

# Large Aircraft Coatings Flight Testing

## ***Background:***

The advent of the National Emission Standard for Hazardous Air Pollutants (NESHAP) and the associated requirements for minimal release of hazardous air pollutants have compelled the U.S. Air Force to adopt the use of paints with reduced Volatile Organic Compounds (VOCs). Self-Priming Topcoat, TT-P-2756, formerly used on the exterior of the KC-135s, was not performing satisfactorily with regards to adhesion, corrosion resistance, weatherability, and cleanability. The High Performance Aerospace Coating System (HPACS) project conducted by AFRL/MLS and the CTIO during 1995-1997 studied 23 coating systems. Manufacturers proclaimed these systems offered vastly improved performance. The study identified four paint systems with improved film properties: System 23 from US Paint, System 6 from PRC-DeSoto (Courtaulds Aerospace), System 14 from Spraylat, and System 3 from Sherwin-Williams.

**Project Sponsor/Customer:** OC-ALC; KC-135 SPD; AMC; ANG

**Period of Performance:** Apr 98 – Jul 00

## ***Objective:***

The objective of this study was to apply these systems to test aircraft and then monitor the performance of these four improved systems. Operational test sites were selected which represent environments that are severely corrosive, marine, and receive high UV radiation. Test aircraft were stationed at MacDill AFB, FL, Kadena AB, Japan and Hickam AFB, HI. These bases are designated as severe corrosive environments in T.O. 1-1-691, requiring a clear water rinse after the last flight of the day and a wash every 30 days for aircraft stationed at these locations. The Deft system from GSA, MIL-P-23377G and MIL-PRF-85285C, were used as a control. In addition, Advanced Performance Coating (APC), a urethane fluoropolymer topcoat from Deft, was added to the monitoring. The table below summarizes the coating systems.

Vendor	HPACS	Epoxy Primer	Polyurethane Topcoat
Deft	GSA*	02-Y-40	03-GY-321
PRC-DeSoto (Courtaulds)	System 6**	513X423C/530K015/ 930K118	832G062/930G052
Sherwin-Williams	System 3	E90G203/V93V230	F93A27/V93V26/V93V1
Spraylat	System 14	EEAE 145A/B	EUBC 105B
US Paints	System 23	S9800/K8032	Awlgrip H.S.
Deft	APC (Advanced Performance Coating)	02-Y-40	99-GY-1
3M	Applique	02-Y-40	03-GY-321 + Applique

**Status:**

Two KC-135s were painted at OC-ALC: one aircraft from MacDill AFB FL, was coated with a system from US Paint, the other aircraft, assigned to Kadena AB, Japan, had the upper surface of the left wing coated with APC (urethane fluoropolymer topcoat from Deft); applique was applied over topcoat to areas of the right wing and a portion of the fuselage. Two KC-135s based at Hickham AFB, HI, were divided in the middle of the fuselage and refinished with different paint systems on each side at Sacramento ALC. One aircraft was coated with paint systems from Deft and PRC-DeSoto (Courtaulds), the other was coated with paint systems from Spraylat and Sherwin-Williams.

The last inspection of the MacDill AFB test aircraft accomplished under this project was in February 1999. This KC-135 had logged 737.2 flight hours and 21 months of environmental exposure since being painted. The aircraft had recorded 408.9 flight hours and 12 months of Florida exposure between the initial and last inspection. Visually, little corrosion and paint defects were noted. Considering the months of exposure, it was considered performing the best, although it exhibited fading and moderate chalking.

The latest inspection of the KC-135s at Hickam AFB, HI, shows the Sherwin-Williams (10 months, 328.7 flight hours) coating system to possess the best appearance, visually, followed by Deft (17 months, 612.9 flight hours), Spraylat (10 months, 328.7 flight hours), and PRC-DeSoto (Courtaulds) (17 months, 612.9 flight hours). The PRC-DeSoto (Courtaulds) system has exhibited unacceptable chalking.

The APC system (8 months) has the best appearance, but the least amount of exposure.

Testing was conducted as outlined in the Operational Test Plan dated August 1997, during the inspections by the CTIO team. The tests included:

TEST	REFERENCE	LOCATIONS
PATTI adhesion (modified)	ASTM D 5179	5-10 per coating system*
Pencil Hardness	ASTM D 3363	5-10 per coating system*
Wet Tape Adhesion	FTMS 141, Method 6301	5 per coating system*
Chalking (modified)	ASTM D 4214, Test Method C	5 per coating system**
Dry Film Thickness		≅ 45 per aircraft***
Gloss, 60° and 85°	ASTM D 523	≅ 45 per aircraft***
CIELab Color (10° observer, D65 illuminant, specular exclusive)	ASTM D 2244	≅ 45 per aircraft***

Preliminary data shows the US Paints system to exhibit improved weatherability over the Deft control judged by the gloss and color stability as well as appearance. Limited exposure data shows Sherwin-Williams to possess improved appearance over the Deft control, but experience has shown exposure of 18 to 24 months is required to differentiate between coating systems.

The CTIO Project Management team recommended continued monitoring of these paint systems. To date additional monitoring has not been possible but future monitoring is planned if cost effective.

**Final Report:** Titled: "Large Aircraft Coatings Flight Testing"

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**Dated:** Feb 2000

**As of Date:** Feb 01

**Report Number:** AFRL-ML-WP-TR-2000-4118