GCP Applied Technologies

MONOKOTE Z-106/HY Test Reports

62 Whittemore Avenue

Cambridge, Massachusetts 02140

USA

COHESION/ADHESION

MONOKOTE TYPE Z-106/HY

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

GCP APPLIED TECHNOLOGIES INC. (FORMERLY W.R. GRACE & CO.)

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 Z-106/HY on bare steel was 2,691 pounds per square foot (psf).

REPORT DETAILS

Dates of Test: March 18, 2015 (mixing & spraying); April 30, 2015 (testing)

Identification of Specimen: Bags were selected at random of Monokote Type Z-106/HY as produced by Construction Products Division, GCP Applied Technologies Inc. (formerly W.R. Grace & Co.). 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 two minutes produced a uniform slurry having a mixer density of 32.9 pounds per cubic foot (pcf) and a nozzle density of 39.8 pcf. The procedures represented typical field construction practices and complied with instructions printed on the Monokote Type Z-106/HY bags.

Description of Test:

I. Apparatus

A. Metal screw cap 2.25 inches [5.7 centimeters] in diameter and 0.4 inches deep [3.974 sq. in. area], with a hook attached at the center.

B. Pull Tester accurate to 0.1 lb. (45 grams) with a capacity of 100 lbs (45 kg).

C. Steel substrate 11.5" (29 cm) x 12.5" (31.8 cm) x 16 gauge to which Monokote Type Z-106/HY was spray applied and allowed to dry in laboratory conditions 72° F ± 3° F (22° C ± 1.6° C) for a period of 43 days.

II. Test Specimen:

A. 3 bare 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 Z-106/HY material using a two- part, fast setting epoxy. This epoxy attachment assembly was allowed to fully dry 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 pull 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	75.7	2742	Cohesive
2	79.3	2872	Cohesive
3	67.9	2459	Cohesive
AVERAGE	**74.3**	**2691**	

Thickness Tested - 1.25" Monokote Type Z-106/HY Density – 22.4 pcf

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.

Anthony Aldykiewicz - GCP APPLIED TECHNOLOGIES INC. (FORMERLY W.R. GRACE & CO.)

Michael Morgan – GCP APPLIED TECHNOLOGIES INC. (FORMERLY W.R. GRACE & CO.)

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

Respectfully submitted,
FROEHLING & ROBERTSON, INC.

Ryne Turner, PE
CMT Manager

COMPRESSIVE STRENGTH – ASTM E761-11

MONOKOTE TYPE Z-106 HY

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES INC. (FORMERLY W.R. GRACE & CO.)

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 Z-106 HY required an average uniform compressive load of 118.7 pounds per square inch (psi) to compress them to 10 percent deformation.

REPORT DETAILS

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

Identification of Specimen: Bags of Monokote Type Z-106 HY were selected at random as produced by GCP Applied Technologies Inc. (Formerly W.R. Grace & Co.). Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote Type Z-106 HY 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 35.2 pounds per cubic foot (pcf) and a nozzle density of 43.7 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote Type Z-106 HY 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 Z-106 HY applied to a galvanized steel sheet approximately 0.25" in thickness. This resulted in an actual Z-106 HY thickness of approximately 1.05". Four 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 ^{O}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	1947.2	121.7
2	1899.3	118.7
3	1885.4	117.8
4	1865.8	116.6
AVERAGE	**1899.4**	**118.7**

Thickness Tested – 1.3" (incl. galvanized sheet) Density – 22.5 pcf

Official Observers:

Steve Ackerman, PE - Froehling & Robertson, Inc.

Doug Macy - GCP Applied Technologies Inc. (Formerly W.R. Grace & Co.)

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne Turner, PE

Ryne Turner, PE
CMT Manager

LOW VELOCITY AIR EROSION – ASTM E859-11

MONOKOTE® Z-106/HY

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES INC (FORMERLY W.R. GRACE & CO.)

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® Z-106/HY, 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 0.001 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 0.00022 grams per square foot**. The test density was 21.01 pounds per cubic foot (pcf).

