

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

Field Evaluation Report XIX:

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

March 24, 2000

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

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EXECUTIVE SUMMARY

At the Boeing Company Military Aircraft and Missile Systems Group 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.

Two F-15 aircraft were used for the field evaluations. These aircraft, numbers 79-011 and 81-024, were originally painted for this field evaluation in June and July of 1997 at Warner Robins Air Logistics Center. Both aircraft are assigned to the Aerial Education and Training Command and have been on station at Tyndall Air Force Base, Florida, since their return from the depot. Dexter 10PW22-2/ECW-119 waterborne nonchromate primer was applied to the upper and lower surfaces of the right wing of each aircraft. The remainder of each aircraft was primed with high-solids chromate (MIL-P-23377) primer. The coatings on each aircraft were repaired in March and April of 1999, as documented in *Field Evaluation Report (FER) XI: Inspection of Aircraft for Validation of Alternatives to Chromate-Containing Primer Coatings for Aircraft Exterior Mold Line Skins*, dated May 19, 1999.

The aircraft were inspected on February 15, 2000. All of the defects were relatively minor except for adhesion failures on the inboard edge of the lower right-hand wing. These adhesion failures were at the intersection of the wing to fuselage where the chromate and nonchromate primer met. Two of these defect areas were chromate primer failures and one failure involved the nonchromate primer.

Most of the defects on the leading edges were due to mechanical damage and erosion with little difference in overall surface area of defects between the wings primed with nonchromate and chromate primers. It is important to note that adhesion failures on the titanium surfaces of aircraft #79-011 occurred within six months after the original painting (see FER I, dated May 22, 1998). By the 12-month inspection (see FER IV, dated September 14, 1998), these adhesion failures had grown to the extent that touching up those coating defects was recommended. Conversely, ten months after complete repair of the wing coating (see FER XI), the paint on the underside of the wing has not failed.

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 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

10PW22-2/ECW-119 and PRC-DeSoto (formerly Spraylat Corporation) EWAE118 A/B for field evaluations on operating aircraft.

A total of seventeen test units were fielded to evaluate operational performance of nonchromate primer. Test units consist of two F-15s, eight F/A-18s, four T-45s, one AV-8B aircraft, and two Harpoon missile canisters. Field evaluation reports (FERs) are written after each inspection. This FER documents the performance of Dexter 10PW22-2/ECW-119 nonchromate primer on two F-15 aircraft at Tyndall Air Force Base, Panama City, Florida. Both aircraft, numbers 79-011 and 81-024, are assigned to the Aerial Education and Training Command and have been on station there since their return from the depot. The results of all field evaluations will be consolidated and reported in a subsequent JTR, *Joint Test Report (MD-R-1-2) for Field Evaluation and Validation of Alternatives to Chromate-Containing Primer Coatings for Aircraft Exterior Mold Line Skins* (in preparation).

2. BACKGROUND ON OPERATIONAL TESTING

As part of the JG-PP and Boeing effort to identify suitable nonchromate primers for application to aircraft exterior mold line skins, nonchromate primer has been applied to portions of operating aircraft by wet-spray techniques. The following text and sketches documents the results of the Dexter nonchromate primer performance on aircraft #79-011 and #81-024. Both aircraft were painted at Warner Robins Air Logistics Center in the summer of 1997.

All exterior surfaces of two aircraft, except for composite and honeycomb components, were stripped with type 5 plastic media followed by light hand sanding prior to entering the paint booth.

Dexter 10PW22-2/ECW119 nonchromate primer was applied to the upper and lower surfaces of the right-hand wings. The remainder of each aircraft was primed with chromate MIL-P-23377 primer (Deft 02-Y-40). The topcoats applied were MIL-C-85285 products manufactured by Deft.

As previously reported (FER XI dated May 19, 1999) both aircraft received paint repairs in the spring of 1999 to correct paint defects on both wings. Aircraft # 81 024 was completely over-coated including the fuselage. Aircraft 79-011 was only repainted where paint defects were present, primarily the leading edges of both wings and the under side of the right-hand wing.

Table 1. Inspection Data for F-15 Test Aircraft

Aircraft #	Date Painted	Flight Hours When Painted	Flight Hours on 15 Feb. 2000	Flight Hours Since Painted
81-024	June, 1997	3,815.2	4,338.8	523.6
79-011	August, 1997	4,649.3	5,346.8	697.5

The inspection team for this inspection included:

- Gene Bishop, Air Force Research Laboratory (AFRL)/MLS-OLR
- F. D. Kisor, AFRL-WL/MLSS
- Larry Gold, Dexter Corporation
- Larry Triplett, B-A&M

Larry Triplett, B-A&M, prepared these inspection results and summary.

