200X Re-formulation Qualification Data

September 2022

ENGINEERING YOUR SUCCESS.

Main Formulation Changes

- **Part A:** Removed fluorosurfactant; replaced with xylene to maintain the same total weight%. A new SDS will be issued.

- **Part B & Part C:** No significant changes made. SDSs will remain the same.

Individual component packaged weights and mix ratios of the CS 2000 series coatings will not change.

CHOSHIELD 2001 and CHOSHIELD 2002 Qualification Testing

- Application – viscosity, spray performance, pot life.
- Conformance – std batch conformance testing including viscosity, adhesion, tack free time, and surface resistivity (Al & G10)
- Environmental – 240 hour dwell. Heat (85C), Heat and Humidity (85C, 85% R.H), and Low temperature (-40C) exposure.
- Mechanical – Conical bend, mandrel bend, impact resistance, and taber abrasion
- Fluid Resistance – JP-8, Lubricating oil (MIL-PRF-7808), Hydraulic Fluid (Mil-H-5606)
- Corrosion – 500 hrs Salt Fog exposure (ASTM B117) on MIL-DTL-5541 TYPE I, Class 3 aluminum

Environmental Tests

85°C/85% RH for 10 days							
Coating	Test	Substrate	Specification	Cure	Initial	Post Test	Post Test Adhesion
CS2002 New	Heat and Humidity	G10 4"x2"	N/A	RT	0.061	0.122	5B
CS2002 Control	Heat and Humidity	G10 4"x2"		RT	0.053	0.094	5B

85°C for 10 days							
Coating	Test	Substrate	Specification	Cure	Initial	Post Test	Post Test Adhesion
CS2002 New	High Temp Dwell	G10 4"x2"	N/A	RT	0.063	0.098	5B
CS2002 Control	High Temp Dwell	G10 4"x2"		RT	0.058	0.086	5B

-40°C for 10 days							
Coating	Test	Substrate	Specification	Cure	Initial	Post Test	Post Test Adhesion
CS2002 New	Low Temp Dwell	G10 4"x2"	N/A	RT	0.074	0.087	5B
CS2002 Control	Low Temp Dwell	G10 4"x2"		RT	0.06	0.068	5B

- All results are averaged values of three samples.

Fluid Immersion Tests

Mil-H-5606 Hydraulic Fluid Immersion Room Temperature for 72 hours						
Coating	Test	Substrate	Specification	Cure	Initial	Post Test
CS2002 New	Hydraulic Fluid	G10 4"x2"	< 0.1 ohms/sq	RT	0.062	0.059
CS2002 Control	Hydraulic Fluid	G10 4"x2"		RT	0.059	0.055

Mil-L-7808 Lubricant Oil Immersion Room Temperature for 72 hours						
Coating	Test	Substrate	Specification	Cure	Initial	Post Test
CS2002 New	Lubricant Oil	G10 4"x2"	< 0.1 ohms/sq	RT	0.062	0.059
CS2002 Control	Lubricant Oil	G10 4"x2"		RT	0.059	0.055

JP-8 Immersion Room Temperature for 72 hours (measured after 6 days + 2hr @ 80°C)						
Coating	Test	Substrate	Specification	Cure	Initial	Post Test
CS2002 New	JP-8	G10 4"x2"	< 0.5 ohms/sq*	RT	0.066	0.356
CS2002 Control	JP-8	G10 4"x2"		RT	0.062	0.164

*Measured after 6 days and 2hr @80C

- All results are averaged values of three samples.

Mechanical Tests: 2002

Conical Bend				
Coating	Test	Substrate Material	Cure	Elongation%
CS2002 New	Conical Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	32% No crack
CS2002 Control	Conical Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	32% No crack

Mandrel Bend				
Coating	Test	Substrate Material	Cure	Mandrel Bar
CS2002 New	Mandrel Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	1/4" no crack
CS2002 Control	Mandrel Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	1/4" no crack

Taber Abrasion				
Coating	Test	Substrate Material	Cure	Weight Loss (mg)
CS2002 New	Taber Abrasion	G10 Round	RT	39.6
CS2002 Control	Taber Abrasion	G10 Round	RT	43.6

Impact Resistance					
Coating	Test	Substrate Material	Cure	Concave	Convex
CS2002 New	Impact	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	45	10
CS2002 Control	Impact	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	40	10

- All results are averaged values of three samples.

