

Ground and Flight Testing of Non-Chrome Paint Systems; Part 2– Evaluation of Paint Systems

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Objectives

- Provide Supporting Data on Performance of Wide Range of Non-Chrome or Reduced Chrome Paint Stackups for Decisions Regarding **Chrome Elimination (This Briefing)**
- Evaluate Compatibility Between Combinations of Pretreatments, Primers, and Topcoat
- Evaluate Effects of Wide Range of Chemical Stresses on Corrosion Threats
- Evaluate Significance of A Severe Ground Exposure to Flight; i.e. **Acceleration Factors (Earlier Briefing)**

Review of Earlier Briefing

- A Large Flight and Ground Exposure Study Is Being Conducted To Evaluate Non-Chrome Paint Stackups In Comparison To Standard Chromated Paint Systems
- Emphasis is on Field Data

Scope and Approach In Study

- >60 Paint Systems Under Evaluation on Ground At Battelle's Daytona Beach Exposure Site
 - Mix and match pretreatments, primers, and topcoats
 - Painted and Scribed **Corrosion Sensors** (Electrical/Quantitative)
 - Painted and Scribed 2024 T3 **Aluminum Panels** (Visual/Subjective)
 - Painted and Scribed **Galvanic Couples** (Steel/Al) (Visual/Subjective)
- 9 Paint Systems Being Flown on Painted and Scribed Corrosion Sensors On Upper Fuselage of 42 Aircraft (Initiated by OSD)
 - C130
 - C5
 - HC144

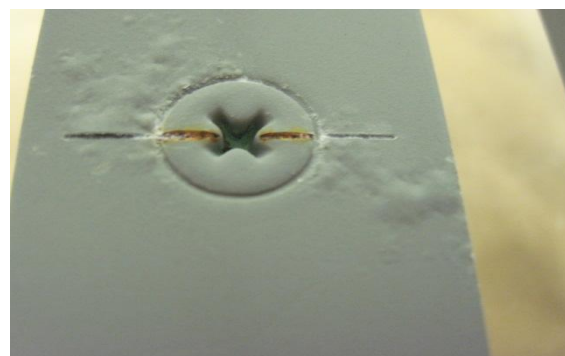
Examples of Ground and Flight



Daytona Test Rack @ 50 Meters
(1 of 3 in use; ESI Steel =
165,000 microgm/cm²/yr.