3. INSPECTION RESULTS

Upper and lower surfaces of the left-hand wing of F-15 #81-024 and both wings of F-15 #79-011 were inspected on February 15, 2000.

3.1. Inspection Results for Aircraft #81-024

At the July 1999 inspection it was noted that the left-hand wing (with the chromate control primer) had been removed and replaced. Due to the removal of the control wing, only results for the right-hand (nonchromate) wing are documented below.

This aircraft has logged only 16.8 flight hours since the inspection performed in July 1999 and there were minimal changes from previous inspection. The small blister noted on the previous inspection was touched-up as shown in Figure 2. There were minor areas of mechanical damage on the leading edge and upper wing skin.

Peeling paint along the inboard most edge of the lower wing was not present at the last inspection. Two of the areas were chromate primer peeling from the substrate and one area was nonchromate primer (see Figure 2). Large areas of the under-wing area were wet with fuel but no paint defects were present in the wetted area.

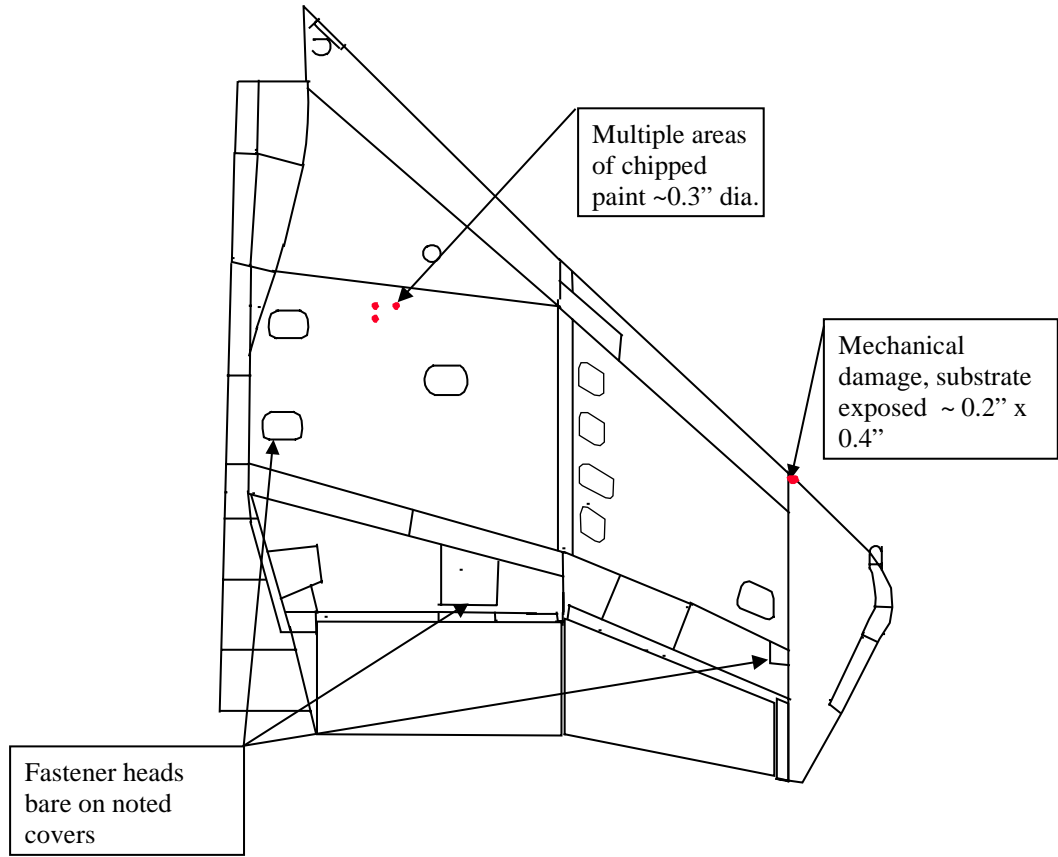


