Coatings Technology Integration Office (CTIO) Coating Systems Baseline

Background:

In response to legislative mandates such as the National Emission Standard for Hazardous Air Pollutants (NESHAP) to reduce pollutants generated by aircraft refinishing operations, the United States Air Force is currently investigating numerous pollution prevention and reduction strategies covering the entire spectrum of the aircraft refinishing process. This process includes all of the chemicals, methods, and equipment currently employed to remove coatings, clean and prepare the surface prior to applying new coatings, and maintain the applied coatings. The current coating systems on USAF aircraft have been optimized for their performance not their environmental impact. Therefore, changing any aspect of a coating system in an effort to reduce pollution may gravely affect the performance of the overall coating. A coating system is defined as the unique combination of cleaners, etchants, conversion coatings, wipe solvents, primers, and topcoats used to apply coatings to an aerospace substrate. Henceforth, the performance of the coating systems currently used by the Air Force should be documented prior to any changes being implemented.

Currently, coating system materials/components are tested and qualified individually only at standard laboratory conditions i.e. 77°F and 50% relative humidity. Unfortunately, the Air Force specifications overlook the effects of temperature and humidity on the performance of the coating components. Additionally, as various vendor's coating components (i.e. primers, topcoats, surface treatments) are mixed to create the final coating system, the performance of the overall coating is unpredictable.

The CTIO Coating Systems Baseline project was designed to examine the performance characteristics of USAF aircraft coating systems under a broad range of application conditions of temperature and humidity. It has long been suspected through empirical evidence that different vendor's products, although qualified to the same government specification, can be incompatible with another vendor's coating system component. In addition, the affects of temperature and humidity on a given component's performance can be unpredictable and can vary greatly, depending on each vendor's specific formulations. Thus in order to resolve field coating system problems, it is necessary to

use precisely the same materials, applied in the same manner, under the same environmental conditions at the field location.

The data derived from this project is an invaluable resource as Air Force aircraft paint facilities change to more environmentally friendly materials to comply with pollution prevention directives.

Project Sponsor/Customer: Air Force wide
Period of Performance: Sep 96 – May 01

Objective:

The CTIO's Coating Systems Baseline project will evaluate the performance characteristics of various combinations of the current coating system components at a range of environmental conditions selected to bracket those experienced at the field units. The raw data will be incorporated into a Coating System Performance Database thereby assisting aircraft refinishing operations in optimizing the performance of current coating systems and evaluating future coating system modifications especially those developed in response to non-performance based issues i.e. pollution prevention and/or reduction.

The project's goals comprise of three phases:

1. Phase 1: Identify the materials in use for refinishing USAF aircraft to include vendor specific cleaners, solvents, surface treatments, primers, and topcoats, and obtain sufficient quantities of each material to complete the project. A test matrix was derived from the ALC Baseline Survey conducted in 1995 and updated in 1997 of current aircraft coating systems used at the Air Logistics Centers (ALCs) and their local environmental conditions during application. 21 coating systems comprise the Test Matrix, the first 20 systems represent permutations of the preparation schemes and coating materials currently in use at the ALC paint facilities. The 21st system is the CTIO lab coating system and serves as the control. Only coating materials from the two most prevalent vendors, Deft and Courtalds, will be evaluated. Vendor specific cleaners, deoxiders, and conversion coating chemicals were included. Selected test equipment and procedures were used for testing the aircraft coating systems. A series of Test Matrix panels were prepared and tested under the mid-range, lab

standard, values of temperature and humidity (i.e. 77°F and 50% RH). The coatings in the test matrix include the following:

- MIL-P-23377G, Type 1, Class C Epoxy Primer (High Solids) Deft and Courtaulds
- MIL-P-23377G, Type 2, Class C Epoxy Primer (HS, Low IR) Deft and Courtaulds
- MIL-P-23377F, Type 1, Class 1 Epoxy Primer Deft and Courtaulds
- TT-P-2760A, Type 1, Class 1 Polyurethane Primer Courtaulds only
- 513-X423 Epoxy Primer (High Solids) Courtaulds
- MIL-C-85285B, Type 1 Topcoat (low gloss) color-36173 Deft and Courtaulds

2. Phase II: Produce a series of replicate-coated test samples under five environmental conditions (EnCons) of temperature and humidity (see table below) that brackets the range of conditions experienced at ALC and field locations. Baselining was completed for selected test equipment and CTIO procedures. An Access database was developed to store and retrieve the collected data.

Environmental Conditions (EnCons) Selected for Testing			
EnCon	**Climate Type**	**Temperature**	**Relative Humidity**
1	Lab Standard	77° F	50 %
2	Hot Humid	90° F	80 %
3	Hot Dry	90° F	20 %
4	Cool Dry	60° F	20 %
5	Cool Humid	60° F	80 %

3. Phase III: Test the performance of each coating system produced at each in regards to color, gloss, adhesion, flexibility, fluid resistance, weathering resistance and corrosion resistance.

Status:

Performance data for the 21 coating systems prepared at 77°F @ 50% RH (i.e. “optimal condition”) have been collected and evaluated. Preliminary results were presented at the 1999 DoD/Aerospace Coatings Conference. Preliminary analysis indicates a marked performance difference between the chemical conversion coatings used with

the Alodine 1200 system being the most robust and offering the best protection. Project results will be available in mid 2001.

Project Plan: Dated Jun 98, Oct 99
Test Plan: Dated Jul 98, Jul 99
Final Report: Completed Dec 2001
As of Date: Apr 01