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6. AUTHOR(S) <b>Joseph H. Osborne</b>				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Boeing Phantom Works P.O. Box 3999 Mail Stop 84-92, Seattle, WA 98124-2499</b>			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) <b>Dr. Airan Perez Office of Naval Research Ballston Center Tower One 800 North Quincy Street Arlington, VA 22217-5660</b>			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
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13. ABSTRACT (Maximum 200 words) <b>Monthly report of progress in developing an enhanced self priming topcoat using high performance urethane resins and advanced concepts in nonchromate corrosion protection. The goal of the program is to develop a coating that meets and exceeds the requirements of TT-P-2756 and exceeds the performance of the existing topcoat material qualified to the specification.</b>				
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Development of an Enhanced Durability Corrosion  
Protecting Self-Priming Topcoat  
Contract No. N00014-02-C-0108

R&D Status Report #22

Reporting Period: April 7, 2004 through May 6, 2004

## **Summary of Current Progress**

- Salt fog corrosion testing of 13% and 20% hydrotalcite formulations is at 2000 hours
- Filiform corrosion testing of HT formulations on alodine, NAVAIR TCP, and Boegel EPII conversion coatings is complete
- Plan to evaluate cleaning methods has been developed
- Inhibitor downselect criteria are being established

Phase I – Formulation Trade Studies is complete. Promising inhibitor systems have been identified for optimization in Phase II.

Phase III – Flight Test is scheduled to start in 2005.

## **Phase II – Optimization**

### **Round One**

#### **Performance Testing – 13% Hydrotalcite Inhibitors**

Completed 2000 hours neutral salt spray corrosion testing. Neutral salt spray corrosion testing is being performed on AA2024-T3 and AA7075-T3 alloys. Ranking of the coatings are shown in Table 1. Corrosion resistant generally increases with inhibitor concentration. The formulation 99GY133, with HT-organic anion (13%) at 25.3% PVC, is the best performing test coating over both alloys (ranks 2<sup>nd</sup>).

Xenon arc testing is being performed by NAVAIR for this round of coatings.

Table 1 -- Corrosion Ranking -- 13% Hydrotalcite Series at 2000 Hours

Coating	Rank after 2000 hours	
	AA2024-T3	AA7075-T6
Deft 03GY369 Control	3	4
Deft 97GY132 (10.4 PVC 13% HT)	4	5
Deft 97GY134 (14.6 PVC 13%HT)	6	6
Deft 97GY129 (18.5 PVC 13%HT)	2	3
Deft 97GY135 (22.0 PVC 13%HT)	5	1
Deft 97GY133 (25.3 PVC 13% HT)	1	1

### Performance Testing – 20% Hydrotalcite Inhibitors

Completed w000 hours neutral salt spray corrosion testing. Neutral salt spray corrosion testing is being performed on 2024 and 7075 alloys. Relative ranking of the coatings are shown in Table 2. The control coating, 03GY369, is performing best over both alloys in the 20% HT series.

Table 2 -- Corrosion Ranking -- 20% Hydrotalcite Series at 2000 Hours

Coating	Rank after 1000 hours	
	AA2024-T3	AA7075-T6
Deft 03GY369 Control	1	1
Deft 97GY137 (10.4 PVC 13% HT)	4	5
Deft 97GY139 (14.6 PVC 13%HT)	6	6
Deft 97GY136 (18.5 PVC 13%HT)	5	4
Deft 97GY140 (22.0 PVC 13%HT)	2	3
Deft 97GY138 (25.3 PVC 13% HT)	2	2

Xenon arc accelerated weathering one half complete. The 1000 hour results are shown in Figure 1. Consistent with the results from the standard inhibitors series, the UV durability decreases with increased PVC. Corrosion performance favors higher PVC so obtaining an optimum coating for both corrosion and weathering will likely be a compromise.

