Engineering and Technical Services for Joint Group on Acquisition Pollution Prevention (JG-APP) Pilot Projects

Field Evaluation Report I

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

May 22, 1998

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

Prepared by
National Defense Center for Environmental Excellence (NDCEE)

Operated by Concurrent Technologies Corporation

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1. INTRODUCTION

The Joint Logistics Commanders (JLC) chartered the Joint Group on Acquisition Pollution Prevention (JG-APP) to coordinate joint service activities affecting pollution prevention issues identified during a weapon system's acquisition process. The primary objectives of JG-APP are to:

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

The focus of JG-APP is on original equipment manufacturer (OEM) design, manufacturing, and remanufacturing locations, with subsequent technology transfer to Department of Defense Sustainment Community locations.

The OEMs currently participating in the JG-APP process produce multiple defense systems for more than one of the tri-services. JG-APP technical representatives for each project begin by selecting a target HazMat that is used in the OEM's production process and may cause environmental and/or worker health concerns.

At the Boeing Company Aircraft & Missiles pilot site 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/Crown Metro Aerospace 10PW22-2/ECW-119 and Spraylat Corporation EWAE118 for field evaluations on operating aircraft.

This field evaluation report documents the first inspection of two F-15s being used for the operational testing. 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-APP 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 text and sketches in Section 3 document the first inspections of the two nonchromate primer test F-15 aircraft at Tyndall Air Force Base, Florida (Tyndall AFB). These aircraft, F-15 numbers 81 024 and 79 011, are assigned to the Aerial Education and Training Command (AETC). They were inspected on January 27, 1998. The inspection team included:

- John Lindsey, Wright Laboratories (WL-MLS/OL)
- Larry Garrett, Warner-Robins Air Logistics Center (WR-ALC)
- J. D. Brown, Warner-Robins Air Logistics Center (WR-ALC/LFPS)
- Edmund Rowe, Warner-Robins Air Logistics Center (WR-ALC/LFEFS)
- Max Delgado, Aeronautical System Center, Environmental Management Office (ASC/EME)
- F. D. Kisor, representing Wright Laboratories Materials Directorate
- Will Estes, Dexter Aerospace Materials/Crown Metro Aerospace
- Larry Triplett, Boeing Company, McDonnell Aircraft & Missile Systems

The two F-15 aircraft were painted at WR-ALC in late June and late August of 1997. Dexter/Crown Metro 10PW-22-2/ECW-119 nonchromate primer was applied on the right wing, upper and lower surfaces, and the remainder of the aircraft was primed with chromate MIL-P-23377 primer. The topcoats applied were MIL-P-85285 products manufactured by Deft.

Table 1. Inspection Data for F-15 Test Aircraft

Aircraft #	Date Painted	Total Flight Hours on 1-27-98	Flight Hours Since Painted
81 024	June 97	3,946.3	131.1
79 011	Aug 97	4,715.8	66.5

The inspection results and summary were prepared by Larry Triplett and reviewed by J. D. Brown, Edmund Rowe, Will Estes, and F. D. Kisor.

3. INSPECTION RESULTS

Aircraft #81 024 was inspected first and was found to have several areas of the titanium substrate exposed on the lower wing surfaces. There was bare titanium on the left wing and right wing but more sites and larger sites on the right wing (see Figure 1 through Figure 4 for additional details).

Topcoat and primer were missing from several fastener heads on the upper surfaces of both wings. Several such areas of missing coating were obviously due to mechanical damage from fastener removal, which resulted in chipped paint around the fasteners and around the removable covers. There were also several fastener heads exposed due to loss of adhesion on titanium and steel fasteners. Paint damage to fasteners on upper surfaces is often caused by walking on the aircraft. The quantity and severity of the areas of missing coating were approximately equal on the left and right wings.

Leading edges of the wings revealed erosion and mechanical paint damage. The left wing had more erosion areas and more severe erosion than the right wing.

Aircraft #79 011 was found to have minimal paint defects on the lower wing surfaces and there were no significant differences between the chromate and nonchromate sides. There were areas of mechanical damage and erosion on leading edges that were more pronounced on the left wing (see Figure 5 through Figure 8 for locations).