REPORT DETAILS

Date of Test: March 18, 2015 (sample preparation); April 29, 2015 (testing)

Identification of Specimen: Bags of Monokote® Z-106/HY were selected at random as produced by GCP Applied Technologies Inc (formerly W.R. Grace & Co.). Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-106/HY was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 33.65 pounds per cubic foot (pcf) and a nozzle density of 40.84 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-106/HY 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® Z-106/HY 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)	1.688	0.000	0.000
1 HR (final)	1.688		
6 HR (initial)	1.596	0.000	0.000
6 HR (final)	1.596		
24 HR (initial)	1.503	0.001	0.00022
24 HR (final)	1.504		

Monokote® Z-106/HY Density – 21.01 pcf

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Anthony Aldykiewicz – GCP Applied Technologies Inc (formerly W. R. Grace & Co.)
Michael Morgan – GCP Applied Technologies Inc (formerly W. R. Grace & Co.)

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

Respectfully submitted,
FROEHLING & ROBERTSON, INC.

Ryne Turner, PE
CMT Manager

HIGH VELOCITY AIR EROSION – ASTM E859-11

MONOKOTE® Z-106/HY

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES INC (FORMERLY W. R. GRACE & CO.)

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® Z-106/HY, when subjected to tangential air stream of a velocity of 45.8 ft./sec [13.7 m/s], resulted in a weight loss of 0.002 grams at one hour, 0.004 grams during the next 5 hours, and 0.003 grams during the next 18 hours (24 hours test time), for a total weight loss of 0.009 grams over the 24 hour test period. **The loss per area of test section for the total test period was 0.00194 grams per square foot**. The test density was 21.01 pounds per cubic foot (pcf).

REPORT DETAILS

Date of Test: March 18, 2015 (sample preparation); April 29, 2015 (testing)

Identification of Specimen: Bags of Monokote® Z-106/HY were selected at random as produced by GCP Applied Technologies Inc (formerly W. R. Grace & Co.). Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-106/HY was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 33.65 pounds per cubic foot (pcf) and a nozzle density of 40.84 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-106/HY 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® Z-106/HY 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)	1.661	0.002	0.0004
1 HR (final)	1.663		
6 HR (initial)	1.663	0.004	0.0009
6 HR (final)	1.667		
24 HR (initial)	1.602	0.003	0.0006
24 HR (final)	1.605		

Monokote® Z-106/HY Density – 21.01 pcf

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Anthony Aldykiewicz - GCP Applied Technologies Inc (formerly W. R. Grace & Co.)
Michael Morgan – GCP Applied Technologies Inc (formerly W. R. Grace & Co.)
The data included in this report constitutes all the tests that were witnessed.

Respectfully submitted,
FROEHLING & ROBERTSON, INC.

Ryne Turner, PE

Ryne Turner, PE
CMT Manager

CORROSION TEST

MONOKOTE® TYPE Z-106/HY

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES INC (FORMERLY W.R. GRACE & CO.)

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 Z-106/HY did not excessively contribute to corrosion of steel when exposed to higher temperature and humidity. Test density was 21.21 pounds per cubic foot (pcf).

REPORT DETAILS

Dates of Testing: April 14, 2015 (mixing & spraying) ; April 24, 2015 (testing)

Identification of Specimen: Bags of Monokote® Type Z-106/HY were selected at random as produced by GCP Applied Technologies Inc (formerly W.R. Grace & Company). Each bag contained the label of Underwriters' Laboratories, Inc. The Monokote® Type Z-106/HY 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 36.75 pcf and a nozzle density of 40.75 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Type Z-106HY 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 Z-106/HY 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 Z-106/HY, 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 Z-106/HY, specimens marked I_a were dried to constant weight at laboratory conditions [68 $\pm$ 9 ^oF with relative humidity not greater than 60%].

(c) Specimens marked II_a were placed into the chamber and kept at 95 $\pm$ 3^oF and 95% ± 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)	1606.1	1606.1	0.0	1610.1	1610.1	0.0
Bare (2)	1610.6	1610.6	0.0	1608.9	1608.8	0.1
Shop Coated (1)	970.9	970.9	0.0	970.8	970.1	0.7
Shop Coated (2)	1031.6	1031.6	0.0	1035.7	1035.7	0.0
Galvanized (1)	937.9	937.9	0.0	939.9	939.9	0.0
Galvanized (2)	938.4	938.4	0.0	941.4	941.4	0.0

Monokote® Type Z-106/HY Thickness = 0.75 inches Density = 21.1 pcf

RESULTS: (Average of two tests)

Weight loss of control specimens : (I_a-I_b)

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

Weight loss of conditioned specimens: (II_a - II_b)

Bare Steel = 0.05 grams Shop Coated Steel = 0.35 grams
Galvanized Steel = 0.0 grams

Difference in weight loss: (II_a - II_b) - (I_a - I_b) Grams/mm^2

Bare Steel	=	0.05 grams	1.2×10^{-6}
Shop Coated Steel	=	0.35 grams	8.5×10^{-6}
Galvanized Steel	=	0.0 grams	0

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Doug Macy - GCP Applied Technologies Inc (formerly W.R. Grace & Company)

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne T. Turner, PE
CMT Manager

DEFLECTION TEST – ASTM E759-11

MONOKOTE® Z-106/HY

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES INC. (FORMERLY W.R. GRACE & CO.)

