth. The sample showed no growth of fungi inoculated .The product was found resistant to fungi tested when incubated at nutrient salt agar medium.



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T. Naqvi M.S Microbiology, M (ASCP). Study Director

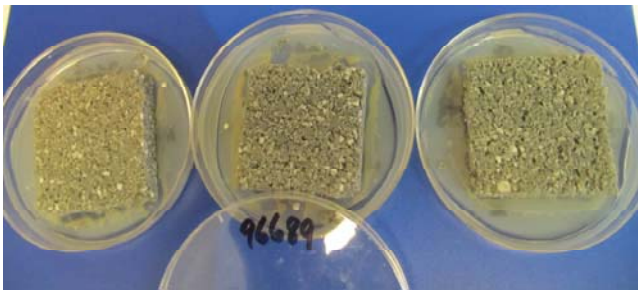

Fig1: Lab# 96689 at Nutrient Salt agar inoculated with fungal spores at 28 days in triplicate Test sample did not support any fungal growth. © Accugen labs

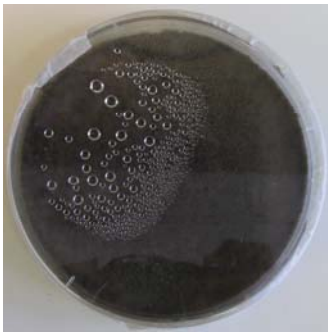

Fig2: Spores Viability control - heavy fungal growth © Accugen labs

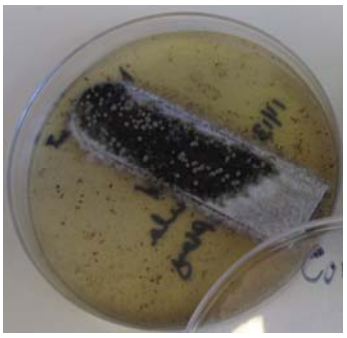

Fig3: Positive control - heavy fungal growth © Accugen labs

ABRASION TEST

MONOKOTE TYPE MK-10/HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY

TRAVELERS REST, SOUTH CAROLINA

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

ABRASION TEST

ABSTRACT

Significance: This test measures the amount of material removed from sprayed fire-resistive material when subjected to abrading forces.

The test was conducted in accordance with ASTM proposed method for testing "Sprayed Fire-Resistive Materials Applied to Structural Members" published in 1978, and as originally developed and adopted by the City of San Francisco.

Results: The average amount of Monokote Type MK-10/HB abraded by this test was 6.3 cubic centimeters. The test density was 14.9 lbs./ft.^{3} [239 Kg/m^3].

REPORT DETAILS

Date of Test: November 23, 1999

Identification of Specimen: Randomly selected of bags of Monokote Type MK-10/HB as produced by Grace Construction Products, W.R. Grace & Co. were used. Each bag of Monokote Type MK-10/HB contained the label of Underwriters' Laboratories, Inc. Each bag of Monokote Type MK-10/HB was mixed with water in a mechanical mixer in accordance with the instructions on each bag of material to produce a cohesive uniform slurry having an average mixer density of 42.7 lbs./ft^3 [684 Kg/m^3] and a nozzle density of 31.4 lbs./ft^3 [503 Kg/m^3]. The procedures truly represented typical field construction practices and complied with the instructions printed on the Monokote Type MK-10/HB bags.

Description of Test:

I. Apparatus
   - A. Abrasion Test apparatus described in the ASTM proposed method for testing "Sprayed Fire-Resistive Materials Applied to Structural Members" published in 1978.
   - B. Ruler, 12 inches [305 mm].
   - C. Ottawa Sand, 100% passing 30-mesh sieve.
   - D. Graduated cylinder, 50 cm^3 capacity.
   - E. Steel-pointed strips of varying widths.
   - F. Rigid substrate, 1/8 inch [3 mm] steel plate 12 by 18 inches [305 by 457 mm].
   - G. Rod, 8 inches [203 mm] long, 1 lb. [454 g] in weight.

II. Test Specimen: Two, 12 x 18 inch [305 x 457 mm] test specimens consisting of sprayed fire-resistive Monokote Type MK-10/HB applied to a 1/8 inch [3 mm] cold rolled steel substrate at 1 inch [25 mm] thickness. Thickness measurements did not vary by more than 3/16 inch [5 mm] from the average thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions. The test was conducted 68 days after application of the Monokote Type MK-10/HB.

