GCP Applied Technologies

MONOKOTE Z-106 G Test Reports

ASTM E736 Cohesive Adhesive	Page 2
ASTM E761 Compressive Strength	Page 6
ASTM E859 Air Erosion	Page 9
ASTM E859 High Speed Air Erosion	Page 13
ASTM E937 Corrosion Test	Page 17
ASTM E759 Deflection	Page 21
ASTM E760 Bond Impact	Page 24
ASTM G21 Mold Resist	Page 28
UL E84 Flame Spread Smoke Develop	Page 36
ASTM D2240-10 Durometer Hardness	Page 38

gcp applied technologies

62 Whittemore Avenue

Cambridge, Massachusetts 02140

USA

COHESION/ADHESION

MONOKOTE TYPE Z-106 G

FIRE RESISTIVE MATERIAL

MADE FOR

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

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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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 G on bare steel was 2051.7 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 Z-106 G as produced by 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 ninety seconds produced a uniform slurry having a mixer density of 41.1 pounds per cubic foot (pcf) and a nozzle density of 48.3 pcf. The procedures represented typical field construction practices and complied with instructions printed on the Monokote Type Z-106 G 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 Z-106 G 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. 5 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 G 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	110.3	1914.6	Cohesive
2	118.7	2060.4	Cohesive
3	127.4	2211.4	Cohesive
4	127.8	2218.4	Cohesive
5	106.8	1853.9	Cohesive
AVERAGE	**118.2**	**2051.7**	

Thickness Tested - 1.25" Monokote Type Z-106 G Density – 22.6 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

COMPRESSIVE STRENGTH – ASTM E761-11

MONOKOTE TYPE Z-106 G

FIRE RESISTIVE MATERIAL

MADE FOR

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

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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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 G required an average uniform compressive load of 53.8 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 Z-106 G 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 G 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 41.1 pounds per cubic foot (pcf) and a nozzle density of 48.3 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote Type Z-106 G 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 G applied to a galvanized steel sheet approximately 0.25" in thickness. This resulted in an actual Z-106 G 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	879.1	54.9
2	887.3	55.5
3	831.1	51.9
4	846.8	52.9
AVERAGE	**861.1**	**53.8**

Thickness Tested – 1.3" (incl. galvanized sheet) Density – 22.6 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

AIR EROSION TEST

MONOKOTE® TYPE Z-106/G

FIRE RESISTIVE MATERIAL

MADE FOR

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

TRAVELERS REST, SOUTH CAROLINA

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

Copyright 1998 GCP Applied Technologies Inc (formerly W. R. Grace & Co.) – Conn.

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® Type Z-106/G when subjected to tangential air stream of a velocity of 1,320 ft./min. or 15.0 m.p.h. [402 m/min. or 24.1 Km/hr.] 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). The total weight loss was 0.000 grams per $ft.^2$ [0.000 grams per $meter^2$] in 24 hours. The test density was 21.94 $lbs./ft.^3$ [351 Kg/m^3].

REPORT DETAILS

Date of Test: September 17, 1998

Identification of Specimen: Bags of Monokote® Type Z-106/G 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/G was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 37.1 $lbs./ft^3$ [594 Kg/m^3] and a nozzle density of 47.0 $lbs./ft^3$ [753 Kg/m^3]. The procedures truly represented typical field construction practices and complied with the instructions printed on the Monokote® Type Z-106/G 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 1,320 ft./min. or 15.0 m.p.h. [402 m/min or 24.1 Km/hr.].

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 [25.4 mm] and 82 picks per inch [25.4 mm].

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® Type Z-106/G was spray applied at 0.528 inch [13.4 mm] in thickness. The

specimen as sprayed was allowed to cure and dry at laboratory conditions for a period of 45 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 1,320 ft./min. or 15.0 m.p.h. [402 m/min. or 24.1 Km/hr].
E. The blower was stopped at intervals of 1, 6, and 24 hours. During this stoppage, the filter was removed, dried, and re-weighed.

IV. Test Data:

A. Density = 21.94 lbs. /ft^3 [351 Kg/m^3]
B. Thickness Tested = 0.913 inches [23.2 mm]
C. Exposed Area = 4.63 $ft.^2$ [0.43 m^2]

WEIGHING TIME	FILTER WEIGHT (g)	WEIGHT LOSS (g)	WEIGHT LOSS (g per ft^2)
1 HR (initial)	2.043	0.000	0.000
1 HR (final)	2.043		
6 HR (initial)	2.178	0.000	0.000
6 HR (final))	2.178		
24 HR (initial)	2.117	0.000	0.000
24 HR (final)	2.117		

Official Observers:

Ross Deaver, Ken Huffman - Froehling & Robertson, Inc.
Walter R. Payment - 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

HIGH VELOCITY AIR EROSION – ASTM E859-11

MONOKOTE® TYPE Z-106/G

FIRE RESISTIVE MATERIAL

MADE FOR

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

TRVELERS REST, SOUTH CAROLINA

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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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."

