



March 21, 2022

Email: jim@corrinnovations.com

Mr. Jim Knocke
Corrosion Innovations
4020 Strawberry Road
Pasadena, TX 77504

SUBJECT: Physical Testing on Prepared Panels; KTA-Tator, Inc. Project No. 420023-R2

Dear Mr. Knocke:

In accordance with KTA-Tator, Inc. (KTA) Proposal Number PN2213217 and the subsequent signed Authorization to Proceed dated January 18, 2022, KTA has completed the panel preparation and testing. This report contains descriptions of the testing procedures employed and the results of the testing.

SAMPLES

The samples listed in Table 1, "Samples" were received from Corrosion Innovations on January 24, 2022. It should be noted that at no time did KTA personnel witness the acquisition of the samples listed below.

Table 1 – Samples

KTA ID	Description	Label
KTA-1A	One 5-gallon bucket of liquid coating	PPG Sigmashield 1090, base, 6C197202/05, 00333952, Batch # 9007790146
KTA-1B	One ½-gallon can of liquid coating	PPG Sigmashield 1090, hardener, 6S197525B/12, 00336383, batch # 9106103308
KTA-2A & KTA-2B	Two prepared 4"x 6" metal panels from client	1-17-22, Corrosion Innovations, Set 1: Blank, Jim Knocke
KTA-3A & KTA-3B	Two prepared 4"x 6" metal panels from client	1-17-22, Corrosion Innovations, Set 2: CorrZe-100, Jim Knocke
KTA-4A & KTA-4B	Two prepared 4"x 6" metal panels from client	1-17-22, Corrosion Innovations, Set 3: Corr-Ze 200 + 100, Jim Knocke



LABORATORY INVESTIGATION

The laboratory investigation consisted of a coating application followed by hot water immersion and tensile adhesion. The test descriptions and the results of the testing are provided below.

Coating Application

Samples KTA-1A and KTA-1B were mixed by volume per the manufacturer recommendations and in small batches due to the density and viscosity of KTA-1A. Coating materials were mixed, and trowel applied to both the front and back of the panels. The panels were allowed to cure for a minimum of 7 days at laboratory conditions, $73 \pm 3^{\circ}\text{F}$ and $50 \pm 5\%$ relative humidity.

Following the coating application, the dry film thicknesses of each side were measured in six locations in accordance with ASTM D7091-13, "Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals," using a PosiTector® Model 6000, nondestructive electronic coating thickness gage verified for accuracy using NIST traceable coated standards. The measurements obtained are contained in Table 2, "Dry Film Thickness Measurements."

Tensile Adhesion Strength

Tensile adhesion was evaluated on the back sides of panels KTA-2A, KTA-3A and KTA-4A that were approximately 4" x 6" x 1/4" prior to the start of the testing outlined below for the hot water soak. After the completion of the hot water soak, the back sides of panels KTA-2B, KTA-3B, and KTA-4B were tested for tensile adhesion and compared to the initial values. Tensile adhesion (pull-off strength) was measured in accordance with ASTM D4541-17, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," Annex A4, "Self-Aligning Adhesion Tester Type V (Test Method E)." The testing surfaces were abraded gently using fine sandpaper and wiped clean.

The fixtures used were 20 mm in diameter and were sandblasted prior to being attached to the coating using a two-component epoxy adhesive (Araldite 2011) which was cured for 24 hours at ambient laboratory conditions ($73.5 \pm 3.5^{\circ}\text{F}$ and $50 \pm 5\%$ RH). The pull stubs were then detached using a Defelsko® PosiTest® AT. The force in psi required to remove each loading fixture was recorded along with the location of break and approximate percentage of each. The location of break is defined as follows:



Adhesive Failure: *A split between layers or a split between the substrate and the first layer.*

Cohesive Failure: *A split within a single layer.*

Glue Failure: *Coating strength exceeds glue strength.*

The results of the testing are provided in Table 3, "Results of Tensile Adhesion Testing."

Hot Water Soak Testing

One 4" x 6" x 1/4" panel from each set was used for the hot water soak test (KTA-2B, KTA-3B, and KTA-4B). The panels were subjected to a 24-hour hot water soak test according to NACE RP0394-2002, "Standard Recommended Practice - Application, Performance, and Quality Control of Plant-Applied, Fusion-Bonded Epoxy External Pipe Coating," Appendix J, "Hot-Water Soak." The panels were fully immersed in deionized water that was maintained at $66 \pm 3^{\circ}\text{C}$ for a period of 24 hours. The panels were removed, allowed to cool to room temperature, and then tested for tensile adhesion. The results from the tensile adhesion from the hot water soak are in Table 3 and compared to the initial tensile adhesion results.