III. Procedure: A test specimen was placed into the abrasion test apparatus and adjustable stops were placed tight against the specimen and locked. The test vehicle guide was placed over the specimen so the guide centerline was 3 inches [76 mm] from one edge of the specimen and adjusted to permit transfer of the test vehicle to the sample without dropping. The test vehicle was placed in the guide with the restraining trigger in place. The pulling cable was attached to the test vehicle and passed over the pulley at the end of the guide. The weights were fastened to the cable. The trigger was removed and the test vehicle made a complete pass over the test specimen, being drawn by the falling weights. There was a drop of not more than 0.1 inch [2.5 mm] of the test vehicle to reach the specimen.

Three such complete passes were made. Each pass of the test vehicle exceeded 12 inches [305 mm] in length on the test specimen and spanned its centerline. The guide was then repositioned such that the guide centerline was 3 inches [76 mm] from the other edge of the specimen and three more passes of the test vehicle were made in the same manner as the first test series. The test was repeated for the second specimen as described above.

Before removal of the test specimen from the apparatus, a centerline on the surface perpendicular to the travel of the test vehicle was scribed. The 6 inch [152 mm] measuring length was then used for determining the abrasion.

Upon its removal from the apparatus, each specimen was turned over and loose material was removed by lightly shaking and then tapping the specimen. Tapping on the back of the inverted specimen was made with a 16 ounce [454 g] rod, 8 inches [203 mm] long, held at one end 2 inches [50 mm] along the rod. The rod was held 3 inches [76 mm] above the specimen in a horizontal position and the long end of the rod was allowed to drop onto the back of the specimen by pivoting about the 2 inch [50 mm] point. The rod was dropped at four equal distant points along the test track parallel to the line of the track.

Thin steel strips were used in the 6 inch [152 mm] measuring area to confine the sand used in measuring the abrasion. Sand was then placed in a 50 cm^3 graduate to its maximum mark. The graduate was tapped with a glass stirring rod twenty (20) times to achieve uniform compacting. Any reduction in volume was made up with sand to the 50 cm^3 mark and the tapping procedure was repeated. Sand was placed slowly into the grooves made by the test vehicle, filling them level to the surface of the original surrounding area. The graduate was again tapped and the amount of sand used to fill the grooves was recorded. The second track was measured in the same manner and the measurement procedure repeated for the second specimen. All measurements were recorded. In addition, provisions were made to determine the thickness and density of the test material.

IV. **Test Data:**

First Specimen		Second Specimen	
Volume of sand - first pass	4.0 cm^3	Volume of sand - first pass	9.0 cm^3
Volume of sand - second pass	4.0 cm^3	Volume of sand - second pass	8.0 cm^3

Averages:

Volume of sand	6.3 cm^3
Thickness of Monokote Type MK-10/HB	1.0 inches [25.5 mm]
Density of Monokote Type MK-10/HB	14.90 $lbs/ft.^3$ [239 Kg/m^3]

Official Observers:
Kenneth L. Huffman - Froehling & Robertson, Inc.
Walter R. Payment - for W.R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Steve Ackerman, PE
Engineering Manager

IMPACT PENETRATION TEST

MONOKOTE TYPE MK-10/HB

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

W.R. GRACE & COMPANY

TRAVELERS REST, SOUTH CAROLINA

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

IMPACT PENETRATION

ABSTRACT

Significance: This test determines the effect of impact on the surface of sprayed fire-resistive material.

The test was conducted in accordance with ASTM proposed method for testing "Sprayed Fire-Resistive Materials Applied to Structural Members" published in 1978, and as originally developed and adopted by the City of San Francisco.

Results: The average amount of Monokote Type MK-10/HB lost through impact by this test was 4.3 cm^3. The test density was 14.9 lbs./$ft.^3$ [239 Kg/m^3].

REPORT DETAILS

Date of Test: November 23, 1999

Identification of Specimen: Randomly selected bags of Monokote Type MK-10/HB as produced by Grace Construction Products, W.R. Grace & Co. were used. Each bag of Monokote Type MK-10/HB contained the label of Underwriters' Laboratories, Inc. Each bag of Monokote Type MK-10/HB was mixed with water in a mechanical mixer in accordance with the instructions on each bag of material to produce a cohesive uniform slurry having an average mixer density of 42.7 lbs./ft^3 [684 Kg/m^3] and a nozzle density of 31.4 lbs./ft^3 [503 Kg/m^3]. The procedures truly represented typical field construction practices and complied with the instructions printed on the Monokote Type MK-10/HB bags.

