

UV-Curable Coatings for Aerospace Applications (ESTCP Project WP-0804)

26 Mar 09



Mr. Randy Straw
AFRL/RXSC (CTC)



Overview



- **Current processes**
- **Team and project approach**
- **Performance baseline/JTP requirements**
- **Coating selection**
- **Planned activities/Project timeline**
- **Summary**
- **Related Efforts**



Current Aerospace Coatings



- **Environmental burdens**
 - Worker exposure
 - Generate hazardous waste
- **Production delays**
 - Long cure times
 - 4 hr for primer / 8-72 hr for topcoat
 - Bottlenecks in production

BASE CHARACTERISTICS*

Wt./Gal.	10.11 lbs.
% solids by weight	63.31
% solids by volume	46.36
VOC pounds/gallon	3.68
VOC grams per liter	441

CATALYST CHARACTERISTICS*

Wt./Gal.	9.00 lbs.
% solids by weight	73.64
% solids by volume	69.62
VOC pounds/gallon	2.34
VOC grams per liter	281





Project Objectives




- **Dem/Val UV-curable topcoats:**
 - **Simple geometry off-aircraft components**
 - **Interior/exterior flat panels**
 - **Aircraft markings**
- **Verify through lab and field testing technology will:**
 - **Meet aerospace performance requirements**
 - **Reduce environmental burden**
 - **Reduce costs**
 - **Increase production throughput**



Project Team



ESTCP Principal Investigator
Glenn Baker



Program Management
 Tom Naguy
 Randy Straw (CTC)



CTC
 Georgette Nelson, *CTC* Project Manager
 Matthew Campbell, Technical Support
 Steve Finley, Technical Support



Concurrent Technologies Corporation

CTIO Lab Testing
 Corey Bliss



Principal Stakeholders
 Ogden Air Logistics Center
 Oklahoma City Air Logistics Center
 Warner Robins Air Logistics Center
 NAVAIR Depot Jacksonville
 USCG Aircraft Repair and Supply Center







Subcontractor
 Bayer Material Science/Deft





Subcontractor
 DSM Desotech





Technical Approach

Project Approach



Task III – Technology Transition

- Modify specifications and technical orders/manuals
- Transition equipment to OO-ALC and train staff
- Compare performance versus baseline data
- Prepare Final Cost & Performance and Final Reports
- Prepare Final Briefing

Task II – Demonstration/Validation

- Make final selection of coatings for dem/val (*complete*)
- Conduct lab testing and optimization (*in-progress*)
- Conduct field testing

Task I – Planning for Demonstration/Validation

- Draft Project Management Plan (PMP) (*complete*)
- Conduct Initial Cost-Benefit Analysis (ICBA) and Performance Baseline (*in-progress*)
- Draft Joint Test Protocol (JTP) (*complete*)
- Draft Demonstration Plan (*in-progress*)



Performance Baseline



• Hill Air Force Base

C-130

- Escape hatches
- Life raft covers
- Landing gear door
- Rudders
- Prop tips
- Stenciling

F-16

- Flaperons
- Horizontal stabilizers
- Stenciling



■ USCG Elizabeth City

HH-60 (primary)

