

## PHYSICAL PROPERTIES OF POWERCRETE DD

### *Independent Laboratory Testing and Results*



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Technical Report No. 95-231

Mr. Bang Tran  
POWER LONE STAR  
11010 Wallisville Rd.  
Houston, Texas

## Water Absorption Determinations

January 25, 1995



Prepared by Gary Cox

# Water Absorption Determinations

## Introduction

As requested by Mr. Bang Tran of Power Lone Star, I.T.I. Anti-Corrosion, Inc. has conducted laboratory testing to determine the water absorption properties of Powercrete.

## Procedure

Procedure: Water Absorption of Plastics  
Designation: ASTM D570  
Specimens Tested: Black Powercrete  
A. 7.000" x 0.956" x 0.109"  
B. 7.000" x 0.969" x 0.104"  
C. 7.000" x 0.979" x 0.121"  
Conditioning: Samples were conditioned for 60 hrs. at 73°F in a dessicator.

*Till saturation*

## Results

Specimen I.D.	Final Weight	Initial Weight	Weight Gained	Water Absorbed	Visual Observation
A	21.3327 g	21.0662 g	0.2665 g	1.26%	No warping, cracking
B	20.6872 g	20.4333 g	0.2539 g	1.24%	or other changes
C	23.7720 g	23.5056 g	0.2664 g	1.13%	in appearance were noted
Mean	21.9306 g	21.6684 g	0.2622 g	1.21%	



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I.T.I. ANTI-CORROSION, INC.

TECHNICAL REPORT # 91-038

POWER LONE STAR

FOR THE ATTENTION OF MR. TOM TUERNER

LABORATORY TESTING OF POWERCRETE

MAY 5, 1991

PREPARED BY GARY COX

Signed:

I.T.I. ANTI-CORROSION CONTRACT # 526

## CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 30 DAY EXPOSURE

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Reagent	Results
Hydrochloric Acid, 10%	
A. Immersed Phase :	
1. General :	Surface blistering (size 4-8 dense) ; extreme softening of surface.
2. At Holiday :	Some delamination from FBE (average 4mm) at edge of holiday; no disbondment of FBE.
B. Vapor Phase :	
1. General :	No blistering or noticeable softening of material surface.
2. At Holiday :	No apparent effect.

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---

Reagent	Results
Nitric Acid, 10%	
A. Immersed Phase :	
1. General :	Dense size 8 blisters and considerable softening of material surface.
2. At Holiday :	Considerable delamination of Powercrete from FBE.
B. Vapor Phase :	
1. General :	No blistering; mild softening of material surface with surface discoloration.
2. At Holiday :	Considerable delamination of Powercrete from FBE .

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## CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 30 DAY EXPOSURE

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Reagent	Results
Acetic Acid, 5%	
A. Immersed Phase :	
1. General :	Total decomposition of Powercrete material extending just past the interface.
2. At Holiday :	Extensive delamination of Powercrete from FBE.
B. Vapor Phase :	
1. General :	No decomposition, softening or blistering.
2. At Holiday :	Considerable delamination of Powercrete from FBE.

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Reagent	Results
Sulfuric Acid, H <sub>2</sub> SO <sub>4</sub> 25%	
A. Immersed Phase :	
1. General :	Bleaching of material from black to white to a depth of $\approx$ 20 mils. No blistering or softening was observed.
2. At Holiday :	No delamination or disbondment.
B. Vapor Phase :	
1. General :	No visible effect.
2. At Holiday :	Some delamination from FBE $\approx$ 5 mil average radius.

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## CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 30 DAY EXPOSURE

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Reagent	Results
Sodium Hydroxide, NaOH, 25%	
A. Immersed Phase :	
1. General :	Mild discoloration.
2. At Holiday :	No visible effect.
B. Vapor Phase :	
1. General :	Mild discoloration.
2. At Holiday :	No visible effect.

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Reagent	Results
Sodium Carbonate, Na <sub>2</sub> CO <sub>3</sub> 25%	
A. Immersed Phase :	
1. General :	Mild discoloration.
2. At Holiday :	1mm average delamination from FBE.
B. Vapor Phase :	
1. General :	No visible effect.
2. At Holiday :	≈ 2 mm delamination from FBE.

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## CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 30 DAY EXPOSURE

---

Reagent	Results
Sodium Chloride, NaCl 10%	
A. Immersed Phase :	
1. General	: No visible effect.
2. At Holiday	: No visible effect.
B. Vapor Phase :	
1. General	: No visible effect.
2. At Holiday	: $\approx$ 1 mm average delamination from FBE.

