GCP Applied Technologies

MONOKOTE Z-146 T Tunnel Test Reports

62 Whittemore Avenue

Cambridge, Massachusetts 02140

USA

AIR EROSION – ASTM E859-11

MONOKOTE® Z-146T

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES 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 low 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-146T, when subjected to tangential air stream of a velocity of 20 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 43.8 lbs./ft.^{3} [701.6 Kg/m^3].

REPORT DETAILS

Date of Test: October 18, 2016 (sample preparation); November 15 and 16, 2016 (testing)

Identification of Specimen: Bags of Monokote® Z-146T were selected at random as produced by GCP Applied Technologies Inc. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-146T was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 54.8 pounds per cubic foot (pcf) and a nozzle density of 61.9 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-146T 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 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-146T was spray applied at 0.75" in thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions for a 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 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)	1.444	0.000	0.000
1 HR (final)	1.444		
6 HR (initial)	1.451	0.000	0.000
6 HR (final))	1.451		
24 HR (initial)	1.464	0.000	0.000
24 HR (final)	1.464		

Monokote® Z-146T Density – 43.8 pcf

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Michael Morgan - GCP Applied Technologies Inc.

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne Turner, PE
CMT Manager

VERY HIGH SPEED

AIR EROSION TEST [100 MPH]

MONOKOTE TYPE Z-146T

FIRE RESISTIVE MATERIAL

MADE FOR

GRACE CONSTRUCTION PRODUCTS

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

TRAVELERS REST, SOUTH CAROLINA

MADE BY

FROEHLING & ROBERTSON, INC.

GREENVILLE, SOUTH CAROLINA

AIR EROSION TEST

ABSTRACT

Significance: This test measures the effect of a high speed air stream upon fire-resistive materials, and evaluates the resistance to dusting, flaking, spalling and delamination of the fire-resistive material.

The test was conducted in accordance with a modified version of ASTM E-859 "Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members." Modifications were made to the duct system and therefore the sample size [see "Description of Test"] to achieve a higher velocity than described in the test method.

Results: Monokote Type Z-146T when subjected to tangential air stream of a velocity of 9,000 ft./min. or 102.2 m.p.h. [2,743 m/min. or 164.4 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 36.70 $lbs./ft.^3$ [588 Kg/m^3].

REPORT DETAILS

Date of Test: June 15, 1998

Identification of Specimen: Randomly selected of bags of Monokote Type Z-146T as produced by Grace Construction Products, GCP Applied Technologies Inc. (formerly W.R. Grace & Co.) were used. Each bag of Monokote Type Z-146T contained the label of Underwriters' Laboratories, Inc. Each bag of Monokote Type Z-146T 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 50.0 $lbs./ft^3$ [801 Kg/m^3] and a nozzle density of 55.4 $lbs./ft^3$ [887 Kg/m^3]. The procedures truly represented typical field construction practices and complied with the instructions printed on the Monokote Type Z-146T bags.

Description of Test:

I. Apparatus

A. Application Base - 12 gauge galvanized steel sheet 7.875 " by 65.5" [200 mm by 1664 mm].

B. Duct System - A duct made of 12 gauge galvanized steel 69 inches long [1.75 meters], with a rectangular cross section of 3" by 6" [76 mm by 152 mm]. The duct had a 6" by 63.5" [152 mm by 1613 mm] opening at the top to accept the test sample. (2.65 $ft.^2$ or 0.246 m^2 exposed area).

C. Blower - capable of moving air through the entire cross section of the duct at a velocity of 9,000 ft./min. or 102.2 m.p.h. [2,743 m/min. or 164.4 Km/hr.].

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

E. Filter - A collecting filter was attached 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 - 12 gauge galvanized steel sheet 7.875" by 65.5" [200 mm by 1664 mm] onto which the Monokote Type Z-146T was spray applied at 0.798 inch [20.3 mm] thickness. The specimen as sprayed was allowed to cure and dry at laboratory conditions. The test was conducted 221 days after application of the Monokote Type Z-146T.