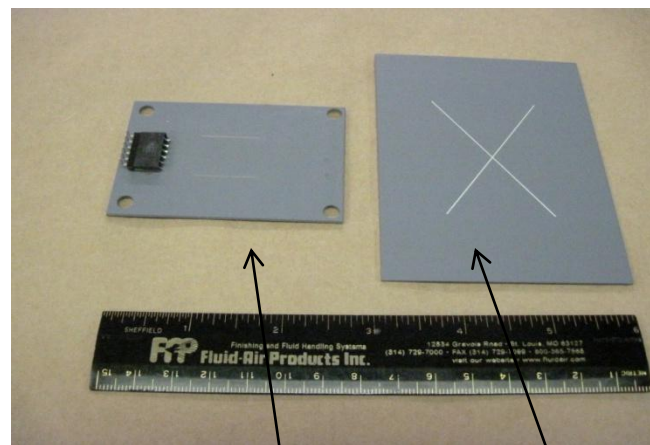


Panel with 6 sensors on C130; Upper Fuselage



Galvanic Sample; 1 Year; Ground

Quantitative/
Objective



Visual/
Subjective

Typical sensor and Panel

Paint Stackups For Flight and Ground Evaluations – 2007 and 2009 Start

2009 Long Term Start; Ground and C130, C5, HC144

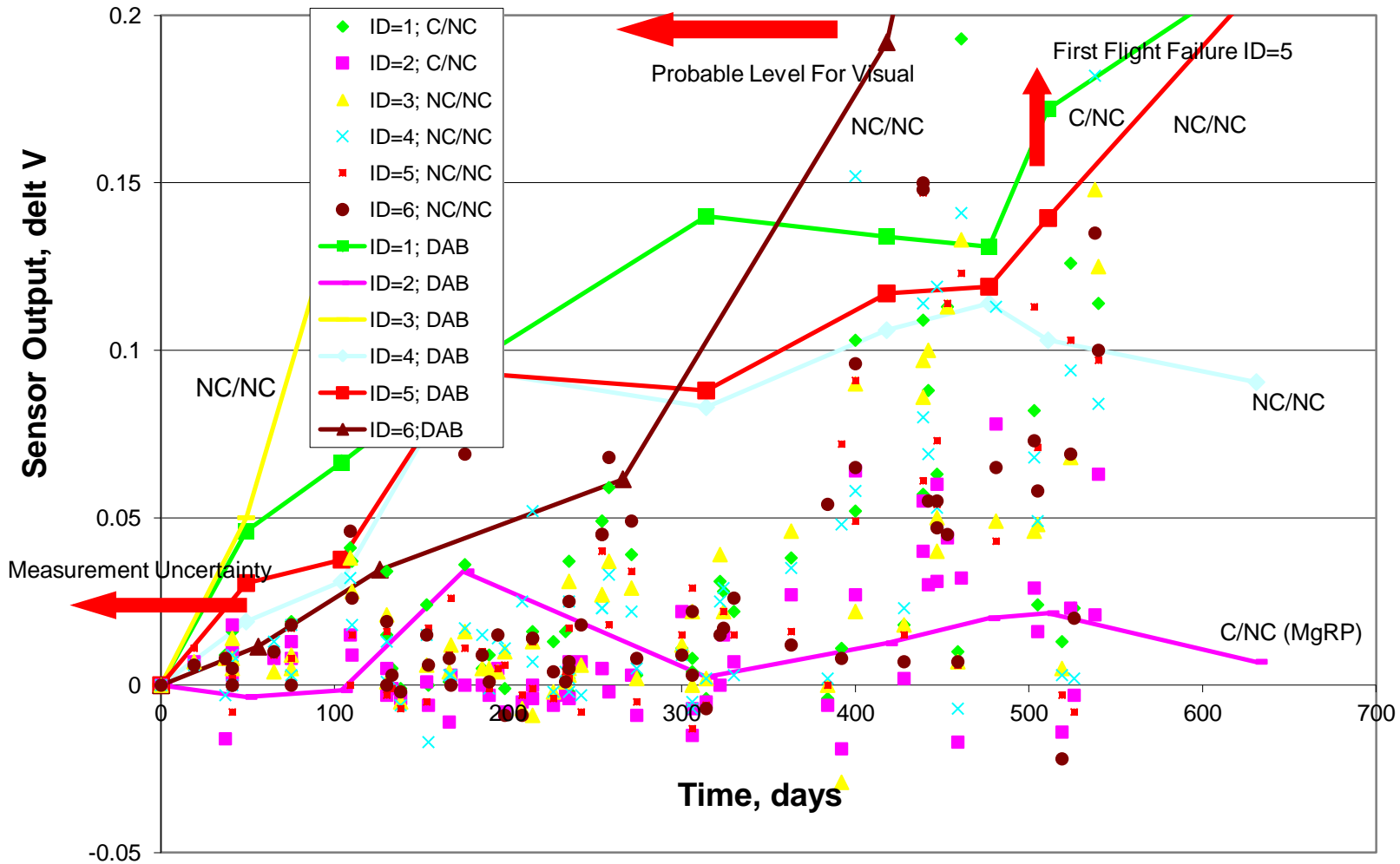
- ID=1 Alumigold / 44GN098 (DEFT) / 99GY001 (DEFT)
- ID=2 Alumigold / AE2100 (XP406-110) ANAC / 99GY001(DEFT)
- ID=3 Alodine 5700 / 02GN084 (DEFT) / 99GY001 (DEFT)
- ID=4 Alodine 5700 / 16708TEP (Hentzen) / 99GY001 (DEFT)
- ID=5 Prekote / Sicopoxy 577-630 (ANAC) / 99GY001 (DEFT) C130 only
- ID=5 Prekote / 02Y040B (DEFT) / 99GY001 (DEFT) C5 only
- ID=6 DEFT 1015/3021 / 02GN093 (DEFT) / 99GY001 (DEFT) C130 ,HC144 only
- ID= 6a Prekote / 02Y040B (DEFT) / PPG Desothane HS Half of C5s only
- ID = 6b Prekote / 02Y040B (DEFT) / AE5000 (ANAC) Half of C5s only