Results: Monokote® Type Z-106/G, when subjected to tangential air stream of a velocity of 2,640 ft./min. or 30.0 m.p.h. [805 m/min. or 48.3 Km/hr.], 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). The total weight loss was 0.000 grams per $ft.^2$ [0.000 grams per $meter^2$] in 24 hours. The test density was 21.94 $lbs./ft.^3$ [351 Kg/m^3].

REPORT DETAILS

Date of Test: September 29 1998

Identification of Specimen: Bags of Monokote® Type Z-106/G 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/G was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 37.1 $lbs./ft^3$ [594 Kg/m^3] and a nozzle density of 47.0 $lbs./ft^3$ [753 Kg/m^3]. The procedures truly represented typical field construction practices and complied with the instructions printed on the Monokote® Type Z-106/G bags.

Description of Test:

I. Apparatus

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

B. Duct System – A duct made of 12 gauge galvanized steel 8 feet 8 inches 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 2,640 ft./min. or 30.0 m.p.h. [805 m/min. or 48.3 Km/hr].

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 [25.4 mm] and 82 picks per inch [25.4 mm].

F. Scale – balance having a capacity of 100 grams with sensitivity of ±0.001 gram.

II. Test Specimen:

A. Substrate – 16 gauge galvanized steel sheet 14.5" by 67.5 " [368 mm by 1715 mm] onto which the Monokote Type z-106/G was spray applied to 0.528 inch [13.4 mm] thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions. The test was conducted 57 days after application of the Monokote Type Z-106/G.

III. Procedure:

A. The collecting filter was dried for one hour at 120 ^{o}F [49 ^{o}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 2,640 ft./min. or 30.0 m.p.h. [05 m/min. or 48.3 Km/hr.].
E. The blower was stopped at intervals of 1, 6, and 24 hours. During this stoppage, the filter was removed, dried, and re-weighed.

IV. Results:

A. Density = 21.94 lbs./ft^3 [351 Kg/m^3]
B. Thickness tested = 0.528 inches [13.4 mm]
C. Exposed area = 4.63 ft.^{2} [0.43 m^2]

WEIGHING TIME	FILTER WEIGHT (g)	WEIGHT LOSS (g)	WEIGHT LOSS (g per ft^2)
1 HR (initial)	2.164	0.000	0.000
1 HR (final)	2.164		
6 HR (initial)	2.232	0.000	0.000
6 HR (final)	2.232		
24 HR (initial)	2.159	0.000	0.000
24 HR (final)	2.159		

Official Observers:

Rick Grubbs - Froehling & Robertson, Inc.
Walter R. Payment - 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 T. Turner, PE
CMT Manager

CORROSION TEST

MONOKOTE® TYPE Z-106/G

FIRE RESISTIVE MATERIAL

MADE FOR

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

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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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/G did not excessively contribute to corrosion of steel when exposed to higher temperature and humidity. Test density was 22.0 p.c.f. [352 kg/m^3].

REPORT DETAILS

Dates of Testing: August 6, 1998

Identification of Specimen: Bags of Monokote® Type Z-106/G 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. The Monokote® Type Z-106/G 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 33.2 pcf [532 kg/m^3] and a nozzle density of 44.9 pcf [719 kg/m^3]. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Type Z-106/G bags.

Description of Test:

(1) Apparatus

(a) An environmental chamber equipped to maintain the temperature at 95 ± 1 °F [35±.5° C] and a relative humidity of 95 ± 1 %.

(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 [20.3 cm x 20.3 cm x 12 gage] sheets of galvanized, bare, and shop-coated steel to which Monokote® Type Z-106/G 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 oxide metal primer.

(3) Procedures:

(a) Prior to the application of Monokote® Type Z-106/G, the duplicate sheets were weighed to the nearest 0.1 gram and identified as I and II. The back (unsprayed sides) of the plates were coated with wax.

(b) After the application of Monokote® Type Z-106/G, specimens marked I were dried to constant weight at laboratory conditions [72 ± 3 °F/22±3° C].

(c) Specimens marked II were placed into the chamber and kept at 95 ± 1°F [35±.5° C] and 95% 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 IIb.

(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 Ib.