Table 2 – Dry Film Thicknesses

Sample No.	DFT No. 1 (mils)	DFT No. 2 (mils)	DFT No. 3 (mils)	DFT No. 4 (mils)	DFT No. 5 (mils)	DFT No. 6 (mils)	Average DFT (mils)
KTA-2A Front	182.0	177.5	165.5	187.0	133.0	133.5	163.1
KTA-2A Back	137.5	120.0	125.5	114.5	150.5	164.5	135.4
KTA-2B Front	252.5	223.5	266.0	243.0	194.5	191.0	228.4
KTA-2B Back	129.5	141.0	117.5	106.5	128.0	158.0	130.1
KTA-3A Front	152.5	147.5	140.0	151.0	193.0	180.5	160.8
KTA-3A Back	132.0	104.5	117.0	142.5	139.5	123.5	126.5
KTA-3B Front	189.5	203.0	199.0	201.5	182.0	175.5	191.8
KTA-3B Back	135.0	137.0	114.0	115.5	126.0	129.5	126.2
KTA-4A Front	106.5	90.0	128.0	101.5	107.0	110.5	107.3
KTA-4A Back	244.5	216.0	261.0	269.0	271.5	239.0	250.2
KTA-4B Front	120.5	94.5	86.5	92.0	150.0	138.5	113.7
KTA-4B Back	247.5	259.5	267.5	232.0	251.0	264.5	253.7



Table 3 – Results of Tensile Adhesion Testing

KTA ID	System ID	Coating DFT (mils)	Pull Stub ID	Pull-Off Strength (psi)	Location of Break	Average Pull-Off Strength (psi)
Pre – Hot Water Soak Testing						
KTA-2A Back	Blank	135.4	A	534	95% adhesive to substrate, 5% cohesive within coating	797
			B	787	90% adhesive to substrate, 10% cohesive within coating	
			C	1071	75% adhesive to substrate, 25% cohesive within coating	
KTA-3A Back	CorrZe-100	126.5	A	575	100% adhesive to substrate	629
			B	707	100% adhesive to substrate	
			C	606	100% adhesive to substrate	
KTA-4A Back	Corr-Ze 200 + 100	250.2	A	386	100% adhesive to substrate	860
			B	989	100% adhesive to substrate	
			C	1204	90% adhesive to substrate, 10% cohesive within coating	
Post – Hot Water Soak Testing						
KTA-2B Back	Blank	130.1	A	1741	75% adhesive to substrate, 25% cohesive within coating	1414
			B	1275	75% adhesive to substrate, 25% cohesive within coating	
			C	1227	50% adhesive to substrate, 50% cohesive within coating	
KTA-3B Back	CorrZe-100	126.2	A	1662	90% adhesive to substrate, 10% cohesive within coating	1665
			B	1831	50% adhesive to substrate, 50% cohesive within coating	
			C	1502	50% adhesive to substrate, 50% cohesive within coating	
KTA-4B Back	Corr-Ze 200 + 100	253.7	A	2185	100% cohesive within coating	2064
			B	1858	100% cohesive within coating	
			C	2149	100% cohesive within coating	



If you have any questions concerning the testing or this report, please contact me by telephone at 412-746-4262, or by email at jglover@kta.com.

Sincerely,

KTA-TATOR, INC.

A handwritten signature in blue ink that reads 'Julie A. Glover'. The signature is fluid and cursive, with the first and last names being more prominent.

Julie A. Glover
Chemist

Appendix: Photographs

R1 – A revision was made to include coating DFT in Table 3.

R2 – A revision was issued to add a photograph appendix

JAG/RBL:edg

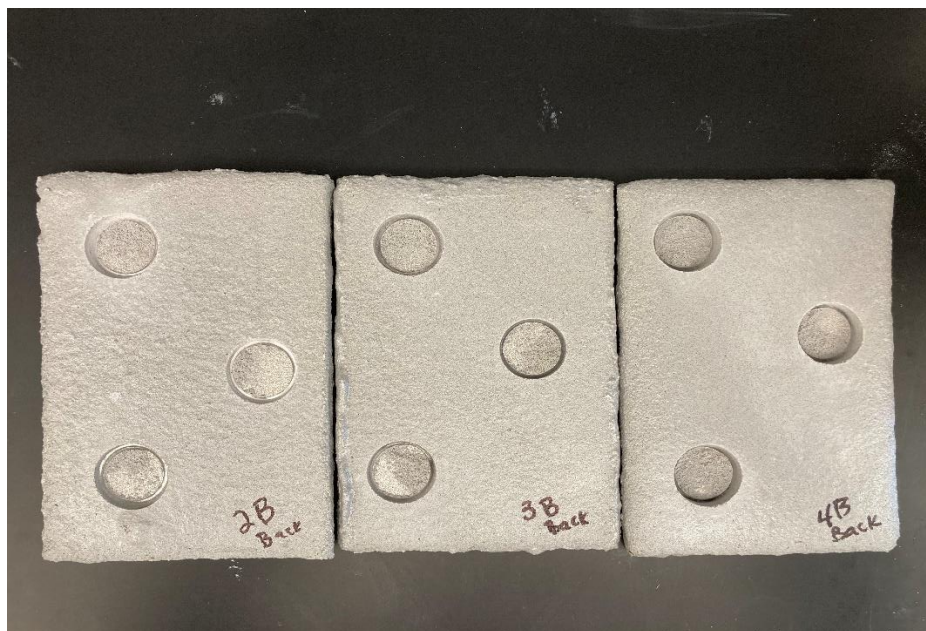
NOTICE: This report represents the opinion of KTA-TATOR, INC. Laboratory activities were performed at our Pittsburgh, PA facility. This report is issued in conformance with generally accepted industry practices. While customary precautions were taken to verify the information gathered and presented is accurate, complete, and technically correct, this report is based on the information, data, time, materials, and/or samples afforded. Results relate only to the items tested. This report should not be reproduced except in full.

Appendix

PHOTOGRAPH APPENDIX



Post Adhesion Testing



Post Immersion Testing