- Doors
- External fuel tanks
- Stenciling

HU-25

- Panel covers
- Stenciling



■ NAVAIR Jacksonville

- Off-aircraft components
- Avionics
- Stenciling





Joint Test Protocol

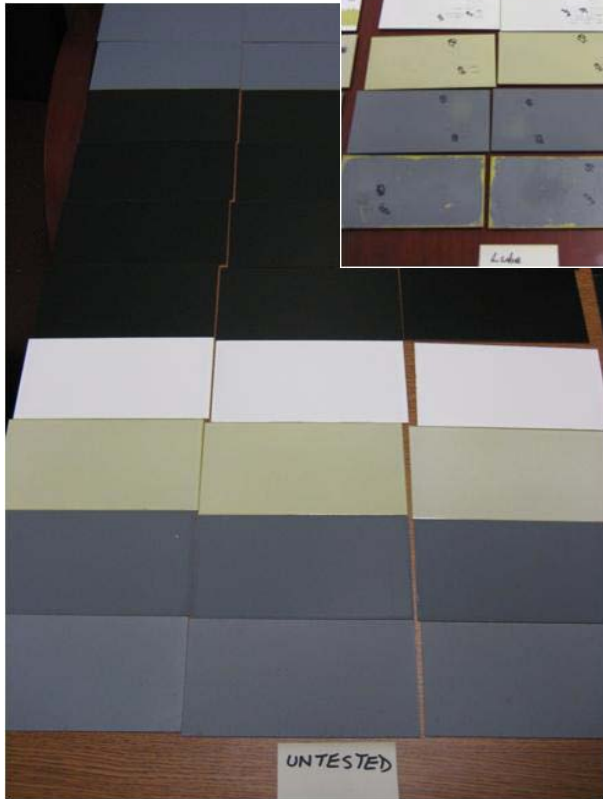
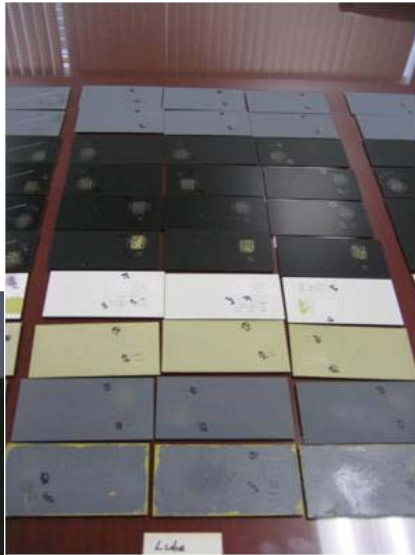


- **Based on MIL-PRF-85285 / MIL-PRF-32239**
 - **Adhesion**
 - **Flexibility**
 - **Color/gloss match**
 - **Color/gloss retention**
 - **Fluid resistance**
 - **Repairability**
 - **Strippability**

Appearance	
Color	ΔE of less than 1 from standard
Gloss	At 60°: ≥ 90 for gloss; ≤ 5 for flat;
Adhesion	
Wet Tape	No peel away; target rating of 4A or 5A
Cross Hatch	No peel away; target rating of 4B or 5B
Flexibility	
Low Temperature	No cracking or adhesion loss over 1 inch bend (gloss and semi-gloss) or 2 inch bend (flat)
GE Impact	Minimum of 40% elongation; no cracking, crazing, or loss of adhesion
Resistance	
Pencil Hardness	2B or harder; initial hardness - data point for fluid resistance
Fluid Resistance	Softening no more than two (2) pencil hardness unit; no blistering or defects after exposure to lube oil, hydraulic fluid and JP-8 fuel
Resistance	
Accelerated Weathering (Color and Gloss)	Color change (ΔE) of less than 1 after 200 hours; Min gloss of 90 for gloss; max five (5) for flat
Heat Resistance	Color change (ΔE) of less than 1 after exposure to 250 \pm 5°F for 60 minutes
Humidity Resistance	No blistering, softening, loss of adhesion or defects
Cleanability	Cleaning Efficiency $\geq 75\%$
Repairability	
Scuff sand /Wet Tape	No peel away; target rating of 4A or 5A
Scuff sand /Cross Hatch	No peel away; target rating of 4B or 5B
Strippability	
Chemical Strippers	Removal of the coating to the substrate
Dry Media (blasting)	Removal of the coating to the substrate



Coating Selection





Selection Results



- **Analysis**
 - Flat black coatings nearly match controls
 - Gloss coatings require more work
 - Flexibility, gloss, and color retention require the most developmental work
- **Follow-up**
 - Reformulate coatings
 - Test IAW JTP



Selected Coatings



Color		Usage	
Camo Black	37038		Aircraft Markings
Camo Gray	36118	B-52, HH-60, F-16	Exterior Topcoat F-16 Markings
Camo Gray	36173	C-17, C-130, KC-135	Exterior Topcoat
Gloss White	17860	Coast Guard White	Exterior topcoat
Gloss White	17925	Air Force White	Landing Gear



Demonstration Activities



- **Lab testing IAW JTP - June 2009**
- **Field application and demonstration - fall 2009**
 - **Time savings**
 - **Environmental savings**
 - **Ease of use**
- **Monitor at aircraft at home stations for one year**
 - **Visual appearance**
 - **Color/gloss stability**
 - **Adhesion**
 - **Fluid resistance**