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® Z-106/HY 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 $1/120^{th}$ of the span. The test density was 21.01 pounds per cubic foot (lbs./ft.^{3}).

REPORT DETAILS

Date of Test: March 19, 2015 (sample preparation); April 28, 2015 (testing)

Identification of Specimen: Bags of Monokote® Z-106/HY were selected at random as produced by GCP Applied Technologies Inc. (formerly W.R. Grace & Co.). Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-106/HY 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 33.7 pounds per cubic foot (pcf) and a nozzle density of 40.8 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-106/HY 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® Z-106/HY 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 at least 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® Z-106/HY 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® Z-106/HY was observed after being subjected to the above described test procedure.

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Anthony Aldykiewicz – GCP Applied Technologies Inc. (formerly W.R. Grace & Co.)
Michael Morgan - GCP Applied Technologies Inc. (formerly W.R. Grace & Co.)

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne Turner, PE

Ryne Turner, PE
CMT Manager

BOND IMPACT TEST – ASTM E760-11

MONOKOTE® Z-106/HY

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES INC. (FORMERLY W.R. GRACE & CO.)

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® Z-106/HY 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 21.01 pound per cubic foot (pcf).

REPORT DETAILS

Date of Test: March 19, 2015 (sample preparation); April 28, 2015 (testing)

Identification of Specimen: Bags of Monokote® Z-106/HY were selected at random as produced by GCP Applied Technologies Inc. (formerly W.R. Grace & Co.). Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-106/HY was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 33.65 pounds per cubic foot (pcf) and a nozzle density of 40.84 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-106/HY 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® Z-106/HY fire-resistive material was then spray applied to the underside of the steel deck to a 3/4 inch [19 mm] thickness. The Monokote® Z-106/HY 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 minimum 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® Z-106/HY 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® Z-106/HY was observed after being subjected to the above described test procedure

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Anthony Aldykiewicz – GCP Applied Technologies Inc. (formerly W.R. Grace & Co.)
Michael Morgan - GCP Applied Technologies Inc. (formerly W.R. Grace & Co.)

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne Turner, PE

Ryne Turner, PE
CMT Manager

TITLE PAGE

Study Title
ASTM Designation: G21-96 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi"

Products Identity
Monokote Z-106

Test Microorganisms
Penicillium funiculosum ATCC 11797
Aspergillus brasiliensis ATCC 9642
Chaetomium globosum ATCC 6205
Trichoderma virens ATCC 9645
Aurobasidium pullulans ATCC 15233

Author
Laura Higgins, B.S.
Kalpa Mehta, Ph.D.

Participating Study Personnel
Laura Higgins, B.S.
Kalpa Mehta, Ph.D.

Reviewed By:
D. Ugarte

Study Completion Date
26 NOV 2012
(Report amended 07SEP2016 by B. Richard)

Testing Facility
Antimicrobial Test Laboratories
1304 W. Industrial Blvd.
Round Rock, Texas 78681

Antimicrobial Test Laboratories Study ID
NG3645

CONCLUSION

A liquid suspension of the pooled fungal species was applied to the test substance Monokote Z-106. After a 60 day incubation period at 30 ± 2 °C, the test substance demonstrated no signs of supporting fungal growth, therefore it is determined that Monokote Z-106, does not provide a carbon source for fungal growth.

STATEMENT OF NO DATA CONFIDENTIALITY CLAIMS

No claim of confidentiality is made for any information contained in this study (sign if applicable)

Company: _____

Agent: _____

Title: _____

Date: _____

Signature: _____

LABORATORY QUALITY ASSURANCE STATEMENT

This study was performed in accordance with Antimicrobial Test Laboratories Standard Operating Procedures (SOPs) related to Experimental Quality and Control.

In general, this suite of SOPs specifies the following:

- Laboratory equipment and devices are verified to function properly and calibrated internally or externally as appropriate to ensure experimental quality.