	MIL-PRF-85285 Ty IV
	MIL-PRF-85285 Ty I
	MIL-PRF-23377 CI C2
	MIL-PRF-23377 CI N
	MIL-PRF-85582 CI N
	MIL-DTL-81706

2007 Long Term Start – Ground and flight (H60/P3/AH64A)

- ID=7 Alodine 1200S / 02GN083 (DEFT) / 99GY001 (DEFT)
- ID=8 Prekote / AE2100 (first generation) / AE5000 (ANAC) Old System 2
- ID=9 Prekote / 02Y-040 (DEFT) / 03GY310 (DEFT) Old System 3
- ID=10 MIL-C-5541 / 02Y040 (DEFT) / 03GY310 (DEFT) Old System 4
- ID=11 Alodine 5200 / Sicopoxy / 03GY310 (DEFT)
- ID=12 Prekote / Americoat 3351 / 03GY310 (DEFT)

Combined Data For Ground and On-Aircraft (Solid Lines = Ground; Points=Flight By T/N)



Conclusions From Flight Tests to Date

- Good Performance Time, Flying
 - Prekote/AE 2100/AE5000 (NC/NC) 4+
 - Alodine 5700/16708 TEP/99GY001 (NC/NC) 1.5
 - Alumigold/AE2100/ 99GY001 (C/NC) 1.5
 - Prekote/02GY040/Desothane HS (NC/C) 1.5
 - Prekote/02GY040/AE5000 (NC/C) 1.5