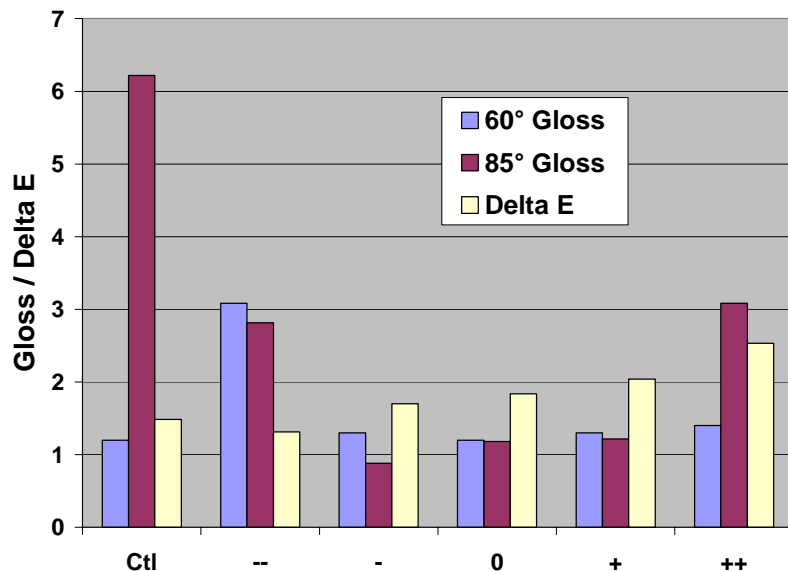


Figure 1 -- Weathering Data at 1000 hours -- 20% HT Formulations

### Nonchromate Coating Systems

Tape adhesion and filiform testing of six ESPT formulations containing various levels of hydrotalcite corrosion inhibiting compounds have been completed. Test panels have accumulated 840 hours of exposure to neutral salt spray. The ESPT coatings being testing have hydrotalcite with either 13% or 20% of the DMTD inhibitor material with PVC loadings of 10.4%, 18.5%, or 25.3%. The ESPT coatings are being tested on AA2024-T3 coupons with each of three conversion coatings: tankline applied Alodine 1200S, spray applied NAVAIR TCP, and spray applied Boegel EPII.

The 99GY133 coating, 13% HT at 25.3% PVC, did not spray well and the surface is noticeably rough with “mud cracks”. The cause of the roughness is not known but is possibly from gelling of the base component caused by the inhibitor. The results for the 99BY133 coating may be influenced by the surface roughness and cracking.

### *Tape Adhesion Test Results*

Dry and wet tape adhesion test results for hydrotalcite ESPT formulations applied to bare AA2024 T3 aluminum substrates processed with each of three different surface treatments are shown in Figure 2, Figure 3, and Figure 4 below. Both room temperature and 150 F water were used to condition wet tape adhesion samples prior to testing.

