

**Engineering and Technical Services for
Joint Group on Pollution Prevention
(JG-PP) Projects**

Field Evaluation Report XXI:

**Inspection of Aircraft
for Validation of Alternatives to
Chromate-Containing Primer Coatings
for Aircraft Exterior Mold Line Skins**

July 11, 2000

Distribution Statement "A" applies.
Approved for public release; distribution is unlimited.

Contract No. DAAA21-93-C-0046
Task No. N.072
CDRL No. B001

Prepared by:
National Defense Center for Environmental Excellence
Operated by: Concurrent Technologies Corporation
100 CTC Drive
Johnstown, PA 15904

This interim report is a presentation of preliminary findings, subject to revisions. Neither the United States Government nor the United States Department of Defense nor any of their employees nor the Boeing Company make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, product, or process disclosed. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement or recommendation by the United States Government or the Boeing Company. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the Boeing Company and shall not be used for advertising or product endorsement purposes. At the conclusion of the testing, the final findings will be published in this project's final Joint Test Report, expected to be published in early 2002.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY.....	ii
1. INTRODUCTION.....	1
2. BACKGROUND ON OPERATIONAL TESTING.....	2
3. INSPECTION RESULTS	2
4. SUMMARY	5

LIST OF TABLES

Table 1. Inspection and Flight Hour Data	2
Table 2. Color Data	4
Table 3. 60° Gloss Data.....	5

LIST OF FIGURES

Figure 1. C-130 #62-1811 Right-Hand Horizontal Stabilizer	3
Figure 2. C-130 #62-1811, Typical Locations of Gloss and Color Readings (Right and Left Sides).....	4

EXECUTIVE SUMMARY

At the Boeing Company Military Aircraft and Missile Systems Group pilot site (formerly McDonnell Douglas Aerospace) located in St. Louis, Missouri, chromium in primer coatings was identified as the target hazardous material to be eliminated or reduced. The chromate primers are applied to aircraft exterior mold line skins by wet-spray coating. The main substrate is aluminum alloy that has been anodized or chromate conversion coated, but other substrates such as steel, carbon epoxy, and titanium are also present on aircraft exterior surfaces and will be coated by these primers. The participants selected Dexter Aerospace Materials/Crown Metro Aerospace 10PW22-2/ECW-119 and PRC-DeSoto (formerly Spraylat Corporation) EWAE118 A/B for field evaluations on operating aircraft and missile canisters.

This field evaluation report documents the performance of the PRC-DeSoto EWAE118 primer on sections of a C-130 (#62-1811) after three months of service. Areas primed with the nonchromate primer in March 2000 were the right-hand horizontal stabilizer, the right-hand side of the vertical stabilizer, and an area of the fuselage aft of the jump door, approximately three feet wide by four feet high. All other areas of the aircraft exterior (except the control surfaces) were primed with chromate primer starting one hour after nonchromate primer application. The aircraft is assigned to the Channel Islands Air National Guard, Port Hueneme, CA.

C-130 #62-1811 was inspected on June 20, 2000. After three months and 44 flight hours the coating system is in excellent condition, except for an area with small blisters near the edges of sealer-filled butt joints. The location of blisters around the perimeter of the cover and on the adjacent skin is indicative of contamination of the surface prior to painting. Squadron maintenance personnel were made aware of the blisters and they committed to repairing the area using the nonchromate test primer.

1. INTRODUCTION

The Joint Logistics Commanders (JLC) and Headquarters National Aeronautics and Space Administration (NASA) co-chartered the Joint Group on Pollution Prevention (JG-PP) to coordinate joint service/agency activities affecting pollution prevention issues identified during system and component acquisition and sustainment processes. The primary objectives of the JG-PP are to:

- Reduce or eliminate the use of hazardous materials (HazMats) at manufacturing, remanufacturing, and sustainment locations
- Avoid duplication of efforts in actions required to reduce or eliminate HazMats through joint service cooperation and technology sharing.

JG-PP projects typically involve an original equipment manufacturer (OEM) producing multiple defense systems for more than one of the Services, as well as at least one depot servicing one or more of the defense systems. JG-PP technical representatives for each project begin by selecting a target HazMat that is used in the production or sustainment processes and may cause environmental and/or worker health concerns. Project participants then identify alternative technologies for evaluation.

At the Boeing Military Aircraft and Missile Systems Group pilot site (B-A&M) located in St. Louis, Missouri (formerly McDonnell Douglas Aerospace), chromium in primer coatings was identified as the target HazMat to be eliminated or reduced. The chromate primers are applied to aircraft exterior mold line skins by wet-spray coating. The main substrate is aluminum alloy that has been anodized or chromate conversion coated, but other substrates such as steel, carbon epoxy, and titanium are also present on aircraft exterior surfaces and will be coated by these primers.

The project technical representatives reached consensus on the critical technical and performance requirements that an alternative must satisfy to be qualified for use in the identified application. These requirements were documented in the *Joint Test Protocol (MD-P-1-1) for Validation of Alternatives to Chromate-Containing Primer Coatings for Aircraft Exterior Mold Line Skins*, dated December 23, 1997. The *Potential Alternatives Report (MD-A-1-1) for Alternatives to Chromate-Containing Primer Coatings for Aircraft Exterior Mold Line Skins*, dated May 1, 1998, provides a list of alternatives recommended for testing.