Mechanical Tests: 2001

Conical Bend				
Coating	Test	Substrate Material	Cure	Elongation%
CS2001 New	Conical Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	32% No crack
CS2001 Control	Conical Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	32% No crack

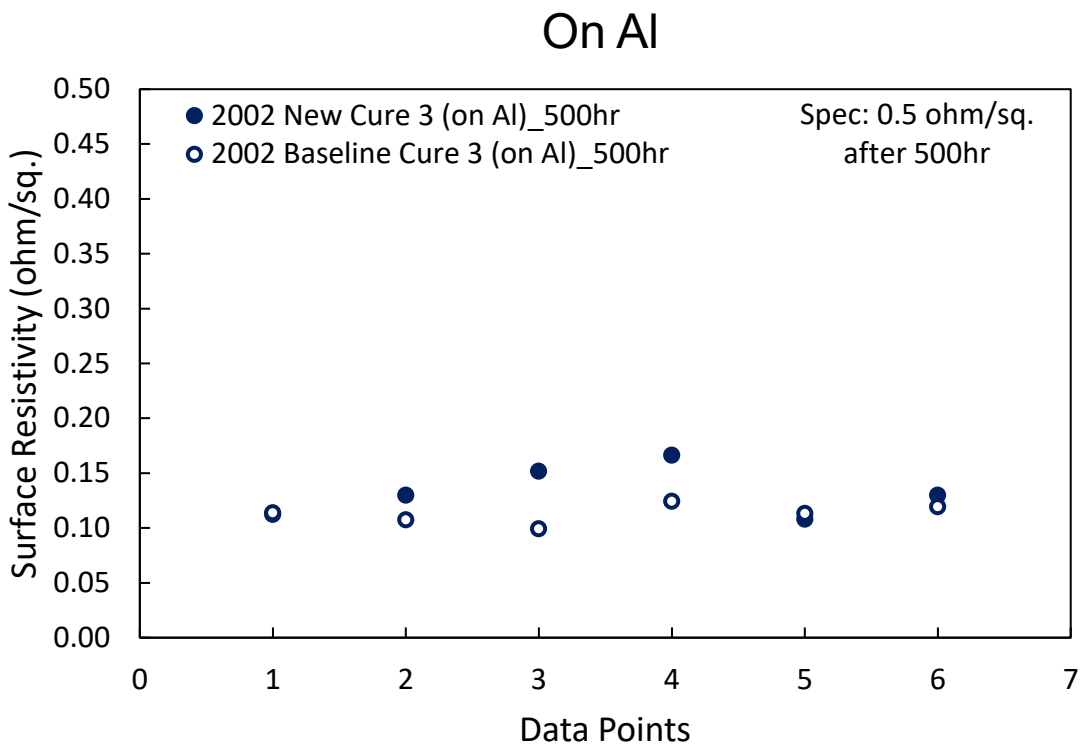
Mandrel Bend				
Coating	Test	Substrate Material	Cure	Mandrel Bar
CS2001 New	Mandrel Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	1/4" no crack
CS2001 Control	Mandrel Bend	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	1/4" no crack

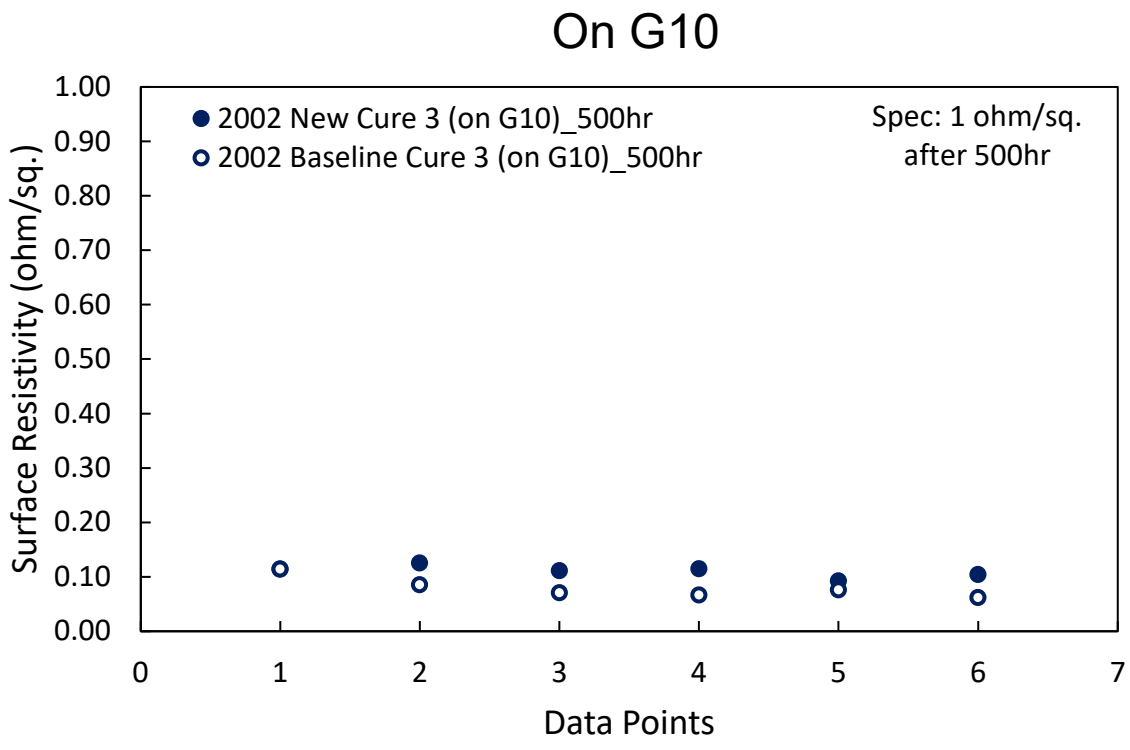
Taber Abrasion				
Coating	Test	Substrate Material	Cure	Weight Loss (mg)
CS2001 New	Taber Abrasion	G10 Round	RT	38.8
CS2001 Control	Taber Abrasion	G10 Round	RT	49.2