Description of Test:

I. Apparatus
   A. Impact Penetration apparatus described in the ASTM proposed method for testing "Sprayed Fire-Resistive Materials Applied to Structural Members" published in 1978.
   B. Ottawa Sand, 100% passing 30-mesh sieve.
   C. Graduated cylinder, 50 cm^3 capacity.
   D. Rod, 8 inches [203 mm] long, 1 lb. [454 g] in weight.

II. Test Specimen: Two, 12 x 18 inch [305 x 457 mm] test specimens consisting of sprayed fire-resistive Monokote Type MK-10/HB applied to a 1/8 inch [3 mm] steel substrate at 1 inch [25 mm] thickness. Thickness measurements did not vary by more than 3/16 inch [5 mm] from the average thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions. These specimens were also used to test "Abrasion". The test was conducted 68 days after application of Monokote Type MK-10/HB.

III. Procedure: A test specimen was placed into the abrasion test apparatus and adjustable stops were placed tight against the specimen and locked. The impact bar was attached to the apparatus and adjusted such that the low point of the swing of the impact device was at a point 1/2 inch [12 mm] into the specimen. The impact device was rotated to the horizontal on one side of the support structure and allowed to free fall onto the specimen.

Three impacts on each side of the impact device support structure were made in the above manner. The impactor at no time encroached upon the tracks in the test specimen made during the above referenced "Abrasion" test. The test was repeated for the second specimen as described above.

Upon its removal from the apparatus, each specimen was turned over and loose material was removed by lightly shaking and then tapping the specimen. Tapping on the back of the inverted specimen was made with a 16 ounce [454 g] rod, 8 inches [203 mm] long, held at one end 2 inches [50 mm] along the rod. The rod was held 3 inches [76 mm] above the specimen in a horizontal position and the long end of the rod was allowed to drop onto the back of the specimen by pivoting about the 2 inch [50 mm] point. The rod was dropped four times over each of the impacted areas.

Sand was then placed in a 50 cm^3 graduate to its maximum mark. The graduate was tapped with a glass stirring rod twenty (20) times to achieve uniform compacting. Any reduction in volume was made up with sand to the 50 cm^3 mark and the tapping procedure was repeated. Sand was placed slowly into the gouged impact area, filling the gouged area level with the surface of the original surrounding area. The graduate was again tapped and the amount of sand used to fill the gouged area was recorded. The procedure was repeated for the second impact-gouged area on the specimen and on the second specimen for both gouged areas. All measurements were recorded. In addition, provisions were made to determine the thickness and density of the test material.

IV. **Test Data:**

First Specimen		Second Specimen	
Volume of first gouged area	3.5 cm^3	Volume of first gouged area	4.0 cm^3
Volume of second gouged area	5.5 cm^3	Volume of second gouged area	4.0 cm^3

Averages:

Volume of sand	4.3 cm^3
Thickness of Monokote Type MK-10/HB	1.0 inches [25.5 mm]
Density of Monokote Type MK-10/HB	14.90 lbs/ft.^{3} [239 Kg/m^3]

Official Observers:
Kenneth L. Huffman - Froehling & Robertson, Inc.
Walter R. Payment - for W.R. Grace & Co.

The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,
FROEHLING & ROBERTSON, INC.

Steve Ackerman, PE
Engineering Manager

gcp applied technologies
GRACE CONSTRUCTION & PACKAGING

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August 19, 2016

Mark S. White
Phillips Company
1414 South State Street
Freeburg, IL 62243

RE: Webster College; St. Louis, MO
LEED 2009 Green Building Rating System™

To whom it may concern:

GCP Applied Technologies has been asked to comment on the raw materials/ingredients and manufacturing location of our Monokote MK-10/HB product for the Webster College project located in St. Louis, MO. We have been informed that the request is in reference to a LEED 2009 Green Building Rating System™ Credits MR 5.1 and MR 5.2.

The GCP Applied Technologies Monokote MK-10/HB product for the Webster College project would be manufactured at the GCP Applied Technologies manufacturing facility in Ajax, Ontario. The Ajax, Ontario facility is not located within 500 miles of the St. Louis, MO project site.