- Also Excellent Performance on Ground

Acceleration Factor Application

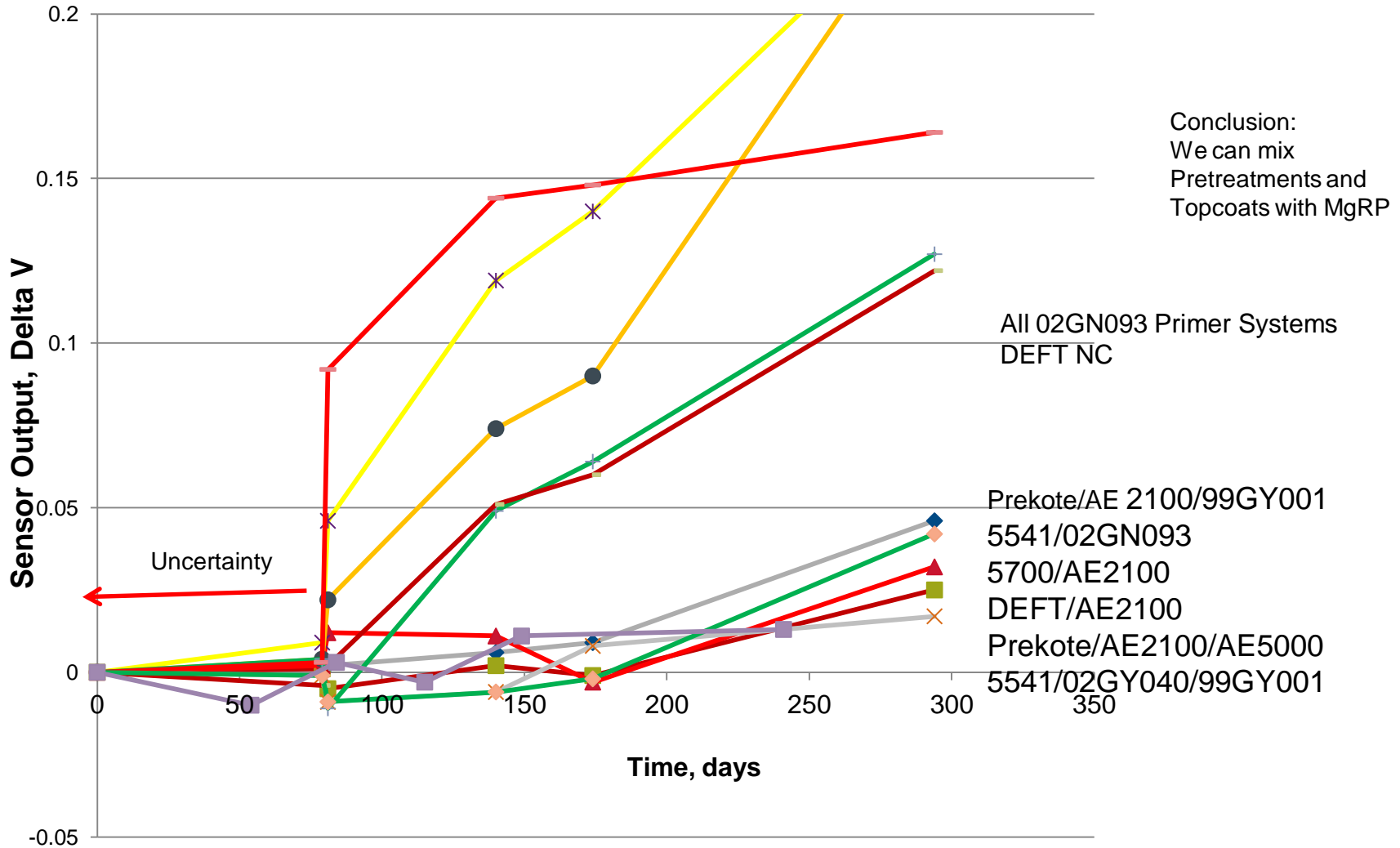
- Painted and Scribed 2024 AI Panels Require 2-4 Times Longer To Reach Visible Degradation Compared to Sensor Results
- Conservative Estimate = 4:1 Acceleration Factor For Severe Ground (Sensor) vs. Flight (2024 AI) For Worst Case Land Based Assets
- Significance of Sensor Results vs Painted 2024
 - Systems Deployed In 2007 Exposed to Equivalent of >10 Years On Wing of C130 and C5
 - Large Matrix Started 2009 Now Exposed to Equivalent of ~8 Years On Wing of C130 and Tail of C5

Best Performance Thru at Least 1 Year of Severe Ground Exposure

- Systems Showing Good Performance In Severe Environment to Date to At Least 1 Year on Sensors (=4+ Yrs Aluminum)

	»	<u>Sensor, Real Time</u>	
– 5541/02GY040/99GY001 (C/C) –		4 yrs	ID=4 (2007 ground and flight)
– Alodine 1600/02GY040/99GY001 (C/C) --		1 yr	
– Alodine 1200s/02GY040/99GY001 (C/C) –		1 yr	
– Alumigold/AE2100/AE5000 (C/NC) --		2 yrs	ID=2 (+2009 flight)
– TCP/AE2100/99GY001 (C/NC) –		1 yr	
– Prekote/02GY040/AE5000 (NC/C) –		1 yr	
– Alodine 5700/16708 TEP/99GY001 (NC/NC) –		1 yr	ID=4 (+2009 flight)
– Alodine 5700/AE2100/AE5000 (NC/NC) –		1 yr	
– DEFT/AE2100/99GY001 (NC/NC) –		1 yr	
– Prekote/AE2100/AE5000 (NC/NC) --		4 yrs	ID=2 (2007 ground and flight)
– Prekote/CA7236/CA9311 (NC/NC) –		1 yr	
– EAP9/CA7236/CA9311 (NC/NC) –		1 yr	