III. 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 into the duct opening so the face of the specimen and the inside face of the duct opening were flush and in the same plane and sealed in place using silicone rubber adhesive. The edges overlapped the duct opening by 1 inch [25.4 mm].
C. The pitot tube was positioned in the center of the tube cross section at the upstream end of the test specimen.
D. With the filter in place, the blower was maintained at an average velocity of 9,000 ft./min. or 102.2 m.p.h. [2,743 m/min. or 164.4 Km/hr.].
E. The blower was stopped at intervals of 1, 6, and 24 hours, the collecting filter removed, dried, and re-weighed.

IV. **Test Data:**

A. Density = 36.7 lbs./ft^3 [588 Kg/m^3]
B. Thickness tested = 0.798 inches [20.3 mm]
C. Exposed area = 2.65 $ft.^2$ [0.246 m^2]

Filter Weight (grams) at:	1 hour	6 hours	24 hours
Ending	3.823	3.832	3.800
Starting	3.823	3.832	3.800
Weight loss by sample	0.000	0.000	0.000
Total weight loss (24 hours) = 0.000 grams			
Total weight loss per $ft.^2$ = 0.000 grams [per m^2 = 0.000 grams]			

Official Observers:
Ken Huffman, Allen Ridenour - 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
CMT Manager
I certified this as an exact copy of the report generated by F&R in 1998

DEFLECTION TEST – ASTM E759-11

MONOKOTE® Z-146T

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES 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® Z-146T 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 43.8 lbs./ft.^{3} [701.6 Kg/m^3].

REPORT DETAILS

Date of Test: October 18, 2016 (sample preparation); November 15, 2016 (testing)

Identification of Specimen: Bags of Monokote® Z-146T were selected at random as produced by GCP Applied Technologies Inc. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-146T was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 54.8 pounds per cubic foot (pcf) and a nozzle density of 61.6 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-146T 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. Load - Pre-weighed bars of iron.

C. Deflection Gauge - a dial micrometer graduated to 0.001 inch [0.25 mm].

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 [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 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-146T 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 35 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-146T fire-resistive material as the lower surface. The specimen had a clear span between supports of 10 feet [3.05 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 [25.4 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® Z-146T was observed after being subjected to the above described test procedure

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Michael Morgan - GCP Applied Technologies Inc.

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne Turner, PE
CMT Manager

BOND IMPACT TEST – ASTM E760-11

MONOKOTE® Z-146T

FIRE RESISTIVE MATERIAL

MADE FOR

GCP APPLIED TECHNOLOGIES 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® Z-146T 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 43.8 lbs./ft.^{3} [701.6 Kg/m^3].

REPORT DETAILS

Date of Test: October 18, 2016 (sample preparation); November 15. 2016 (testing)

Identification of Specimen: Bags of Monokote® Z-146T were selected at random as produced by GCP Applied Technologies Inc. Each bag contained the label of Underwriters' Laboratories, Inc. Each bag of the Monokote® Z-146T was mixed with water in a mechanical mixer in accordance with the noted instructions to produce a uniform slurry having a mixer density of 54.8 pounds per cubic foot (pcf) and a nozzle density of 61.9 pcf. The procedures represented typical field construction practices and complied with the instructions printed on the Monokote® Z-146T 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-146T 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-146T 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® Z-146T 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-146T was observed after being subjected to the above described test procedure

Official Observers:

Ryne Turner, PE - Froehling & Robertson, Inc.
Michael Morgan - GCP Applied Technologies Inc.

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

Respectfully submitted,

FROEHLING & ROBERTSON, INC.

Ryne Turner, PE
CMT Manager

ONLINE CERTIFICATIONS DIRECTORY

BLPR.R4339
Cementitious Cement and Plaster Mixtures

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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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