Figure 1. F-15 #81-024, Looking Down at Right-Hand Wing

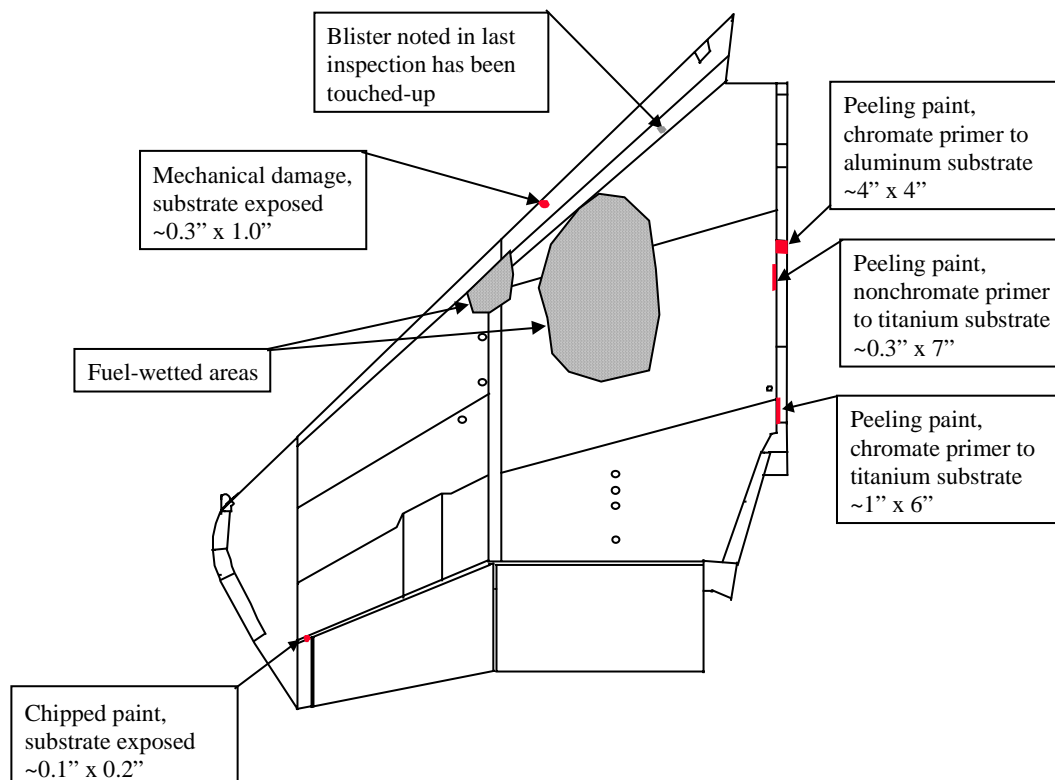


Figure 2. F-15 #81-024, Looking Up at Right-Hand Wing

3.2. Inspection Results for Aircraft #79-011

Inspection results are detailed below for the left and right wings of aircraft #79-011. The left-hand wing of aircraft #79-011 was primed with chromate primer, and the right-hand wing of aircraft #79-011 was primed with nonchromate primer.

3.2.1. Inspection Results for the Left-Hand Wing

The upper surface had several areas of chipped paint. Much of the defects appeared to be due to mechanical damage. Paint was also missing from most of the fastener heads on removable covers with most due to cover removal. However, several fastener heads were bare with no signs of fastener or cover removal indicating poor adhesion to the fasteners (see Figure 3).

There were multiple areas of exposed aluminum substrate on the leading edges. Some of the paint failures were due to obvious mechanical damage and some due to erosion.

There were several area of chipped paint on the lower wing skins due to mechanical damage and one small area of peeling paint.