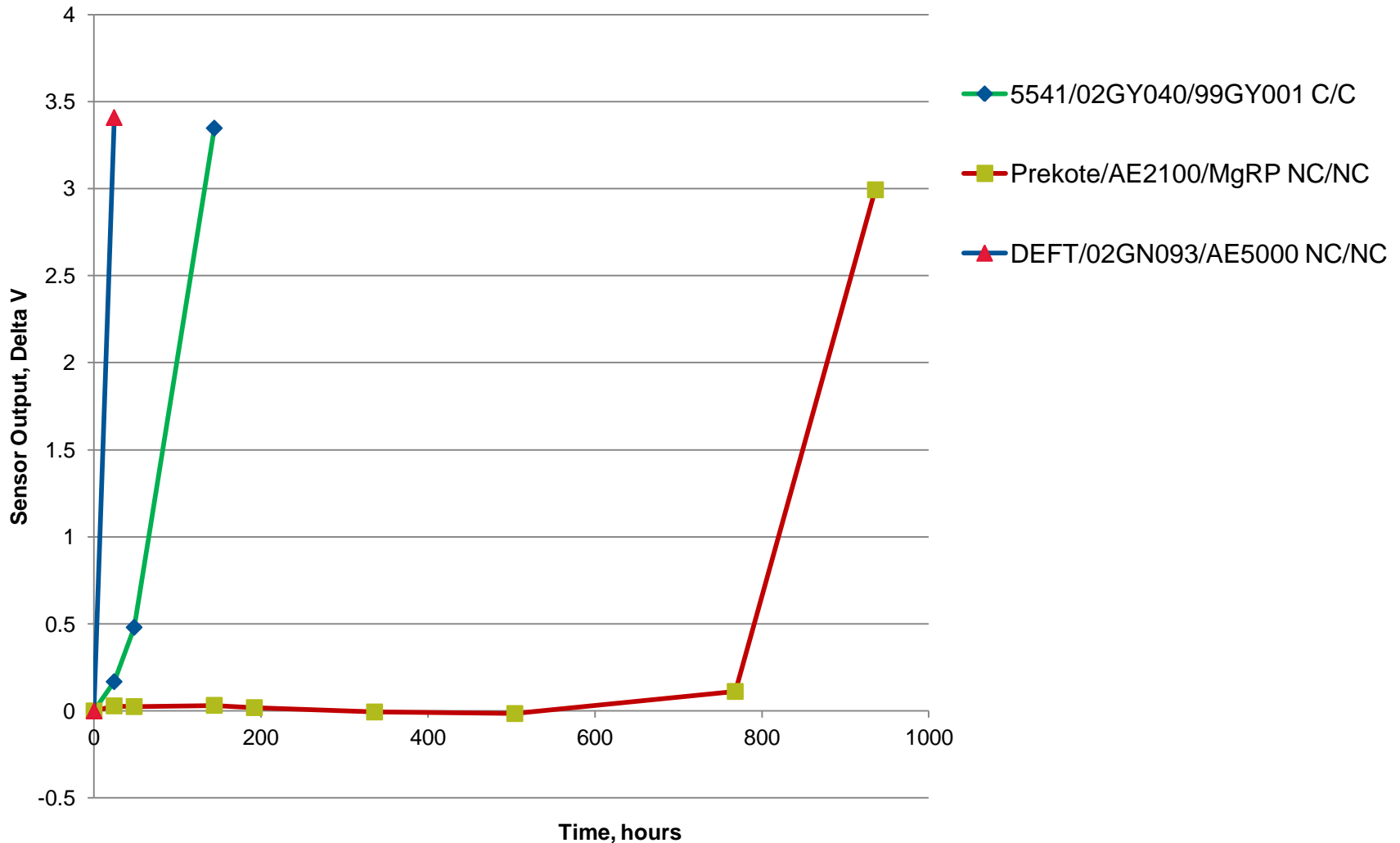
Effects of Pretreatments and Topcoats on Performance of MgRP and Comparisons To 02GN093 Primer; Daytona Ground Data