Several of the raw materials/ingredients in the GCP Applied Technologies Monokote MK-10/HB product are extracted, harvested or recovered within 500 miles of the St. Louis, MO project site. The following are the percentages by weight of the raw materials/ingredients extracted, harvested or recovered within 500 miles of the project site:

GCP Applied Technologies Product	Percent by Weight of raw materials/ingredients extracted, harvested or recovered within 500 miles of the subject project site
Monokote MK-10/HB	4.51%

According to the information provided above, the GCP Applied Technologies product listed does not contribute to the LEED 2009 Green Building Rating System™ Credit MR 5.1 and MR 5.2 for the Webster College project located in St. Louis, MO as the requirement has been described to us. Please contact us if there are any questions.

Sincerely,

John A. Dalton
Technical Service Manager

Provide LEED submittal per specification 078100 paragraph 1.4.B (EQ 4.2).

CANNONDESIGN

SUBMITTAL IDENTIFICATION SHEET

To be completed by Contractor/CM

WEBSTER UNIVERSITY ISB
PROJECT NAME

8274 BIG BEND BLVD
ADDRESS

NUMBER

WEBSTER UNIVERSITY
OWNER

CANNON DESIGN
ARCHITECT / ENGINEER

DEVIN D GATES
SUBMITTED BY

078100-001
CONTRACTOR / CM SUBMITTAL NO.

CANNON DESIGN SUBMITTAL NO.

DRAWING / DETAIL REFERENCE

078100
SPECIFICATION SECTION / PARAGRAPH

MANUFACTURER / SUPPLIER

ITEM / PRODUCT ID

REQUIRED DATE

PRIORITY

○ CRITICAL

ITEM BEING SUBMITTED (check only one)

- ○ Shop Drawings
- ○ Samples (_____ copies)
- ○ LEED Submittal
- ○ Certification / Qualifications
- ◉ Record Documents
- ○ Product Data
- ○ Coordination Drawing
- ○ Calculations
- ○ Schedules
- ○ O&M Manuals
- ○ Other _____

ITEM BEING SUBMITTED FOR (check only one)

◉ Action ○ Information Only ○ Record

REMARKS OR DEVIATIONS

CONTRACTOR / CM CERTIFICATION
(SUBMITTALS NOT CERTIFIED WILL BE RETURNED WITHOUT REVIEW)

PARIC

PARIC CORPORATION
SUBMITTAL STAMP

THIS SHOP DRAWING HAS BEEN REVIEWED BY PARIC CORPORATION

Subcontractor remains responsible for dimensions, quantities, coordination with other trades and compliance with contract documents.

By:
Devin D. Gates

DEVIN D GATES — 10/7/16
REVIEWED BY — DATE

To be completed by Reviewer

07 8100-001
CANNON DESIGN SUBMITTAL NUMBER

10/10/16
RECEIVED DATE

- ○ A. No Exceptions Taken
  No further review of submittal is required.
- ◉ B. Make Corrections Noted
  Incorporate corrections in work; resubmission is not required.
- ○ C. Revise and Resubmit
  Revise as noted, and resubmit for review.
- ○ D. Rejected
  Submittal is not in compliance with Contract Documents; provide new submittal.
- ○ E. For Record / Information Only
  Submittal was reviewed for Record / Information purposes only.
- ○ F. Not Required for Review
  Submittal is not required by Contract Documents and has not been reviewed.

Review is for conformance with the design concept of this project and for general compliance with contract documents. Contractor is responsible for quantities, dimensions and compliance with contract documents and for information that pertains to fabrication processes, construction techniques and coordination of this work with all trades which will be affected thereby. This review is null and void if submittal deviates from contract documents and does not indicate or note deviations.

A/E COMMENTS ○ See attached sheet(s) for additional comments

1. Product data approved.
2. Provide LEED submittal per specification 078100 paragraph 1.4.B (EQ 4.2).
3. Provide information regarding specification section 078100 paragraph 1.5.A and 1.5.E.

Kelvin Patel — Digitally signed by Kelvin Patel DN: C=US, E=kpatel@cannondesign.com, O=Cannon Design, OU=Architect, CN=Kelvin Patel Date: 2016.10.19 18:33:13-05'00' — 10/19/16
REVIEWED BY — DATE