Technology Transition

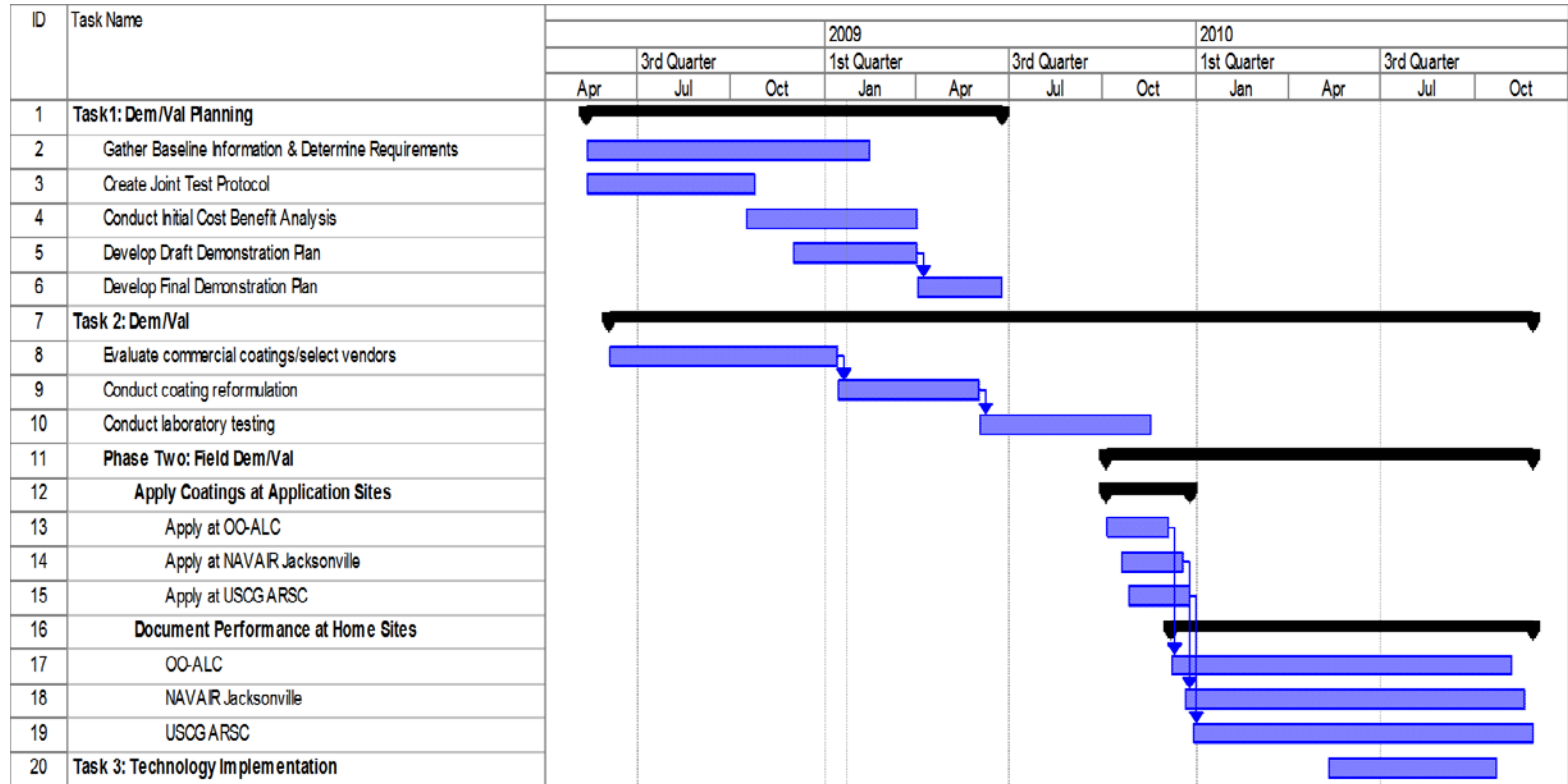


- **Initial transition - Hill AFB**
- **Update technical documentation**
 - **General series and weapon system specific technical orders/manuals**
 - **Performance specifications**
- **Transition UV application and curing equipment**
- **Train site personnel**





Project Timeline





Summary



- **Coatings and potential applications identified**
- **Reformulation activities underway**
- **Lab testing and field demonstrations in 2009**
- **Field evaluation 2009-2010**
- **Implementation upon successful demonstration**



Related Efforts



- **Continued evaluation of reformulated UV-curable primers, one-coats, and systems**
- **Evaluation of UV lamp technology from USAF needs perspective**
- **UV-curable rain erosion coating technology search**
- **Large area applications**



Points of Contact



- **USAF Environmental & Energy Quality Team**
 - **Randy Straw**
 - randall.straw@wpafb.af.mil (937) 255-5598
- **USAF Coatings Technology Integration Office (CTIO)**
 - **Mr. Corey Bliss**
 - Corey.bliss@wpafb.af.mil (937) 255-0943
- **Concurrent Technologies Corporation**
 - **Ms. Georgette Nelson**
 - nelsong@ctc.com (412) 992-5355