- Each experiment is evaluated relative to rigorous in-process experimental controls.
    - Media sterility controls (negative controls)
    - Vehicle (carrier) sterility controls
    - Media growth controls (positive controls)
    - Verification of positive cultures as target organism

- Review by Antimicrobial Test Laboratories' Scientific Director, Benjamin Tanner, Ph.D. for scientific clarity, accuracy, and completeness.

This study is exempt from 40 CFR Part 160 (non-GLP). *Per sponsor communication, data not intended to support a United States antimicrobial pesticide registration.*

TABLE OF CONTENTS

FINAL STUDY REPORT

Study Title
ASTM Designation: G21-09 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi"

Study Number
NG3645

Study Sponsor
Bret Simpson
GCP Applied Technologies

Test Facility
Antimicrobial Test Laboratories
1304 W. Industrial Blvd.
Round Rock, Texas 78681

Study Director
Laura Higgins, B.S.
Kalpa Mehta, Ph.D.

Study Completion Date
26 NOV 2012

Study Objective
To assess the potential for mold growth on products and to evaluate the products as a potential food source for mold growth.

SUMMARY OF THE TEST METHOD

Materials

- Pure culture of each test system (microorganism).
- Sufficient quantity of test substance(s).
- Sufficient quantity of clean, sterile plastic Petri dishes containing solidified Nutrient Salts Agar.
- Sufficient volume of sterile Nutrient Salts Solution.
- Bunsen burner, microbiological incinerator, or micro-torch as appropriate to ensure rapid and complete flame-sterilization of forceps and/or loops.
- Sufficient quantity of micropipettes and appropriately sized sterile micropipette tips.
- Automatic pipettor (PipetAid or similar) and various sizes of sterile serological pipettes.
- Sufficient quantity of sterile 50ml centrifuge tubes.
- Preval sprayer and jar or other equivalent atomizer.
- Sterile 10-20ml syringe.
- Sterile glass wool.
- Incubators capable of sustaining temperatures of 30± 2 °C.
- Sufficient amount of sterile Fisher P2 Filter paper
- Centrifuge
- Sufficient amount of sterile RO Water
- Sufficient amount of Triton X-100

PROCEDURE

Preparation of Test Cultures

- Test cultures are initiated from the monthly working stock plates. Each culture is incubated at 30 ± 2 °C.
- Plates are washed with a 10ml volume of sterile distilled, de-ionized or reverse osmosis water (or other equivalent sterile solution such as phosphate buffered saline) supplemented with 0.1% Triton X-100.
- Suspended fungal growth is decanted into separate sterile 50ml conical centrifuge tubes.
- Each spore suspension is passed through a syringe (without plunger) with a thin layer of sterile glass wool inside the bottom of the syringe. The volume passed through the glass wool syringe is collected in a separate 50ml conical tube. Each tube is washed with sterile water or phosphate buffered saline and the volume is collected in the same collection vessel.
- Each spore suspension is centrifuged at 1,000 rpm for 10 minutes and suspended in sterile water or phosphate buffered saline. Spores are centrifuged for a total of two times and the final spore suspension suspended in 10ml Nutrient Salts Solution.
- A 5-10ml aliquot of each spore suspension is added to a sterile Preval sprayer jar.
- Sterile Nutrient Salts Solution is added to bring the final volume to 100ml.

Preparation of Test Substance and Controls

- The test substance is cut to approximately 2" x 2" and placed on the surface of the Nutrient Salts Agar.
- A sterile 1" x 1" filter paper is cut and placed on the surface of the Nutrient Salts Agar, and serves as the positive control for the test.
- A blank Nutrient Salts Agar plate is used as the negative control.
- All samples (including positive and negative controls) are inoculated by spraying the surface with the pooled spore suspension for approximately 1 second, or until surface is visibly moistened.
- Once all the plates have been inoculated, the plates are covered, sealed and placed into the incubator at 30± 2 °C with no less than 85% relative humidity.
- The samples are incubated over 28 days or other as requested by the Study Sponsor._ During the incubation period, observations are made at intervals of 7 days. The test may be terminated at the discretion of the Study Sponsor, before the 28 day mark if samples show a rating of 2 (light growth) or higher. Observations of 0 (no growth) will be confirmed by microscopic observation and the magnification used should be noted.
- Once the contact time is met the samples are removed from the incubator, observations are made and plates are properly disposed of.