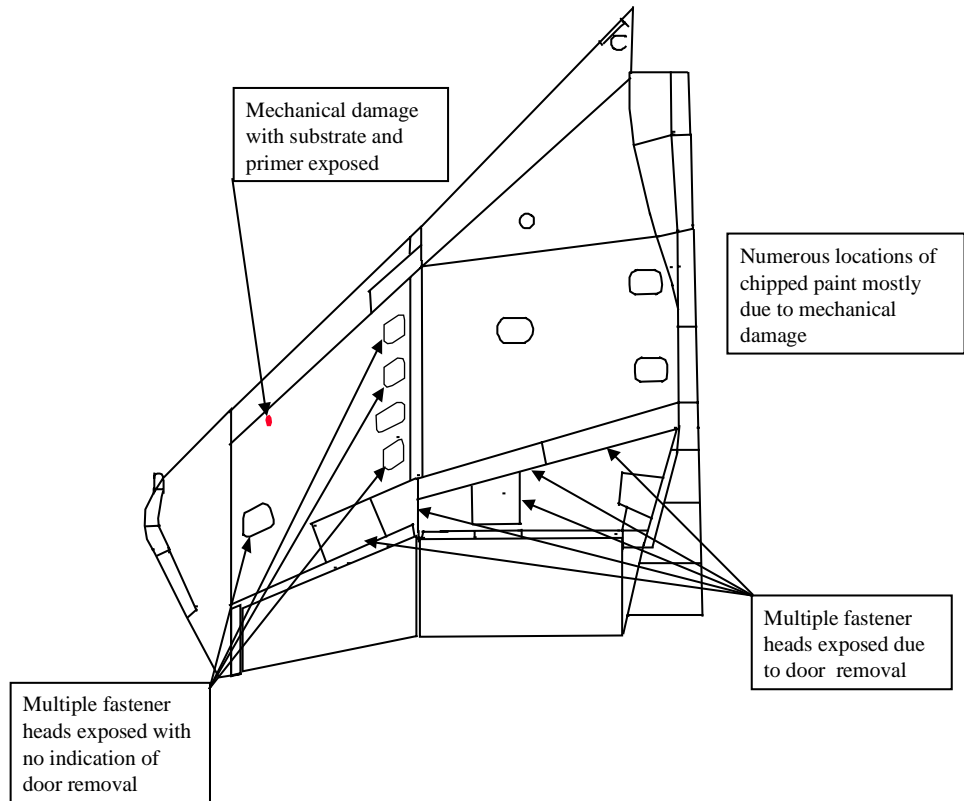


Figure 3. F-15 #79 011, Looking Down at Left-Hand Wing

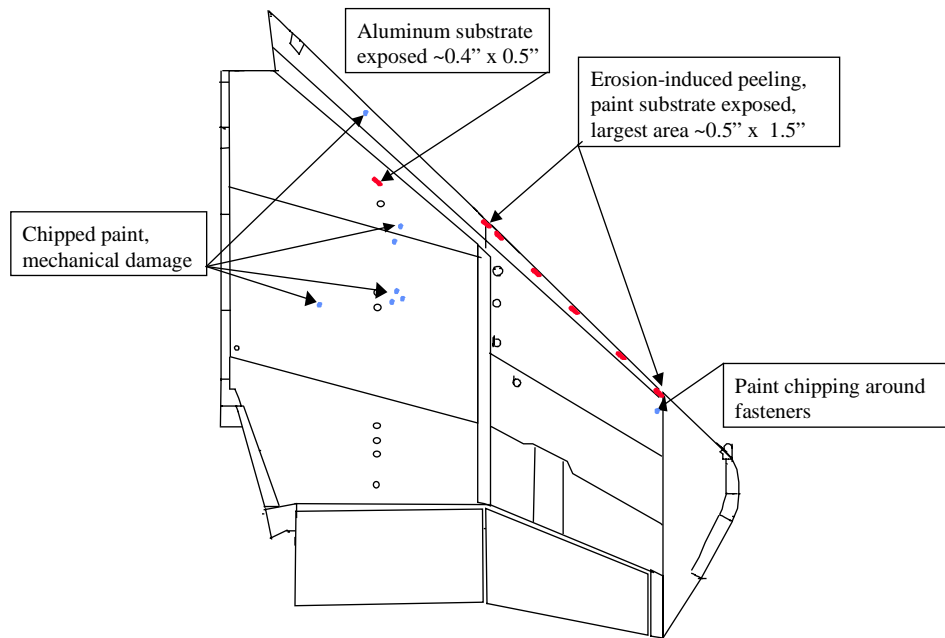


Figure 4. F-15 #79 011, Looking Up at Left-Hand Wing

3.2.2. Inspection Results for the Right-Hand Wing

There were several bare fasteners on the upper surface, similar to the left-hand wing. The fasteners were not touched-up when the paint repairs were performed in April 1999. There were fewer areas of erosion/peeling on the leading edge of the right-hand wing than on the left-hand wing, but the wing tip had a larger erosion/peeling area than any location on the left wing (see Figure 5).

The peeling paint on the titanium aileron actuator cover (see Figure 6) was noted at the last inspection and has grown in size. The failure is chromate MIL-P-23377 primer that was likely applied by the squadron prior to the paint repairs in April 1999, or the actuator cover was replaced by the squadron.