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Reagent	Results
Calcium Hydroxide Saturated Solution, Ca(OH) <sub>2</sub>	
A. Immersed Phase :	
1. General	: No visible effect.
2. At Holiday	: No visible effect.
B. Vapor Phase :	
1. General	: No visible effect.
2. At Holiday	: 5mm average delamination from FBE .

---

### Discussion

Powercrete was unaffected by alkaline solution and salt water in both immersed and vapor phases but did not perform well in acidic immersion and was seen to delaminate extensively from the FBE in acetic acid vapor phase.

CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 60 DAY EXPOSURE

---

Reagent	Results
Hydrochloric Acid 10%	
A. Immersed Phase :	
1. General :	Extensive surface blistering (size 4-8 dense); extreme softening of surface, and bleaching.
B. Vapor Phase :	
1. General :	Dense size 8 blisters at interface.
2. At Holiday :	No apparent effect.

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Reagent	Results
Nitric Acid, 10%	
A. Immersed Phase :	
1. General :	Dense size 8 blisters, coating deterioration and rust breakthrough.
B. Vapor Phase :	
1. General :	Complete discoloration with some surface softening.

---

CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 60 DAY EXPOSURE

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Reagent	Results
Acetic Acid 5%	
A. Immersed Phase :	
1. General :	Complete decomposition of coating; peels away completely from FBE substrate.
B. Vapor Phase :	
1. General :	Dense size 8 blistering with softening of material surface.

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Reagent	Results
Sulfuric Acid, $H_2SO_4$ , 25%	
A. Immersed Phase :	
1. General :	Total bleaching of material from black to white; dense size 8 blisters; coating very friable and flakes easily.
B. Vapor Phase :	
1. General :	No visible effect..

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CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 60 DAY EXPOSURE

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Reagent	Results
Sodium Hydroxide, NaOH, 25%	
A. Immersed Phase :	
1. General :	Mild discoloration.
2. At Holiday :	No visible effect.
B. Vapor Phase :	
1. General :	Mild discoloration.
2. At Holiday :	No visible effect.

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---

Reagent	Results
Sodium Carbonate, Na <sub>2</sub> CO <sub>3</sub> , 25%	
A. Immersed Phase :	
1. General :	Mild discoloration.
2. At Holiday :	1 mm average delamination from FBE.
B. Vapor Phase :	
1. General :	No visible effect.
2. At Holiday :	≈ 2mm delamination from FBE.

---

## CHEMICAL RESISTANCE TESTS : POWERCRETE OVER FBE - 60 DAY EXPOSURE

---

Reagent	Results
Sodium Chloride, NaCl, 10%	
A. Immersed Phase :	
1. General :	No visible effect.
2. At Holiday :	No visible effect.
B. Vapor Phase :	
1. General :	No visible effect.
2. At Holiday :	≈ 1mm average delamination from FBE

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Reagent	Results
Calcium Hydroxide Saturated Solution, Ca (OH) <sub>2</sub>	
A. Immersed Phase :	
1. General :	No visible effect.
2. At Holiday :	No visible effect.
B. Vapor Phase :	
1. General :	No visible effect.
2. At Holiday :	5 mm average delamination from FBE .

---

### Discussion

Powercrete was unaffected by alkaline solution and salt water in both immersed and vapor phases but did not perform well in acidic immersion and was seen to delaminate extensively from the FBE in acetic acid vapor phase.



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Technical Report No. 94-229

Mr. Bang Tran  
POWER LONE STAR  
11010 Wallisville Rd.  
Houston, Texas

Laboratory Testing - Pull-Off Strength

December 30, 1994

  
Prepared by Gary Cox

I.T.I. Contract No. 1114

## LABORATORY TESTING - PULL-OFF STRENGTH

### Introduction

As requested by Mr. Bang Tran of Power Lone Star, I.T.I. Anti-Corrosion, Inc. has conducted laboratory testing to determine pull-off strength of Powercrete when applied to fusion bonded epoxy which had undergone various periods of exposure to ultraviolet light and under different surface preparation procedures.

Test specimens were 4" x 4" x 3/8" panels

FBE conditioning and surface preparation prior to application of "Powercrete".

