TEST REPORT

Evaluation of Cho-Shield® 2000 Series Coatings: Fluid Resistance and Moisture Absorption

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Chomerics Approved Signatory:

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

Abstract:

Cho-Shield 2000 series coatings are frequently subjected to aggressive operational fluids including hydraulic and deicing fluids, fuels, oils, coolants, and cleaning solutions. This test report focuses on the fluid resistance and moisture absorption characteristics of both Cho-Shield 2001 and Cho-Shield 2002 when applied to 2024 T-3 aluminum with MIL-C-5541 Class III.

Fluid Resistance

Both Cho-Shield 2001 and Cho-Shield 2002 coatings cured either by room temperature or accelerated means yield encouraging physical and electrical results when immersed in any of the eleven test fluids for a 72 hour dwell at room temperature (excluding MIL-D-8243 Deicing Fluid which was evaluated at 150°F). All test specimens exposed to the hydraulic and deicing fluids, jet fuels, lubricating oils, coolants, and cleaning solutions evaluated with the exception of isopropyl alcohol returned their initial pre-immersion surface resistance (<0.100 Ω/Sq) following the dwell. Cho-Shield 2001 and Cho-Shield 2002 specimens exposed to isopropyl alcohol under the pre-described scenario experienced an increase in surface resistance by approximately 0.125-0.300 Ω/Sq following six days of air drying and two hours at 175°F.

When evaluating the physical properties of the coatings post immersion, none of the test specimens revealed any visible defects as a result of the fluid immersion including wrinkling, sagging, bubbling, streaking, solvent popping or other irregularities. All of the test specimens also survived 50 double wipes with methyl ethyl ketone without exposing the substrate.

Moisture Absorption

Both Cho-Shield 2001 and Cho-Shield 2002 coatings exhibited negligible moisture absorption per a modified version of ASTM D 570, The Standard Test Method for Water Absorption of Plastics.

Introduction:

Cho-Shield 2000 series coatings are electrically conductive copper filled urethane coatings that provide corrosion protection for enclosure flanges which mate with EMI shielding gaskets and can also provide a corrosion resistant conductive surface coating on both aluminum and plastic substrates. The Cho-Shield 2000 series coatings offer a highly conductive surface interface that which improves the overall EMI shielding performance of the substrate[1].

Cho-Shield 2001 coating is intended primarily for use as an aluminum flange treatment when conductive surfaces must be maintained in corrosive environments. It consists of a stabilized copper filled particle in a urethane binder. Additional protection of the aluminum flange is provided by a chromate-based inhibitor[2].

Cho-Shield 2002 coating is intended for use on non-metallic substrates and as a field repair compound for Cho-Shield 2001 coatings. It does not contain a chromate inhibitor and therefore does not provide the same degree of protection to aluminum substrates as the Cho-Shield 2001 coating[2].

The fluid resistance and moisture absorption characteristics of Cho-Shield 2003 were expected to be identical to Cho-Shield 2001 due the compositional similarities between the two coatings and was therefore omitted from the experiment.

Test Method:

Both Cho-Shield 2001 and Cho-Shield 2002 were mixed and applied to 2024 T-3 aluminum with MIL-C-5541 Class III sample coupons per the instructions described in the Cho-Shield 2000 Series Corrosion-Resistant Conductive Flange Coatings Technical Bulletin. The coupons were then cured by using one of the following cure cycles:

- Cure Cycle 1: Room temperature cure cycle: 7 days at 70°F.
- Cure Cycle 2: High temperature cure cycle: 2 hours at RT / 30 min. at 250°F.

Fluid Resistance

The fully cured sample coupons were immersed in approximately two inches of test fluid within a small polypropylene container. The containers were then sealed with a cover and stored at room temperature for 72.0 hours.

Following the dwell, the sample coupons were removed and physically dried using an absorbent cloth prior to testing. The dried sample coupons were then evaluated for:

- Surface Resistance - CEPS-0002
- Visual Surface Inspection - Evaluate the presence of any wrinkling, sagging, bubbling, streaking, solvent popping or other irregularities.
- Solvent Rub Resistance - 50 double wipes with Methyl Ethyl Ketone using a two-pound ball-peen without exposing the substrate (Chomerics 95-40-6013 Rev. A).

The following fluids and dwell conditions were evaluated:

Immersion Fluid	Dwell Temperature (°F)	Dwell Time (Hrs)
Isopropyl Alcohol	70.0	72.0
Soap in Water (5% Proctor & Gamble Manual Pot & Pan Detergent in tap water)	70.0	72.0
Water (tap water)	70.0	72.0
Hydraulic Fluid MIL-H-5606	70.0	72.0
Jet Fuel Type JP4	70.0	72.0
Jet Fuel Type JP5 MIL-PRF-5624	70.0	72.0
Jet Fuel Type JP8 MIL-P-83133	70.0	72.0
Polyalphaolefin Coolant MIL-C-87252	70.0	72.0
Deicing Fluid MIL-D-8243 (Note: 150°F immersion dwell)	150.0	72.0
Lubricating Oil MIL-PRF-23699	70.0	72.0
Lubricating Oil MIL-PRF-7808	70.0	72.0

Moisture Absorption

The moisture absorption of both Cho-Shield 2001 and Cho-Shield 2002 was evaluated per a modified version of ASTM D 570, The Standard Test Method for Water Absorption of Plastics. Prior to immersion, fully cured sample coupons were placed in a desiccator for 2.0 hours before being weighed. The specimens were then fully immersed in acclimated room temperature deionized water for 24.0 hours.