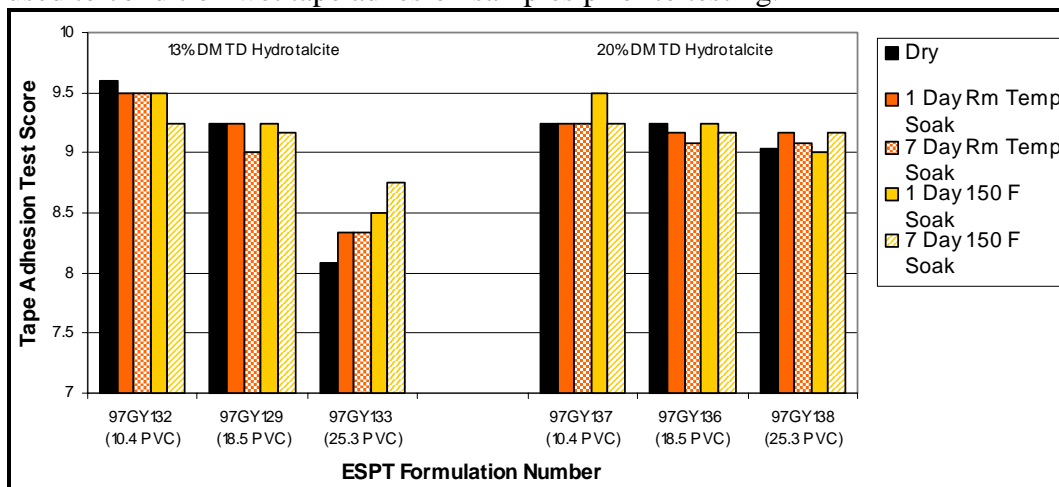


Figure 2 -- Tape adhesion results for Alodine 1200S Conversion Coating

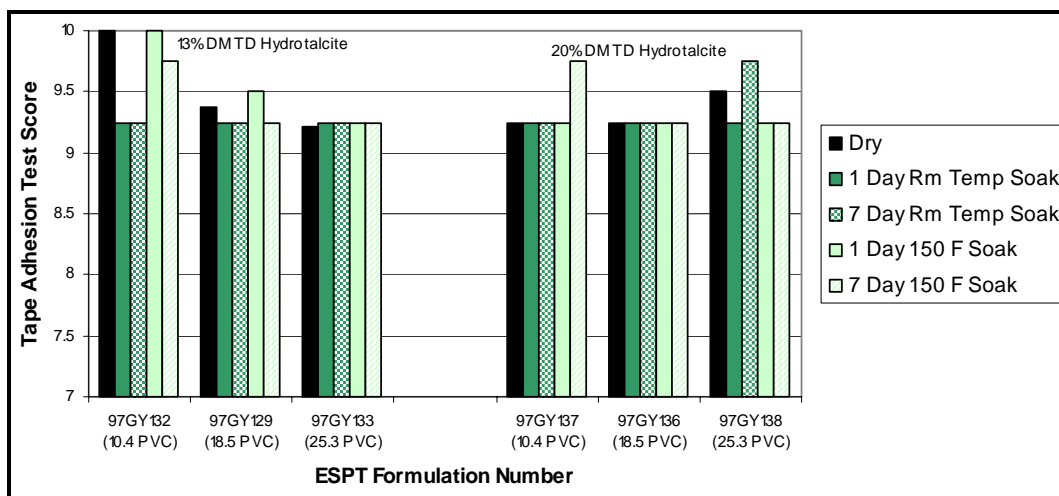


Figure 3 -- Tape adhesion results for Boegel EPII Conversion Coating

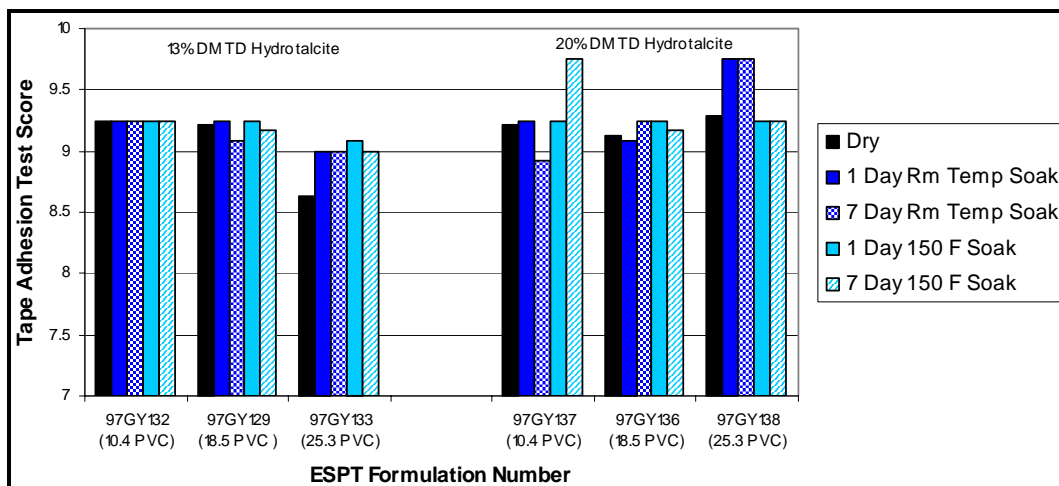


Figure 4 -- Tape adhesion results for NAVAIR TCP5P Conversion Coating

Coating adhesion was acceptable for all specimens tested, although performance tended to be lower for the 13% DMTD hydrotalcite coatings as the PVC of the inhibitor compound was increased. Tape adhesion values for 25.3 PVC 13% DMTD hydrotalcite coatings on either Alodine 1200S or NAVAIR TCP5P were somewhat worse for the dry, ambient conditioned samples than they were for samples soaked for one or seven days in water.