Specimen I.D.	U.V. Exposure*	F.B.E. Surface Preparation
OUV-SA-1 OUV-SA-2	None None	None None
OUV-BA-1** OUV-BA-2	None None	None None
16-UV-A-1 16-UV-A-2	16 hours 16 hours	None None
16-UV-B-1 16-UV-B-2	16 hours 16 hours	25 rubs with 3M Scouring Pad
16-UV-C-1 16-UV-C-2	16 hours 16 hours	Acetone Washed
32-UV-A-1 32-UV-A-2	32 hours 32 hours	None None
32-UV-B-1 32-UV-B-2	32 hours 32 hours	25 rubs with 3M Scouring Pad
32-UV-C-1 32-UV-C-2	32 hours 32 hours	Acetone Washed
48-UV-A-1 48-UV-A-2	48 hours 48 hours	None None
48-UV-B-1 48-UV-B-2	48 hours 48 hours	25 rubs with 3M Scouring Pad
48-UV-C-1 48-UV-C-2	48 hours 48 hours	Acetone Washed

\* Ultraviolet exposure was by Q.U.V. per ASTM G53 using UVA 340 lamps cycling 8 hours light at 60°C followed by 4 hours dark (condensation) at 40°C (Results attached).

\*\* Powercrete was brush applied to panels OUV-BA-1 & OUV-BA-2. Powercrete was spray applied to all other panels.



LABORATORY DATA SHEET

Procedure: Determination of Adhesive Strength  
 Specification: ASTM D4541-93 "Standard Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers"  
 Test Material I.D. : Power Lone Star "Powercrete Black"  
 Test Instrument : SEMicro "Patt Jr" W/F-16 Piston  
 Date Last Calibrated: 5/20/94 by National Standard Testing Laboratory

Specimen I.D.	Pull-Off Strength, psi	Type of Failure
OUV-SA-1	2682	Cohesive at Powercrete to glue interface
OUV-SA-2	2764	Cohesive at Powercrete to glue interface
OUV-BA-1	3334	Cohesive at Powercrete to glue interface
OUV-BA-2	3253	Cohesive at Powercrete to glue interface
16-UV-A-1	4068	Adhesive to F.B.E.
16-UV-A-2	2682	Cohesive at Powercrete to glue interface
16-UV-B-1	4312	Cohesive at Powercrete to glue interface
16-UV-B-2	3253	Cohesive at Powercrete to glue interface
16-UV-C-1	3171	Cohesive at Powercrete to glue interface
16-UV-C-1	3416	Cohesive at Powercrete to glue interface

Tested by:

*Gary Cox*  
 Signature

12/22/94  
 Date

*Gary Cox*  
 Laboratory Manager

12/22/94  
 Date



94M006C / 1114  
Control No. Job No.

LABORATORY DATA SHEET

Procedure: Determination of Adhesive Strength  
Specification: ASTM D4541-93 "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers"  
Test Material I.D. : Power Lone Star "Powercrete Black"  
Test Instrument : SEMicro "Patt Jr" W/F-16 Piston  
Date Last Calibrated : 5/20/94 by National Standard Testing Laboratory

Specimen I.D.	Pull-Off Strength, psi	Type of Failure
32-UV-A-1	2927	Cohesive at Powercrete to glue interface
32-UV-A-2	2438	Cohesive at Powercrete to glue interface
32-UV-B-1	3579	Cohesive at Powercrete to glue interface
32-UV-B-2	3416	Cohesive at Powercrete to glue interface
32-UV-C-1	3579	Cohesive at Powercrete to glue interface
32-UV-C-2	3334	Cohesive at Powercrete to glue interface
48-UV-A-1	4394	Cohesive at Powercrete to glue interface
48-UV-A-2	2519	Cohesive at Powercrete to glue interface
48-UV-B-1	3090	Cohesive at Powercrete to glue interface
48-UV-B-2	3660	Cohesive at Powercrete to glue interface
48-UV-C-1	3416	Cohesive at Powercrete to glue interface
48-UV-C-2	4475	Cohesive at Powercrete to glue interface

Tested by: *Gary Cox*  
Signature  
*Gary Cox*  
Laboratory Manager

12/29/94  
Date

12/29/94  
Date

**TECHNICAL INSPECTION SERVICES, INC.**  
**Quality Audit - Quality Control**  
**Houston, Texas 77034**

**5202 South Shever**  
**Telephone 713-947-6630**  
**Fax 713-947-7796**

Report # 05-1896-2

Testing Performed on 8" (Powercrete-Black  
Over FBE) and 10" (Powercrete-J) Pipe  
for Power Lone Star