(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:

$L_{II} = (IIa - IIb)/A_{II}$ $L_I = (Ia - Ib)/A_I$ and $D = L_{II} - L_I$

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

Ia = original weight of steel plate I in grams

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

IIa = original weight of steel plate II in grams

IIb = 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)	826.2	825.8	0.4	813.1	812.9	0.2
Bare (2)	819.4	819.1	0.3	810.0	809.9	0.1
Shop Coated (1)	831.6	831.5	0.1	834.3	834.6	-0.3
Shop Coated (2)	831.4	831.4	0.0	818.8	818.8	0.0
Galvanized (1)	834.1	834.7	-0.6	833.1	833.1	0.0
Galvanized (2)	839.2	936.0	-0.2	835.5	835.6	-0.1

Monokote® Type MK-10 HB Thickness = 0.75 inches [19 mm] Density = 22.0 pcf [352kg/m^3]

RESULTS: (Average of two tests)

Weight loss of control specimens : (I_a-I_b)

Bare Steel = 0.4 grams Shop Coated Steel = 0.1 grams
Galvanized Steel = -0.4 grams

Weight loss of conditioned specimens: (II_a - II_b)

Bare Steel = 0.2 grams Shop Coated Steel = -0.2 grams
Galvanized Steel = -0.1grams

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

Bare Steel	=	-0.2 grams	-4.9×10^{-6}
Shop Coated Steel	=	-0.3 grams	-7.5×10^{-6}
Galvanized Steel	=	0.3 grams	7.5×10^{-6}

Official Observers:

Kenneth L. Huffman - Froehling & Robertson, Inc.
Richard P. Perito - 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 T. Turner, PE
CMT Manager

DEFLECTION TEST

MONOKOTE® TYPE Z-106/G

FIRE RESISTIVE MATERIAL

MADE FOR

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

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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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® Type Z-106/G 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.

REPORT DETAILS

Date of Test: September 14, 1998

Identification of Specimen: Bags of Monokote® Type Z-106/G 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/G was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 37.1 p.c.f. [594 kg/m^3] and a nozzle density of 44.2 p.c.f. [708 kg/m^3]. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Type Z-106/G bags.

Description of Test:

I. Apparatus

A. Supports - A rigid base to provide four (4) inch [10 cm] bearing and a clear span between supports of 10 feet [3 meters].

B. Load - Pre-weighed bars of iron.

C. Deflection Gauge - a dial micrometer graduated to 0.001 inch [.25 mm].

II. Test Specimen:

The test specimen was a cellular steel deck of non-composite type, nominal 1.5 inches [3.8 cm], 24 inches [61 cm] wide by 12 feet [3.7 meters] 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 [15.2 cm] on center. The fire-resistive material was then spray applied to the underside of the steel deck to a 5/8 inch [16 mm] thickness. The Monokote® Type Z-106/G was not applied to an area 12 inches [30.5 cm]from each end of the specimen in order to permit the steel deck to bear directly on the supports of the test fixture. The prepared specimen was allowed to condition at atmospheric conditions.

III. Procedure:

The test specimen was placed on the test fixture supports to simulate field conditions of a floor construction with sprayed Monokote® Type Z-106/G fire-resistive material as the lower surface. The specimen had a clear span between supports of 10 feet [3 meters]. 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 [25 mm]. 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® Type Z-106/G HB was observed after being subjected to the above described test procedure. The dry in-place density of the tested Monokote Type Z-106/G was 21.9 p.c.f. [351 kg/m^3].

Official Observers:

Robert F. Williams - Froehling & Robertson, Inc.
Robert S. Young - 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

MONOKOTE® TYPE Z-106/G

FIRE RESISTIVE MATERIAL

MADE FOR

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

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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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® Type Z-106/G 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 [33 kg-meters] (60 pounds [27 kg] dropped from 4.0 feet [1.2 meters]).

REPORT DETAILS

Date of Test: September 14, 1998

Identification of Specimen: Bags of Monokote® Type Z-106/G 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/G was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 37.1 p.c.f [594 kg/m^3] and a nozzle density of 44.2 p.c.f. [708 kg/m^3]. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Type Z-106/G bags.

Description of Test:

I. Apparatus

A. Supports – a rigid base to provide four inch bearing and a clear span between supports of 10 feet [3 meters].

B. Sandbag – The sandbag used was as described in the proposed test method for sprayed fire-resistive material Rev. 7/1/76.

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 [20,610 kN/m^2], 2.5 inches deep [6.4 cm] as measured to the top plane of the steel decking. The Monokote® Type Z-106/G 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-1000 HB was not applied to an area 12 inches [30.5 cm] from each end of the specimen in order to permit the steel deck to bear directly on the supports of the test fixture. The prepared specimen was allowed to condition at atmospheric conditions.

III. Procedure:

The test specimen was placed on the fixture supports to simulate field conditions of a floor construction with sprayed Monokote® Type Z-106/G 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 meters]. An impact load was applied once to the middle of the upper face to 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/G was observed after being subjected to the above described test procedure. The dry in-place density of the tested Monokote Type Z-106/G was 21.9 p.c.f. [351 kg/m^3].