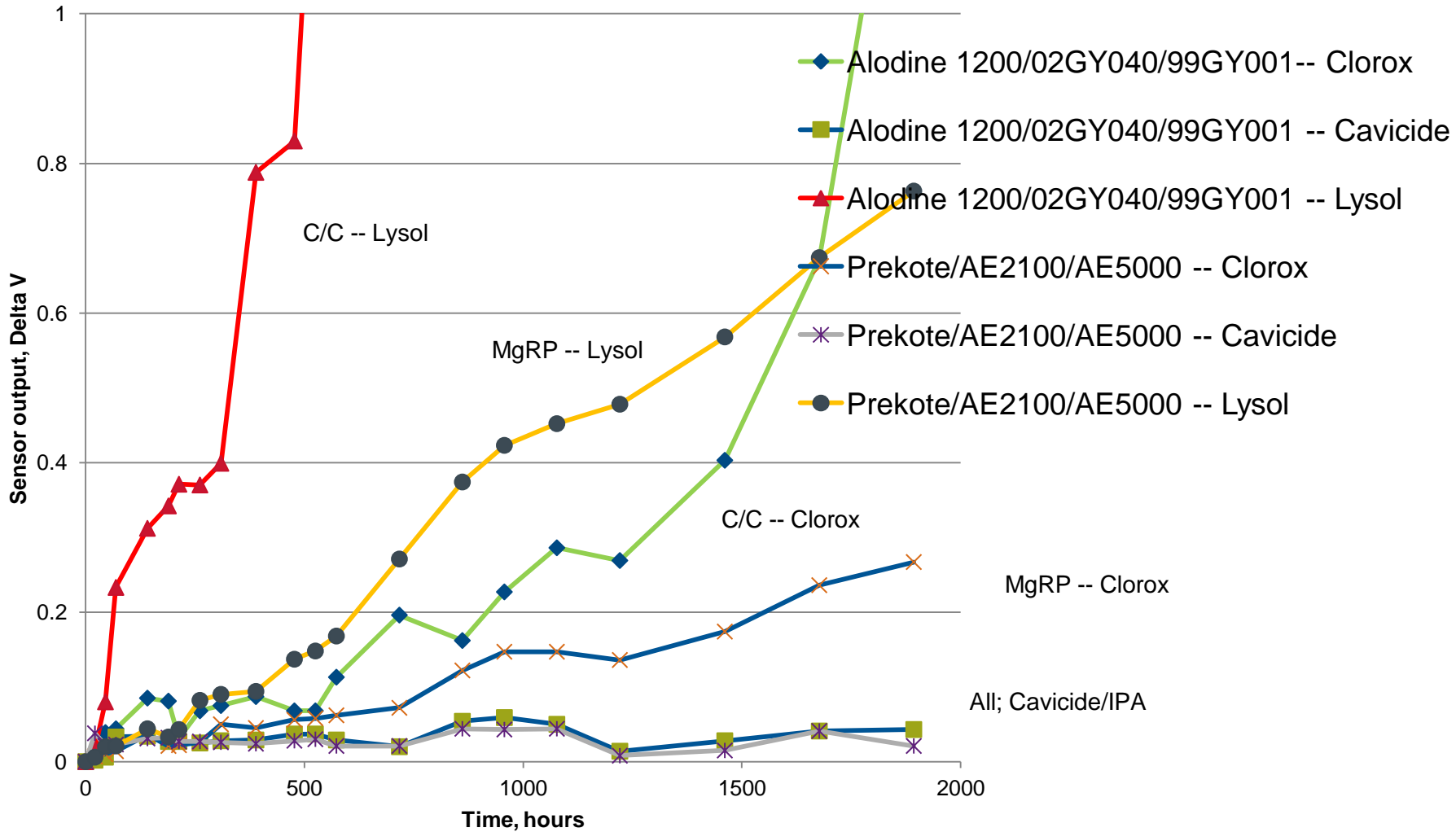
Effects of Other Chemical/Biological Stresses on Paint Systems