For: Chaofeng Chen  
Power Lone Star  
11010 Wallisville Road  
Houston, Texas 77013

By:



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Karl Kelso  
March 21, 1997

## IMPACT TEST RESULTS

<u>Material</u>	<b>Average</b> <u>DFT (mils)</u>	<u>Avg. Pass</u>	<u>Avg. Fail</u>	<u>ASTM G14</u>
8" Diameter (Powercrete-black/FBE)	95	287 in-lbs	320 in-lbs	305 in-lbs
10" Diameter (Powercrete-J)	90	203 in-lbs	233 in-lbs	218 in-lbs
10" Diameter (Powercrete-J)	103	120 in-lbs	131 in-lbs	126 in-lbs

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**Telephone 713-947-6630**  
**Fax 713-947-7796**

Report # 05-2141-2

Flexibility Testing Performed  
on Black Powercrete Over FBE  
Power Lone Star, Inc

For: Chaofeng Chen  
Power Lone Star  
11010 Wallisville Road  
Houston, Texas 77013

By:



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Karl Kelso  
March 21, 1997

## INTRODUCTION

Two 4" wide by 8" long panels, coated with black Powercrete over FBE, were received at this laboratory for flexibility testing. The first panel was received June 26, 1998 and the other was received at a later date. Three straps measuring 1" wide by 8" long were cut from each panel and bent to failure at 32°F on a four-point bending apparatus.

### TEST RESULTS FOR PANEL REC. 6-26-98

<u>Specimen</u>	<u>Strap</u>	<u>D.F.T.</u>	<u>%pd</u>	<u>Pass/Fail</u>
Black PC	1	26-28	0.564	Tears
Over FBE	2	23-27	0.282	Tears @ Contact Points
	3	29-31	1.010	Tears

### TEST RESULTS FOR PANEL REC. 6-26-98

<u>Specimen</u>	<u>Strap</u>	<u>D.F.T.</u>	<u>%pd</u>	<u>Pass/Fail</u>
Black PC	1	40	1.670	Tears
Over FBE	2	35	1.090	Tears

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Report # 05-1932-A

Abrasion Resistance  
Testing on Powercrete J, Powercrete JT,  
and Powercrete (Black)

For: Chaofeng Chen  
Power Lone Star  
11010 Wallisville Road  
Houston, Texas 77013

By:



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Karl Kelso  
March 8, 1999

## INTRODUCTION

Panels coated with Powercrete-J and Powercrete JT, along with a free-film sample of Powercrete (black), were received at this laboratory on March 28 and April 4, 1997. The materials were tested for abrasion resistance.

## TEST DESCRIPTION AND RESULTS

### Abrasion Test

The panels were tested for abrasion resistance, similar to the method described in ASTM D4060, on a Taber abrasion machine. The Powercrete (black) was tested using a weight of 1000 grams for 1000 cycles with H-18 wheels. The Powercrete-J and Powercrete-JT were tested for 5000 cycles with a 1000 grams using CS-17 wheels. The wheels were resurfaced every 500 cycles on all three specimens.

<u>Sample</u>	<u>Weight Loss</u>	<u>Wear Index</u>	<u>Cycles Per Mil</u>
Powercrete-black free-film (140 mils) H18/1000cyc./1000 grams	2.0375 g	2.0375 g	66.6667
Powercrete-J direct to steel CS-17/5000 cyc./1000 grams	0.6194 g	0.1239 g	1250
Powercrete-JT direct to steel CS-17/5000cyc./1000 grams	0.5624 g	0.1125 g	1250



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Technical Report No. 94-222

Mr. Bang Tran  
POWER LONE STAR  
11010 Wallisville Rd.  
Houston, Texas

Laboratory Testing

November 28, 1994



Prepared by Gary Cox

I.T.I. Contract No. 1091

# LABORATORY TESTING

## Introduction

As requested by Mr. Bang Tran of Power Lone Star, I.T.I. Anti-Corrosion, Inc. has conducted laboratory testing of three Power Lone Star coating materials.