Impact Resistance					
Coating	Test	Substrate Material	Cure	Concave	Convex
CS2001 New	Impact	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	60	35
CS2001 Control	Impact	Aluminum MIL C5541 Class III 4"x4"x0.032"	RT	60	30

- All results are averaged values of three samples.

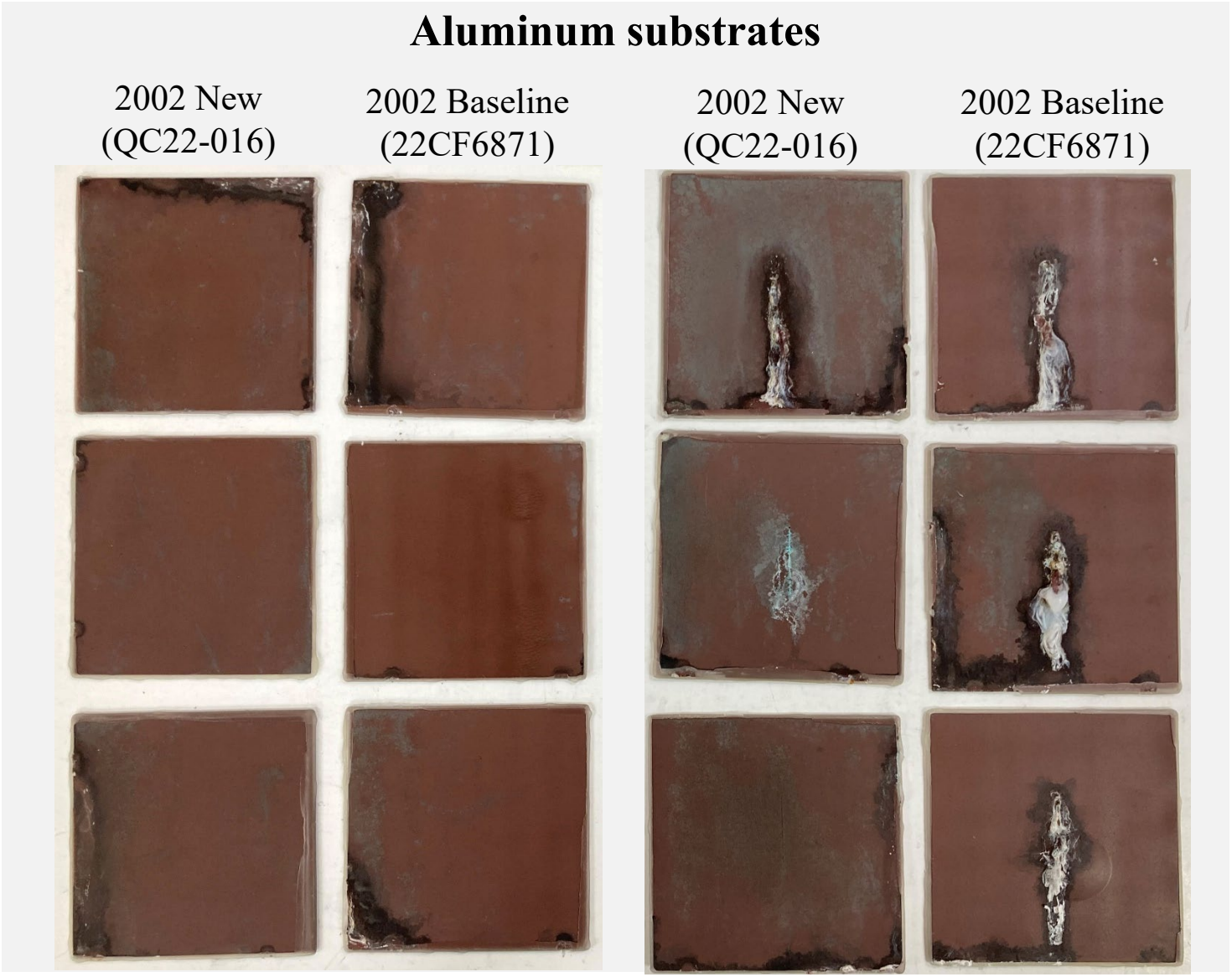
2002 Salt Fog Corrosion (Cure 3)