Following the dwell, the sample coupons were removed and physically dried using an absorbent lint free cloth before being weighed. The water absorption was calculated and expressed as a weight percent.

Results:

Fluid Resistance

Immersion Fluid	Cho-Shield 2001			
	Cure Cycle 1 (Ω/Sq.)	Cure Cycle 2 (Ω/Sq.)	Post Exposure Surface Characteristics (a)	MEK Rub (b)
Isopropyl Alcohol	<0.250	<0.280**	Pass	Pass
Soap in Water (5% Proctor & Gamble Manual Pot & Pan Detergent in tap water)	<0.100	<0.100	Pass	Pass
Water (tap water)	<0.100	<0.100	Pass	Pass
Hydraulic Fluid MIL-H-5606	<0.100	<0.100	Pass	Pass
Jet Fuel Type JP4	<0.100*	<0.100	Pass	Pass
Jet Fuel Type JP5 MIL-PRF-5624	<0.100**	<0.100	Pass	Pass
Jet Fuel Type JP8 MIL-P-83133	<0.100**	<0.100	Pass	Pass
Polyalphaolefin Coolant MIL-C-87252	<0.100	<0.100	Pass	Pass
Deicing Fluid MIL-D-8243 (Note: 150°F immersion dwell)	<0.100	<0.100	Pass	Pass
Lubricating Oil MIL-PRF-23699	<0.100	<0.100	Pass	Pass
Lubricating Oil MIL-PRF-7808	<0.100	<0.100	Pass	Pass

Immersion Fluid	Cho-Shield 2002			
	Cure Cycle 1 (Ω/Sq.)	Cure Cycle 2 (Ω/Sq.)	Post Exposure Surface Characteristics (a)	MEK Rub (b)
Isopropyl Alcohol	<0.200	<0.400*	Pass	Pass
Soap in Water (5% Proctor & Gamble Manual Pot & Pan Detergent in tap water)	<0.100	<0.100	Pass	Pass
Water (tap water)	<0.100	<0.100	Pass	Pass
Hydraulic Fluid MIL-H-5606	<0.100	<0.100	Pass	Pass
Jet Fuel Type JP4	<0.100*	<0.100	Pass	Pass
Jet Fuel Type JP5 MIL-PRF-5624	<0.100**	<0.100	Pass	Pass
Jet Fuel Type JP8 MIL-P-83133	<0.100**	<0.100	Pass	Pass
Polyalphaolefin Coolant MIL-C-87252	<0.100	<0.100	Pass	Pass
Deicing Fluid MIL-D-8243 (Note: 150°F immersion dwell)	<0.100**	<0.100	Pass	Pass
Lubricating Oil MIL-PRF-23699	<0.100	<0.100	Pass	Pass
Lubricating Oil MIL-PRF-7808	<0.100	<0.100	Pass	Pass

* Retested post immersion resistance after 6 days at room temperature.
** Retested post immersion resistance after 6 days at room temperature followed by 175°F for 2.0 hours.
(a) Coating showed no visible effects from fluid immersion; i.e. no blisters, wrinkling or other deformation of the coating = Pass
(b) MEK soaked cloth affixed to the ball peen portion of a 2 pound hammer / 50 double rubs: Pass = no substrate exposed

Moisture Absorption

Material	Cure Cycle	Total Weight Change (gm)	%Water Absorption
Cho-Shield 2001	1	0.0000	0.000%
	2	0.0000	-0.003%
Cho-Shield 2002	1	0.0007	0.006%
	2	0.0000	0.000%

Conclusions:

Surface Resistance:
All non-isopropyl alcohol samples of Cho-Shield 2001 and Cho-Shield 2002 Cure Cycles 1 and 2 yielded post fluid immersion surface resistivites of <0.100 Ω/Sq following a 72 hour room temperature dwell. Sample panels coated with Cho-Shield 2001 yielded surface resistance values of <0.250 Ω/Sq for Cure Cycle 1 and <0.280 Ω/Sq for Cure Cycle 2 respectively following six days of air drying and two hours at 175°F. Sample panels coated with Cho-Shield 2002 yielded surface resistance values of <0.200 Ω/Sq for Cure Cycle 1 and <0.400 Ω/Sq for Cure Cycle 2 respectively following six days of air drying and two hours at 175°F.

Visual Inspection:
All samples of Cho-Shield 2001 and Cho-Shield 2002 Cure Cycles 1 and 2 passed visual inspection and were free of any wrinkling, sagging, bubbling, streaking, solvent popping or other irregularities.

MEK Solvent Rub Resistance:
All samples of Cho-Shield 2001 and Cho-Shield 2002 Cure Cycles 1 and 2 survived 50 double wipes with Methyl Ethyl Ketone without exposing the substrate.

Moisture Absorption:
All samples of Cho-Shield 2001 and Cho-Shield 2002 Cure Cycles 1 and 2 exhibited negligible moisture absorption per a modified version of ASTM D 570, The Standard Test Method for Water Absorption of Plastics.

1 Chomerics Technical Bulletin 30 – "Cho-Shield® 2000 Series Corrosion-Resistant Conductive Flange Coatings."

2 P. Lessner, "Evaluation of Cho-Shield® 2000 Series Coatings Subjected to Salt Fog Exposure", Report No. CHO-TR3, Parker Hannifin Chomerics Division, Woburn, MA.