The testing was executed in three phases: two phases of laboratory testing and one of field evaluation. The *Joint Test Report (MD-R-1-1) for Laboratory Validation (Testing) of Alternatives to Chromate-Containing Primer Coatings for Aircraft Exterior Mold Line Skins*, dated February 24, 1998, documents the laboratory testing accomplished on the potential alternatives. The results of the laboratory testing were analyzed to select a limited number of nonchromate primers to be applied to operating aircraft to allow further evaluation of the nonchromate primers. After examining the test panels and analyzing the test results, the project participants selected Dexter Aerospace Materials

10PW22-2/ECW-119 and PRC-DeSoto EWAE118A/B for field evaluations on operating aircraft.

2. BACKGROUND ON OPERATIONAL TESTING

Operational testing was originally scheduled for completion in December 1999. In September 1999 the project participants elected to extend the operational testing phase for two additional years, through December 2001. The rationale for the extension was to observe the effects of additional six-month sea deployments on the seven F/A-18 test aircraft and to expand the operational testing to include additional test units. Additional test units include the C-130 described in this report, two F-15s painted in February 2000, and a C-17 scheduled to be painted in July 2000.

This field evaluation report documents the performance of the PRC-DeSoto EWAE118 primer on sections of the C-130 after three months of service. Areas primed with the nonchromate primer were the right-hand horizontal stabilizer, the right-hand side of the vertical stabilizer, and an area of the fuselage aft of the jump door, approximately three feet wide by four feet high. All other areas of the aircraft exterior (except the control surfaces) were primed with chromate primer starting one hour after nonchromate primer application. The aircraft is assigned to the Channel Islands Air National Guard, Port Hueneme, CA.

Table 1. Inspection and Flight Hour Data

Aircraft #	Date Painted	Flight Hours When Painted	Flight Hours on 20 Jun 2000	Flight Hours Since Painted
62-1811	March, 2000	20,104.4	20,149.1	44.7

The inspection team for this inspection included:
Gene Bishop, Air Force Research Laboratory (AFRL)/MLS-OLR
F. D. Kisor, AFRL-WL/MLSS
Steve Finley, Air Force Coatings Technology Integration Office
Duane Utter, PRC-DeSoto International
Larry Triplett, B-A&M

Larry Triplett, Boeing, Aircraft & Missiles Systems Group prepared these inspection results and summary.

3. INSPECTION RESULTS

Except for one area of blisters around an access cover on the upper surface of the right-hand horizontal stabilizer (see Figure 1), the coating system was intact on the test and control areas. There were no indications of erosion, corrosion or peeling paint.

The blisters found on the nonchromate primer surfaces were all confined to within 0.4 inch of the edges of sealer-filled butt joints. Blisters were approximately 0.2 inch to 0.3 inch in diameter, and the paint film was not broken. During the inspection some blisters were broken and peeled away to inspect the substrate. There was no evidence of corrosion or visible contaminants present under the blisters. The location of blisters around the perimeter of the cover and adjacent to a skin is indicative of contamination of the surface prior to painting.

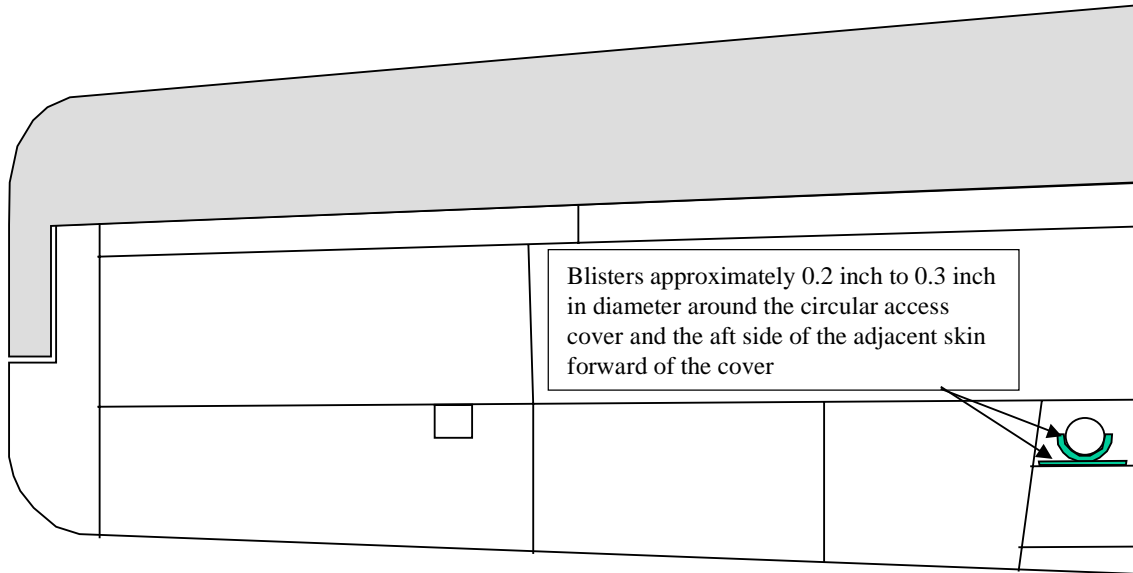


Figure 1. C-130 #62-1811 Right-Hand Horizontal Stabilizer

For documentation purposes it was noted that the anti-skid walkway coating on the upper surface of the left-hand horizontal stabilizer was not uniform. Filler material was concentrated in several areas, resulting in thick clumps of coating toward the center and outboard end.