Official Observers:

Robert Williams - Froehling & Robertson, Inc.
Robert S. Young - 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

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 Z-106 G

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Web address: www.accugenlabs.com
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DATE RECEIVED
11-12-13

DATE REPORTED
12-17-13 & 01-16-14

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TABLE OF CONTENT

FINAL REPORT - COVER PAGE……1

TABLE OF CONTENTS……..2

INTRODUCTION……..3

TEST SUMMARY……3

TEST CONDITIONS……3

STUDY DATES AND FACILITIES……4

RECORDS TO BE MAINTAINED……..4

TEST PROCEDURE……4

RESULTS……...6

CONCLUSIONS……6

PICTURES……..7

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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 Z-106 G

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°C)
Humidity 85% +

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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 11/12/13.The study completion date is the date the study director signed the final report which is 12/17/13.

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.

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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°C 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

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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.

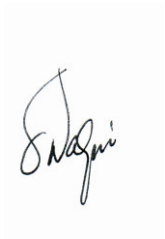
Table 1: Visual Rating of Fungal growth Observed

Sample	7 days			14 days			21 days			28 days			60 days		
Lab# 100753 Monokote Z-106 G	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)	2	2	2	3	3	3	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

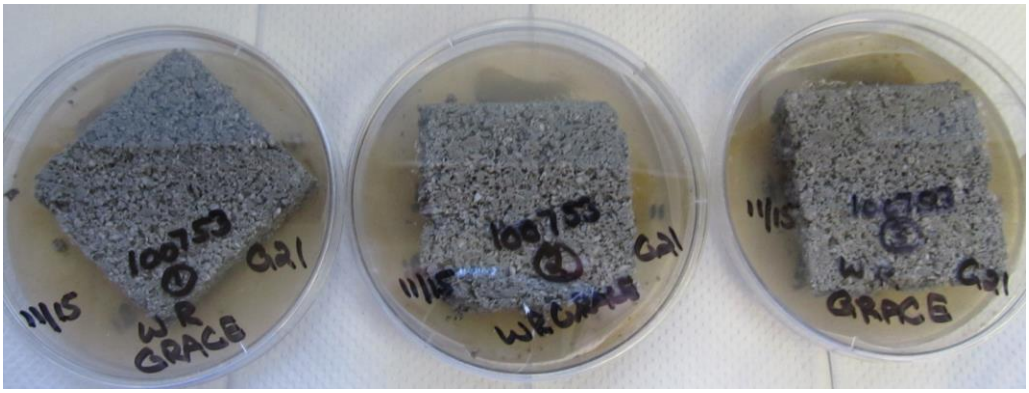

Fig1: Lab# 100753 at Nutrient Salt agar inoculated with fungal spores at 28 days in triplicate
Test sample did not support any fungal growth. © Accugen labs

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

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Fig3: Positive control - heavy fungal growth © Accugen labs

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ONLINE CERTIFICATIONS DIRECTORY

BLPR.R4339
Cementitious Cement and Plaster Mixtures

Page Bottom

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	5	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 2016-09-23

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DUROMETER HARDNESS

MONOKOTE® TYPE Z-106/G

FIRE RESISTIVE MATERIAL

MADE FOR

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

CAMBRIDGE, MASSACHUSETTS

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

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DUROMETER HARDNESS
ABSTRACT

Significance: This test measures the hardness of sprayed fire-resistive materials as measured by a Shore Type D Durometer.

The test was conducted in accordance with ASTM D2240-10, "Rubber Property – Durometer Hardness".

Results: A reading of 3 was obtained on the Monokote Type Z-106/G.

REPORT DETAILS

Dates of Testing: August 7,1998

Identification of Specimen: Bags of Monokote® Type Z-106/G 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. The Monokote® Type Z-106/G 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 33.2 p.c.f. [532 kg/m^3] and a nozzle density of 44.9 p.c.f. [719 kg/m^3]. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Type z-106/G bags.

Description of Test:

I. Apparatus:

A. A standard type D hand held durometer.

B. Test Specimen

A. Substrate – 12 inch by 12 inch by 0.25 inch [31 cm by 31 cm by 0.6 cm] hot rolled steel sheet.

B. Monokote® Type Z-106/G was spray applied at 0.75 inch [19 mm] in thickness. The specimen was allowed to dry to a constant weight at laboratory conditions (72° F ± 3° F) [22° C ± 1.6° C].

C. Surface – was troweled level and parallel to the steel backing sheet

C. Procedure

A. Ten readings were taken at different points on the surface of the test specimen. The ten readings were then averaged.

D. Test Data

A. Density = 22.0 p.c.f. [352 kg/m^3]

B. Durometer Hardness = 3

Official Observers:

Kenneth L. Huffman - Froehling & Robertson, Inc.

Richard P. Perito – 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 T. Turner, PE
CMT Manager