- The Threats From Other Chemical Stresses Are Real and Must Be Considered In Paint Evaluations
- One NC/NC System Has Shown Exceptional Resistance
- The Following Slides Show 3 Stress Examples
 - Urine – Bilges; Cockpits
 - Decon Solutions – General Use
 - Fungal Influenced Corrosion – IML; OML (TBD)

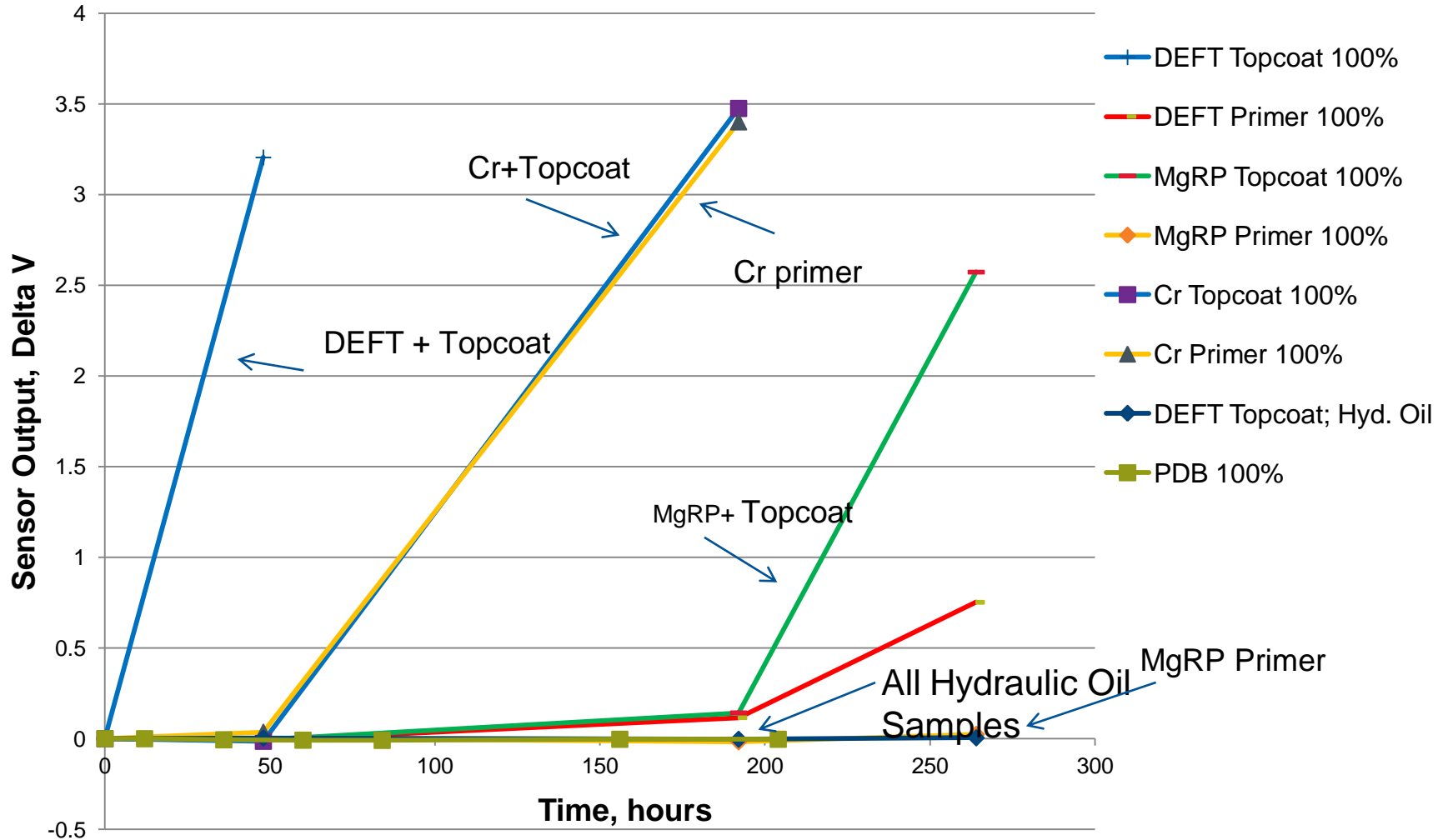
Effects of Urine on Corrosion Sensor Response For 3 Painted and Scribed Coatings; 30 C; 85% rh