### Filiform Testing

Filiform testing was completed on the ESPT hydrotalcite formulations applied to Alclad 2024-T3 substrates processed with either Alodine 1200 S, Boegel EPII or NAVAIR TCP5P. Preliminary observations have been made after examining the panels visually.

Coating samples containing 10.4 PVC loadings of either 13% DMTD and 20% DMTD hydrotalcite showed varying degrees of filiform corrosion along the scribe. Of these samples, those with substrates treated with Alodine 1200 S had the shortest and least dense filiform corrosion. Those samples treated with NAVAIR TCP5P had slightly denser filiform corrosion, while those treated with Boegel EPII had much wider bands of filiform corrosion extending down the length of the scribes. Coating samples containing 18.5 PVC or 25.3PVC loadings of the inhibitor showed little or no evidence of filiform corrosion along the scribe, but tended to have pitting, bubbling or blistering in the field of the coating away from the scribe. After the coating was removed from a portion of these panels, evidence of corrosion was apparent in the field of the substrate away from the scribe.

The topcoat of samples with higher PVC loadings of the hydrotalcite inhibitors developed a noticeable yellow coloration by the end of the humidity chamber exposure. Some yellow stains in small areas of the scribes were also noticed. Examples of the filiform panels are shown in Figure 5. The discoloration of the topcoat can easily be seen. This is likely from the inhibitor material “blooming” to the surface of the coating during the humidity exposure period. Discoloration is not observed on the salt spray corrosion panels.

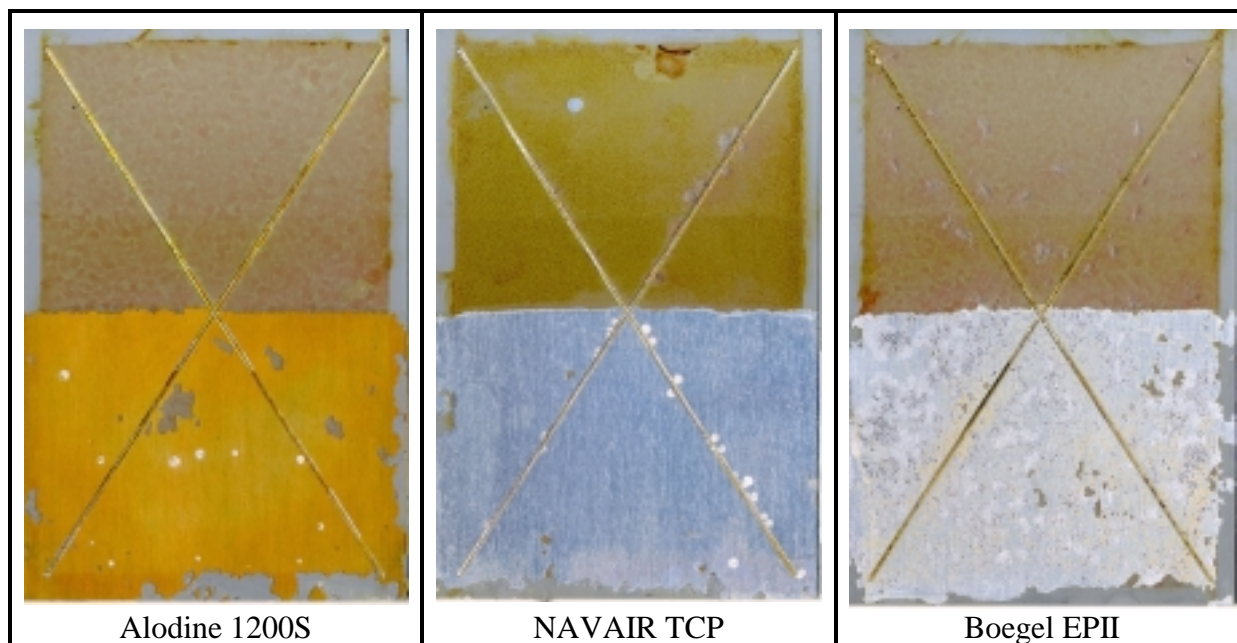


Figure 5 -- Representative Filiform Corrosion Panels

### Neutral Salt Spray

Figure 6 and Figure 7 show the performance of status of samples coated with the ESPT hydrotalcite coating formulations after 840 hours of neutral salt spray testing. The coatings were applied to bare 2024 T3 aluminum substrates processed with either Alodine 1200S, Boegel EPII or NAVAIR TCP5P.