Color and gloss readings were taken at the same locations as those recorded after painting in February with insignificant changes since the initial readings. Figure 2 shows the general locations of the color and gloss measurements. Table 2 documents the changes between the initial color readings and those recorded during this inspection, while Table 3 documents changes in gloss readings. There was no evidence of paint application since the aircraft left the paint facility, therefore coating thickness was not measured.

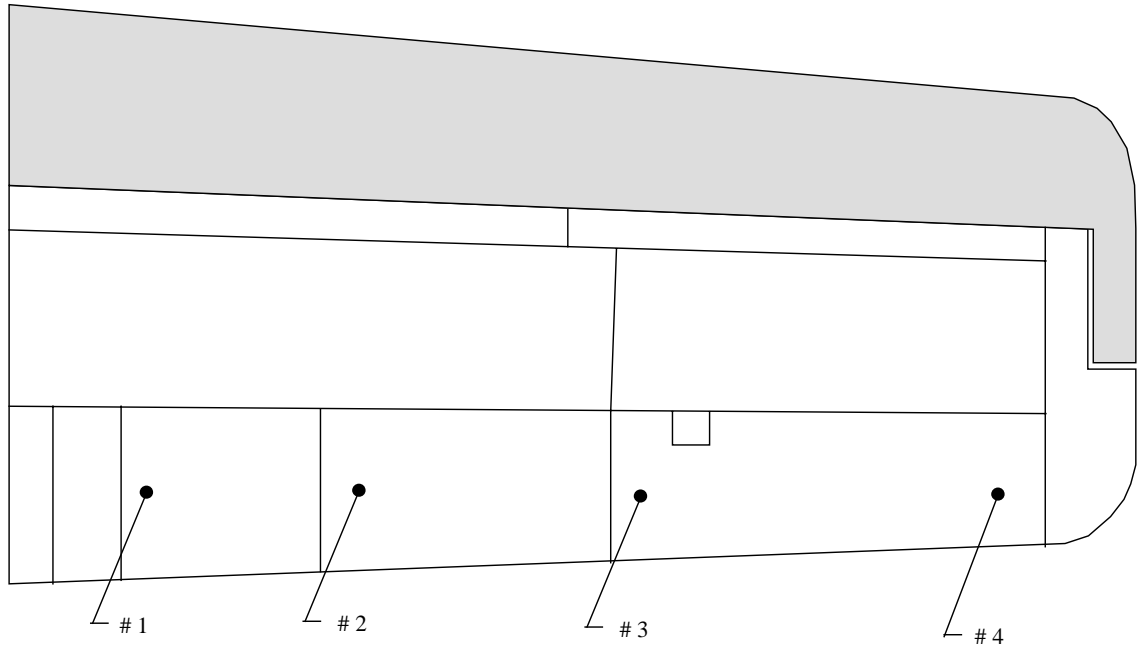


Figure 2. C-130 #62-1811, Typical Locations of Gloss and Color Readings (Right and Left Sides)

Table 2. Color Data

Location	Delta*			
	ΔL	Δa	Δb	ΔE
R/H 1	-0.97	0.00	0.27	1.01
R/H 2	-0.88	0.07	0.48	1.00
R/H 3	-0.78	-0.08	0.33	0.85
R/H 4	-0.48	-0.05	0.27	0.55
L/H 1	-0.66	0.13	1.11	1.30
L/H 2	-0.64	0.05	0.77	1.00
L/H 3	-0.66	0.01	0.47	0.81
L/H 4	-0.63	-0.03	0.80	1.02

* Deltas are differences between the initial readings after painting and inspection readings, actual readings omitted for brevity.

Table 3. 60° Gloss Data

Location	Initial 3-13-00	1st Insp. 6-20-00	Delta
R/H 1	2.1	1.3	-0.8
R/H 2	2.7	1.4	-1.3
R/H 3	2.7	1.5	-1.2
R/H 4	2.2	1.4	-0.8
L/H 1	2.6	1.5	-1.1
L/H 2	2.7	1.5	-1.2
L/H 3	2.1	1.4	-0.7
L/H 4	2.4	1.3	-1.1

4. SUMMARY

After three months and 44 flight hours the coating system is in excellent condition, as expected, except for the area with small blisters. Squadron maintenance personnel were made aware of the blisters and they committed to repairing the area using the nonchromate test primer. The inspection team made a specific request to treat the area with chromate conversion coating prior to application of primer.

The aircraft will be inspected at six-month intervals through 2001 with the next inspection occurring in November or early December.