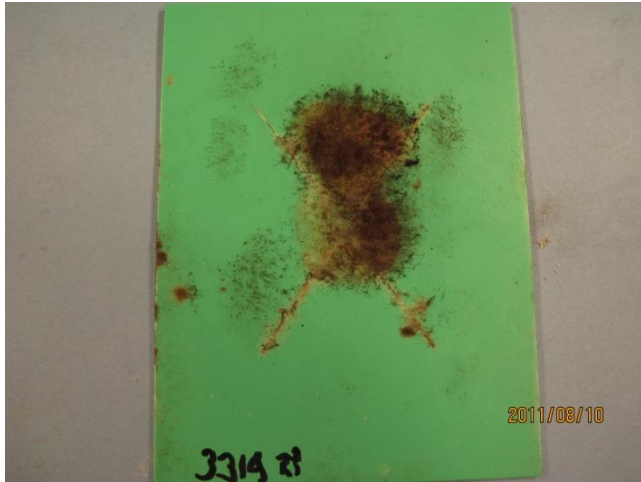
Effects of Disinfectants on Painted and Scribed Corrosion Sensors; 30 C, 85% rh; No Rinse Series



Painted and Scribed Sensors With 3 Primers (w and w/o Topcoats) Treated With Fungal Consortia In PDB Nutrient; Aged 30 C, 100 % rh



Effects of Fungal Growth on Painted and Scribed 2024 T3 Al With NC Primer Only



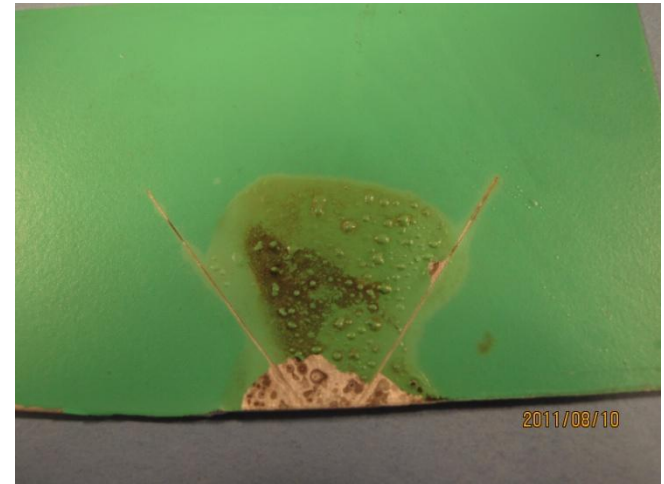
Intact Panel; 40 Days, 100% rh



After Cutting at Middle



SEM View of Aerial Hyphae/Growth



After IPA; Blistering, Pitting

Conclusions

- At Least 2 Totally Non-Chrome Systems Are Performing Well In Ground and Flight Tests
 - Data on Color, Gloss, and Chalking Being Developed
 - EIS Supporting Data being Developed
- Data For MgRP Appear To Eliminate Sole Source Concerns
- Other Systems Are Under Study; Possible That Other Competing Systems May Emerge
- All Data Support The Need To Thoroughly Evaluate Any New Paint System In The **Field**
 - Slow ?
 - Minimum of 1-2 Years In Field
- Need Still Exists For Better/More Realistic Lab Tests
 - ASTM B117 Not Realistic of Ground or Flight
 - Wrong Answers Otherwise