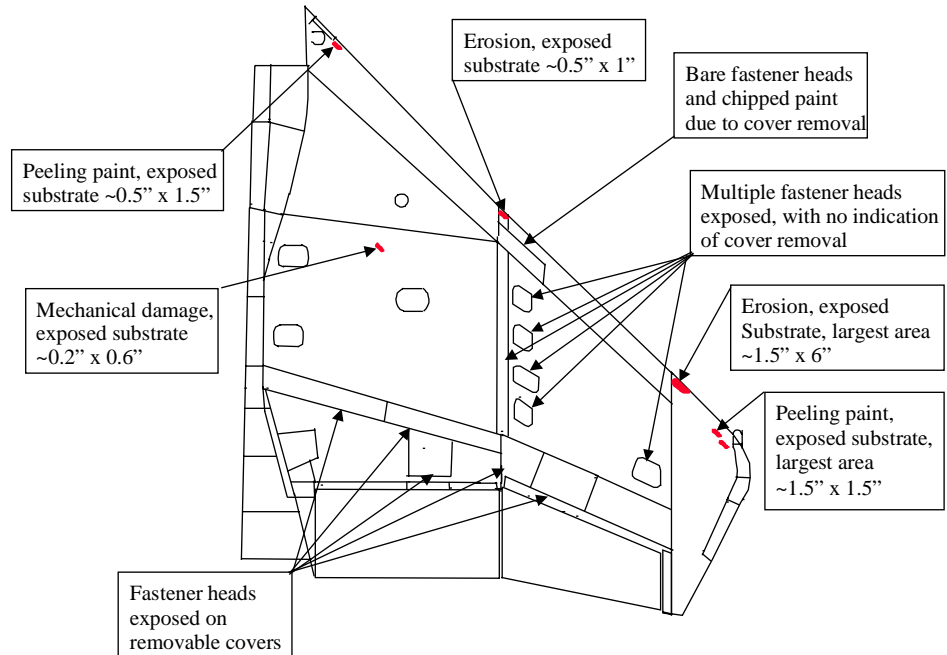


Figure 5. F-15 #79 011, Looking Down at Right-Hand Wing

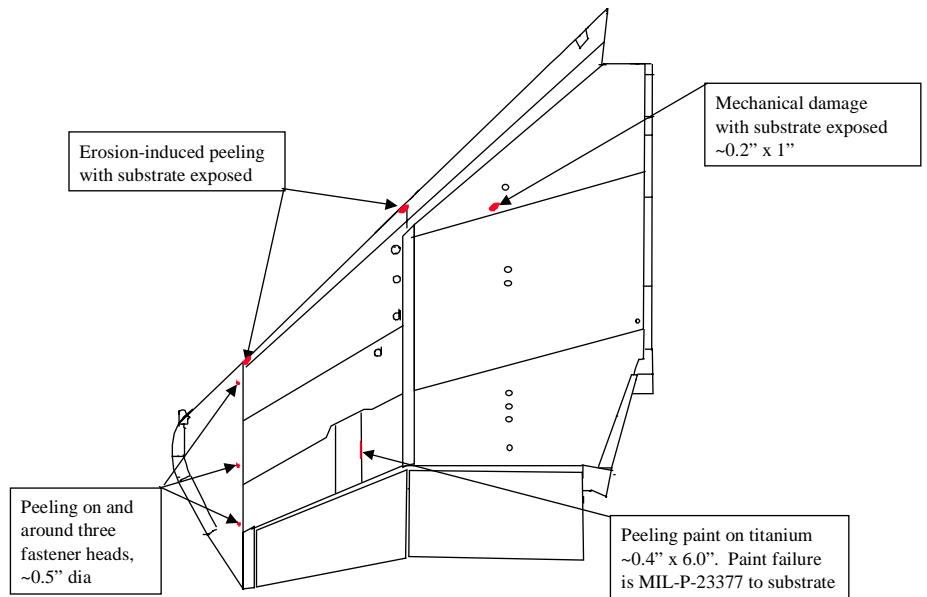


Figure 6. F-15 #79 011, Looking Up at Right-Hand Wing

4. SUMMARY

All of the defects were relatively minor except for adhesion failures on the inboard edge of the lower right-hand wing. The adhesion failures were at the intersection of the wing to fuselage where the chromate and nonchromate primer met. Two of the defect areas were chromate primer failures and one was nonchromate primer.

Most of the defects on the leading edges were due to mechanical damage and erosion with little difference in overall surface area of defects between the wings primed with nonchromate and chromate primers. It is important to note that adhesion failures on the titanium surfaces of aircraft #79-011 occurred within six months after the original painting (see FER I, dated May 22, 1998). By the 12-month inspection (see FER IV, dated September 14, 1998), these adhesion failures had grown to the extent that touching up those coating defects was recommended. Conversely, ten months after complete repair of the wing coating (see FER XI), the paint on the underside of the wing has not failed.