## Test Materials & Procedure

4- 4" x 6" x 1/8" plates coated with black Powercrete CDT per ASTM G95

1- 2" dia. x 8" L pipe with "Black Formula 2215" over FBE, bendability

1- 2" dia. x 8" L pipe with "Gray Formula 941011" over FBE, bendability

## Results

1. Cathodic Disbondment                      ASTM G95

Duration:                      30 days

Electrolyte:                      NaCl, 3%

Potential:                      -1.5 VDC

<b>Sample I.D.</b>	<b>Temperature</b>	<b>Disbondment Radius, mm</b>	<b>Comments</b>
Black Powercrete - 1	90°F	5.750 mm	
Black Powercrete - 2	110°F	7.625 mm	
Black Powercrete - 3	125°F	7.750 mm	
Black Powercrete - 4	140°F	12.250 mm	2 large blisters



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Technical Report No. 95-234

Mr. Bang Tran  
POWER LONE STAR  
11010 Wallisville Rd.  
Houston, Texas

Impact Resistance of Powercrete over Fusion  
Bonded Epoxy at Sub-Zero Temperatures

January 26, 1995



Prepared by Gary Cox

I.T.I. Contract No. 1125

# IMPACT RESISTANCE OF POWERCRETE OVER FUSION BONDED EPOXY AT SUB-ZERO TEMPERATURES

## Introduction

As requested by Mr. Bang Tran of Power Lone Star, I.T.I. Anti-Corrosion, Inc. has conducted impact resistance testing of "Powercrete over F.B.E. at sub-freezing temperatures.

## Test Procedure

ASTM G14 modified as "Impact to Failure Only"

## Results

<b>Sample No.</b>	<b>Temperature °C</b>	<b>Impact at Failure</b>	<b>Impact at Pass</b>
1. Powercrete over F.B.E.	-46°C	No Failure	40 in-lbs
2 . Powercrete over bare steel	-50°C	50 in-lbs	
3. Powercrete over F.B.E.	-56°C	-----	100 in-lbs
4. Powercrete over F.B.E.	-74°C	60 in-lbs	50 in-lbs

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e-mail techsales@polyhedronlab.com

Client

Power Lone Star, Inc  
11010 Wallisville Road  
Houston, TX 77013

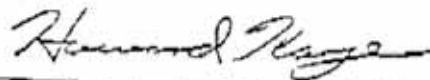
Attn: Mr Bang Tran

April 26, 1999

PO: 4104

## Dielectric Strength by ASTM D 149

<u>Sample</u>	<u>Thicness (in)</u>	<u>Breakdown Voltage (kv)</u>	<u>Dielectric Strength (V/mil)</u>
Powercrete - 990329 3" x 3"			
J Fast Cure "Light Grey"	.055	32	581.8
	.062	32	516.1
	.055	31	563.6
	.062	33	532.3
	.063	33	523.8
			AV = $\frac{523.8}{5} = 543.5 \pm 28.0$
"Black"	.052	28	538.5
	.051	27.5	539.2
	.050	29	580.0
	.051	30	588.2
	.030	20	666.7
			AV = $\frac{666.7}{5} = 582.5 \pm 52.3$



Howard Kaye, Ph.D., FAIC

Director



**POLYHEDRON LABORATORIES® , INC**

1210 Hamblen Road • Suite 200 • Kingwood • Texas 77339 • (713) 359-6431

Test Report

Project: Power Lone Star Cube Tests  
Client: Power Lone Stra, Inc  
Contractor: N/A

Project No.: 333076  
Date of Test: 12/13/93  
Test Method: ASTM C-109

COMPRESSIVE STRENGTH OF 2" CUBES  
ASTM C-109

SET # 1

<u>Specimen (#)</u>	<u>Dimensions (in)</u>	<u>Area (in<sup>2</sup>)</u>	<u>Load (lbs)</u>	<u>Compressive Strangth (psi)</u>
P.C. Stand-1	1.95 x 2.00	3.90	39200	10,050
P.C. Stand-2	1.96 x 2.00	3.92	40100	10,230
P.C. Stand-3	1.94 x 2.00	3.88	39800	10,260
Average:				10.180

SET # 2

<u>Specimen (#)</u>	<u>Dimensions (in)</u>	<u>Area (in<sup>2</sup>)</u>	<u>Load (lbs)</u>	<u>Compressive Strangth (psi)</u>
931209-1	1.94 x 2.00	3.88	6200	1,600
931209-2	1.96 x 2.00	3.92	6400	1,630
931209-3	1.96 x 2.00	3.92	6300	1,610
Average:				1.610

Tested by :

Neil Jaegers

Reviewed by:

David W. Knight. P.E.

# Powercrete® DD Abrasion Resistant Overlay

Liquid Epoxy Coating for the Protection of Fusion Bonded Epoxy in Directional Drilling Applications

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*Covalence CPG is a division of Covalence Specialty Materials Corp.*

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