All of the Boegel EPII treated samples have been removed from further testing as the result of corrosion in the scribe or blistering in the field. One set of NAVAIR TCP5P treated samples coated with a 10.4 PVC loading of the 13% DMTD hydrotalcite ESPT formulation has also been eliminated from further testing at this point due to the presence of dozens of small blisters in the field. The performance rating of the samples remaining in test at this point is relatively low at this early point in the test.

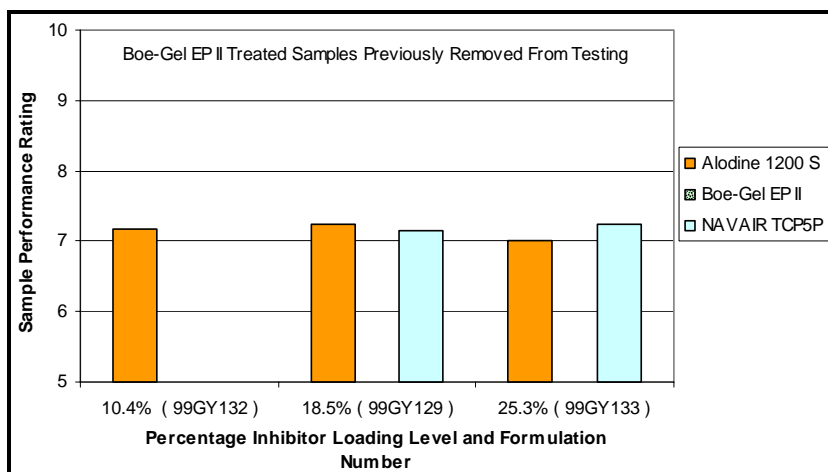


Figure 6 -- 840 Hour Neutral Salt Spray Rating -- 13% DMTD hydrotalcite

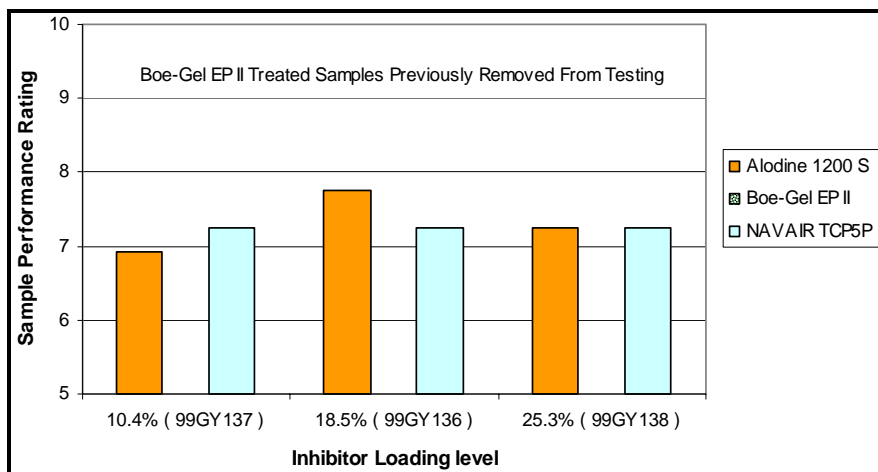


Figure 7 -- 840 Hour Neutral Salt Spray Rating -- 20% DMTD hydrotalcite

### Downselect Criteria

Specific criteria to base downselection of inhibitors for the next round of optimization are being discussed. Downselect is expected in May when performance results for the hydrotalcite inhibitors are available.

### Plans For Next Month

- Finish testing of HT concentration ladder formulations
- Start cleaning methods testing
- Finalize inhibitor downselect criteria for optimized coatings and make preliminary cut

**Task Schedule:** -- See Attached. Program is on schedule.

**Cost Summary:** -- Sent under separate cover.

Prepared by:

*Joseph H Osborne*

Joseph H. Osborne  
Principal Investigator

## Program Schedule – June 2002 through July 2006