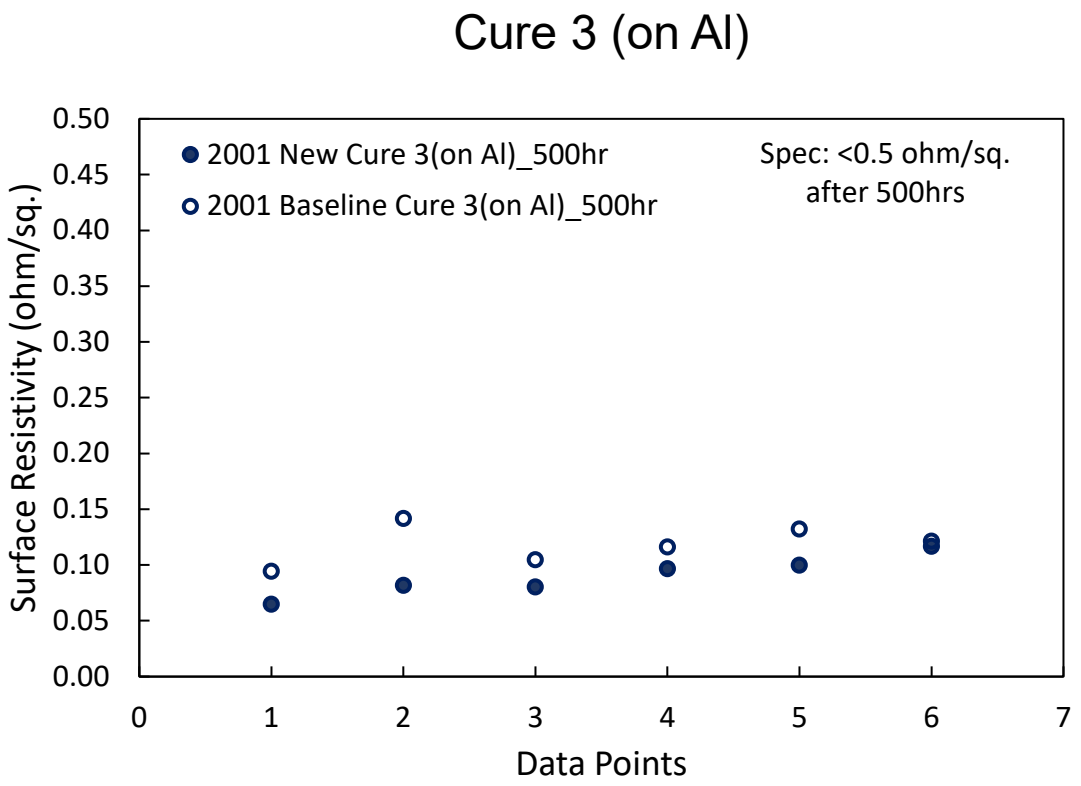
Cure 3: 7-Day RT cure

2002 Corrosion Resistance: After 500-hr (RT Cure)



Chomerics

2001 Salt Fog Corrosion

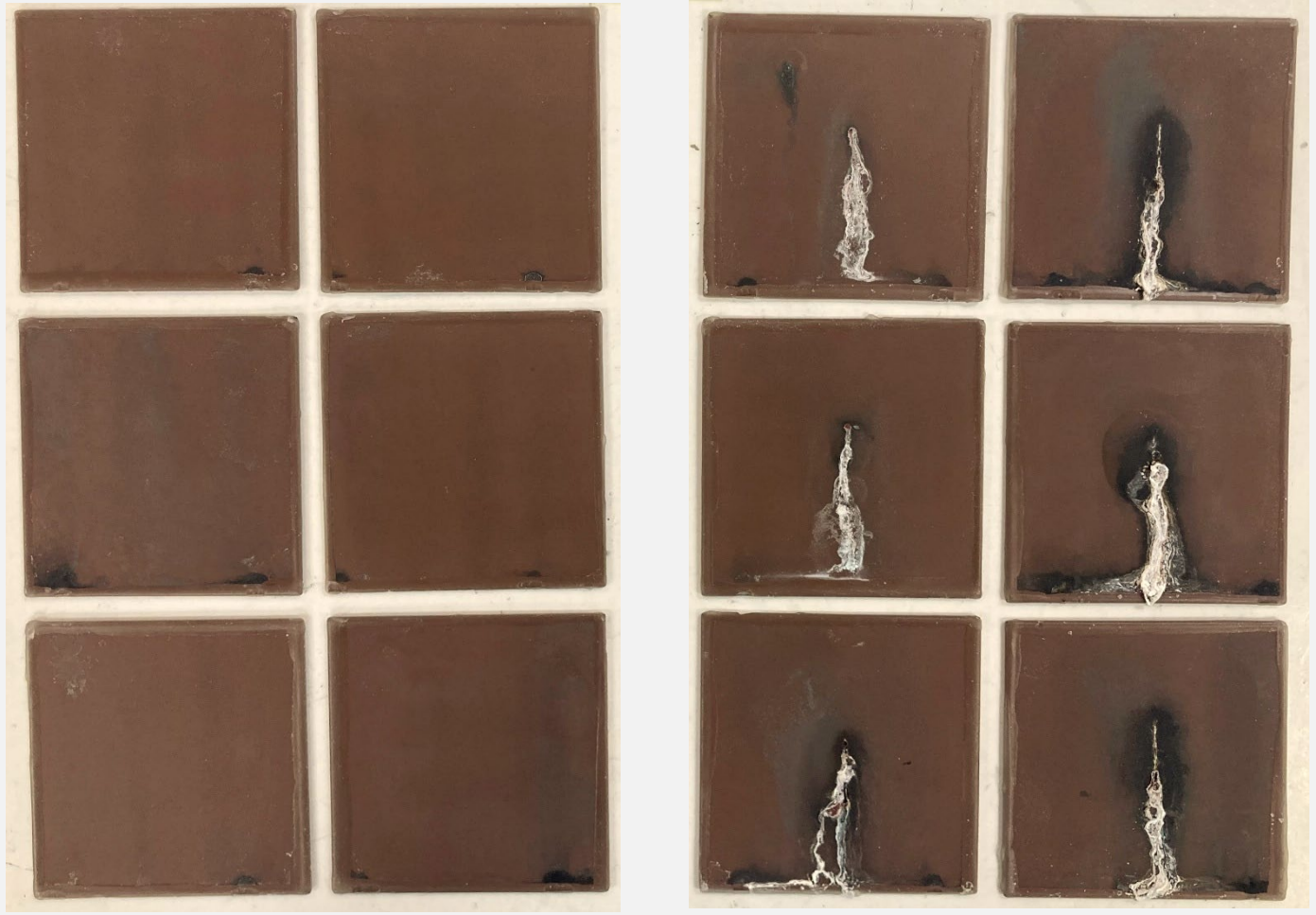


Cure 3: 7-day RT cure

2001 Salt Fog Corrosion: After 500-hr (RT Cure)

After 500-hr on aluminum substrates

2001 New (QC2001)	2001 Baseline (22CF6909)	2001 New (QC2001)	2001 Baseline (22CF6909)



Summary (Based on Current Available Results)

- Reformulated CS 200X has the same viscosity, spray performance, and pot life as the current CHOSHIELD 200X series formulations.
- Re-formulated CHOSHIELD 200X performs similar to current CHOSHIELD 200X formulations in mechanical, environmental, and fluid testing.
- Re-formulated CHOSHIELD 200X has similar corrosion performance after 500-hr salt fog tests on MIL-DTL-5541-TYPE I, Class 3 conversion coated aluminum (6061).
- Additional environmental and fluid tests for CHOSHIELD 2001 on-going, expect to be completed by the end of September 2022
- Parker CHO-SHIELD 2000 Series Re-formulation test report will be completed in October 2022.