TEST INFORMATION

Client Information

Company Name:	GCP Applied Technologies
Study Sponsor:	Bret Simpson
Sponsor's Email:	Bret.T.Simpson@grace.com

General Test Information

Test Performed:	ASTM G21
ATL Study ID:	NG3645
Performed By:	L. Higgins
Date Initiated	27 SEP 2012
Date Completed:	26 NOV 2012

Test Substance Information

Name:	Monokote Z-106
Date Received:	25 SEP 2012

Test Parameters

Microorganisms:	*Penicillium funiculosum*	ATCC 11797
	Aspergillus brasiliensis	ATCC 9642
	Chaetomium globosum	ATCC 6205
	Trichoderma virens	ATCC 9645
	Aurobasidium pullulans	ATCC 15233
Contact Temperature:	30 ± 2 °C	
Contact Humidity:	≥85%	
Inoculum Volume:	1 second spray	
Suspension Medium:	Nutrient Salts Solution	
Agar Medium:	Nutrient Salts Agar	
Contact Time:	60 days	
Replicates:	Triplicate	

Controls

Negative Control:	Passed; all plates showed <10% growth
Positive Control:	Passed; all plates showed copious growth

The data reported herein represents the results of the product(s) submitted to Antimicrobial Test Laboratories when tested under the conditions and method reported, and not necessarily that of all product(s) bearing the same product name and/or manufacturer.

RESULT TABLES AND CHARTS

Observations are qualitatively made on a scale from 0-4 as follows:

Score	Description
0	No growth detected on sample
1	Traces of growth detected on sample (<10%)
2	Light growth detected on sample (10%-30%)
3	Medium growth detected on sample (30%-60%)
4	Heavy growth detected on sample (60%-Complete)

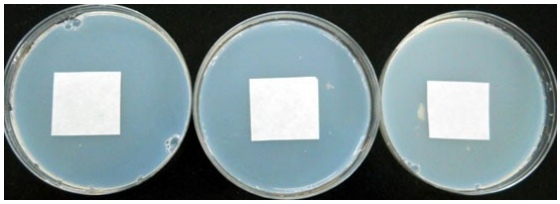
RESULTS:

Incubation Time and Score				
Date	**Sample**	**Replicate 1**	**Replicate 2**	**Replicate 3**
Day 60 (26NOV2012)	ATL Negative Control	1	1	1
	ATL Positive Control	4	4	4
	Monokote Z-106	0	0	0

PHOTOS FROM STUDY

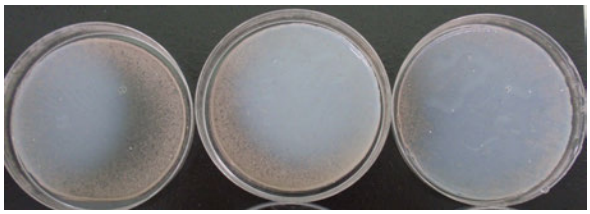
Day 0

ATL Negative Control

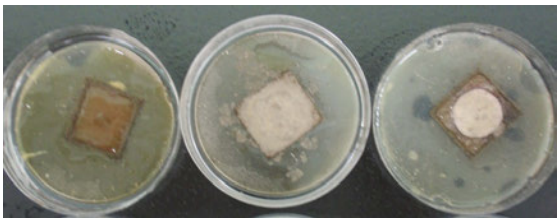


ATL Positive Control

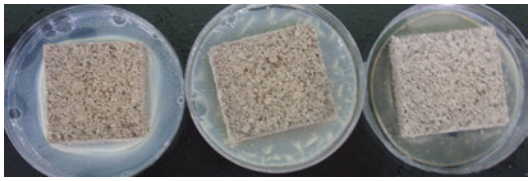
Day 60



ATL Negative Control



ATL Positive Control



Monokote Z-106

Antimicrobial Test Laboratories • 1304 W. Industrial Blvd. • Round Rock, Texas 78681 • (512) 310-8378

STUDY ACCEPTANCE CRITERIA

Success Criteria

- The experimental success (controls) criteria follow:
  1. After 14 days of incubation, copious amounts of growth are observed on all three of the positive control specimens.
  2. After 14 days, less than 10% of growth is observed on all three negative control plates.

STUDY RECORD AND SPECIMEN RETENTION

Study Record Retention

This study report and corresponding data sheets will be held by Antimicrobial Test Laboratories at the following address for at least 2 years after the date of this report:

Antimicrobial Test Laboratories
1304 W. Industrial Blvd.
Round Rock, Texas 78681

Specimen Retention

The test substances used in Non-GLP studies are disposed of after 30 days unless otherwise requested by the study sponsor.

STUDY CONCLUSION

A liquid suspension of the pooled fungal species was applied to the test substance Monokote Z-106. After a 60 day incubation period at 30 ± 2 °C, the test substance demonstrated no signs of supporting fungal growth, therefore it is determined that Monokote Z-106, does not provide a carbon source for fungal growth.

REFERENCES

1. ASTM G21-09. Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi. West Conshohocken, PA: American Society for Testing and Materials.

UL Product iQ™

BLPR.R4339 - CEMENTITIOUS CEMENT AND PLASTER MIXTURES

Cementitious Cement and Plaster Mixtures

See General Information for Cementitious Cement and Plaster Mixtures

GCP APPLIED TECHNOLOGIES INC R4339
FIRE OPERATING UNIT
62 WHITTEMORE AVE
CAMBRIDGE, MA 02140 USA
Cementitious mixtures applied to inorganic reinforced cement board and/or foamed plastic.

Applied To Inorganic Reinforced Cement Board

	MK-4	MK-5	RG	Type 105	KM-106
Flame Spread	10	10	0	0	0
Smoke Developed	0	0	0	0	0

	Z-3306G	MK-6/HY or MK-6/HB or MK-10/HB or MK-10/HB ES or MK-6/HY ES	Z-106/HY	MK-6 GF or MK-6 GF Extended Set	MK-6s or Z-106G or MK-1000/HB or MK-1000/HB Extended Set	AK-1
Flame Spread	0	0	0	0	0	0
Smoke Developed	0	0	0	0	0	0

	Type 105	Type Z-106	Type KM-601	Type Z-146, Z-146 NPP, Z-146PC, Z-146T, Z-156, Z-156PC, Z-156T	Monokote Acoustic 1	Monokote Acoustic 5	Monokote Acoustic 35
Flame spread	0	0	0	0	0	0	0
Smoke developed	0	0	0	0	0	0	0

	Applied to Inorganic Reinforced Cement Board in a Max Thk of 1 In. Type Z-3300TB+, ++
Flame Spread	5
Smoke Developed	0

	Applied to Inorganic Reinforced Cement Board In a Max Thk of 1/2 in. Type Z-Accoustical Plaster
Flame Spread	0
Smoke Developed	0

+ FOR SURFACE BURNING CHARACTERISTICS APPLIED OVER FOAMED PLASTIC, SEE CLASSIFICATION MARKING OF UNDERWRITERS LABORATORIES INC. ON PRODUCT OR CARTON.

++ Systems utilizing cementitious mixture covering over 2 in. thickness of foamed plastic, fire tested in accordance with the International Conference of Building Officials Research Committee Acceptance Criteria for Foam Plastics under Section 1717 (b) of the 1976 Uniform Building Code.

	Applied Over 2 In. Thk Foamed Plastic† In. a Min Thkns of 1/2 In. Type Z-3300TB††
Flame spread	10
Smoke developed	0

* A Foamed plastic formed by the simultaneous spraying of two liquid components (CPR-485, Component "A" and CPR-485, Component "B") as manufactured by The Upjohn Company, CPR Division. This foamed plastic has values of Over 200 for flame spread, 15 for fuel contributed and Over 500 for smoke developed.

* A1 Systems utilizing 3/4 in. thick cementitious mixture covering over 2 in. thickness of foamed plastic, fire tested in accordance with the Uniform Building Code Standard 26-3.

	Applied Over 2 In. Thk Foamed Plastic * In. a Min Thkns of 1/2 in. Type Z3300TB*
Flame spread	5
Smoke developed	0

* Foamed plastic in the form of boards identified as Type B and manufactured by GCP Applied Technologies Inc. and bearing the Fire Hazard Classification Marking of Underwriters Laboratories Inc. The 2 in. thickness of foamed plastic exhibited values of 5 for flame spread, not determinable for fuel contributed, and 40 for smoke developed, while material remained in original test position; ignition of molten residue on the furnace floor resulted in flame travel equivalent to calculated Flame Spread Classification of 100 and Smoke Developed Classification of Over 500.

** A system utilizing 1/2 in. thickness of cementitious mixture covering 2 in. thickness of foamed plastic,thickness of foamed plastic.

FOR SURFACE BURNING CHARACTERISTICS SEE CLASSIFICATION MARK OF UL ON PRODUCT OR CARTON

Last Updated on 2019-08-26