Topcoat and primer were missing from fastener heads on the upper surfaces of both wings. As with aircraft #81 024, topcoat and primer were missing from several fastener heads on the upper surfaces of both wings. Several such areas were obviously due to mechanical damage from fastener removal, which resulted in chipped paint around the fasteners and around the removable covers. There were also several fastener heads exposed due to loss of paint adhesion on titanium and steel fasteners. The quantity and severity of the areas of missing coating were approximately equal on the left and right wings.

#81 024
27 Jan 98
Inspection
Results

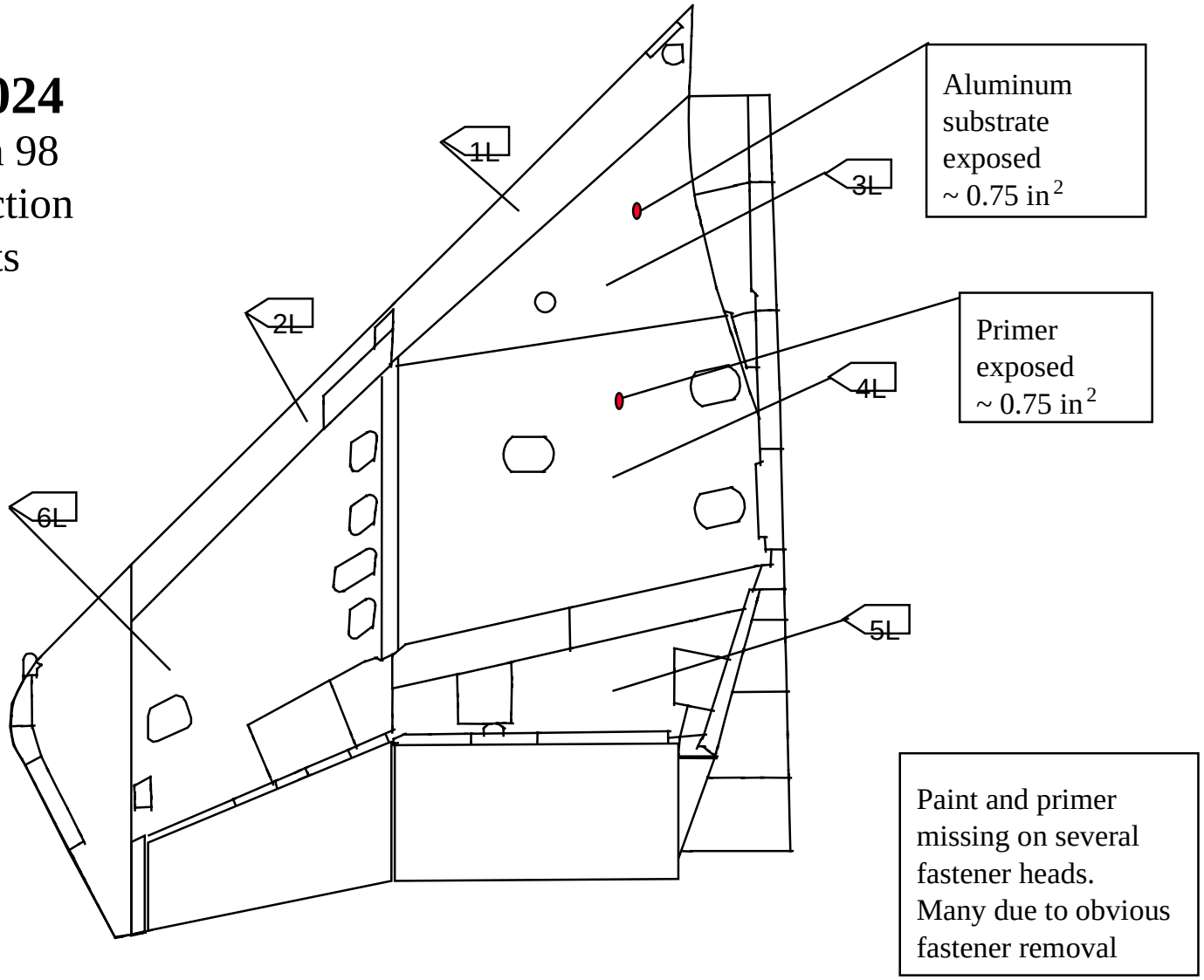


Figure 1. F-15 #81 024, View Looking Down, Left Wing

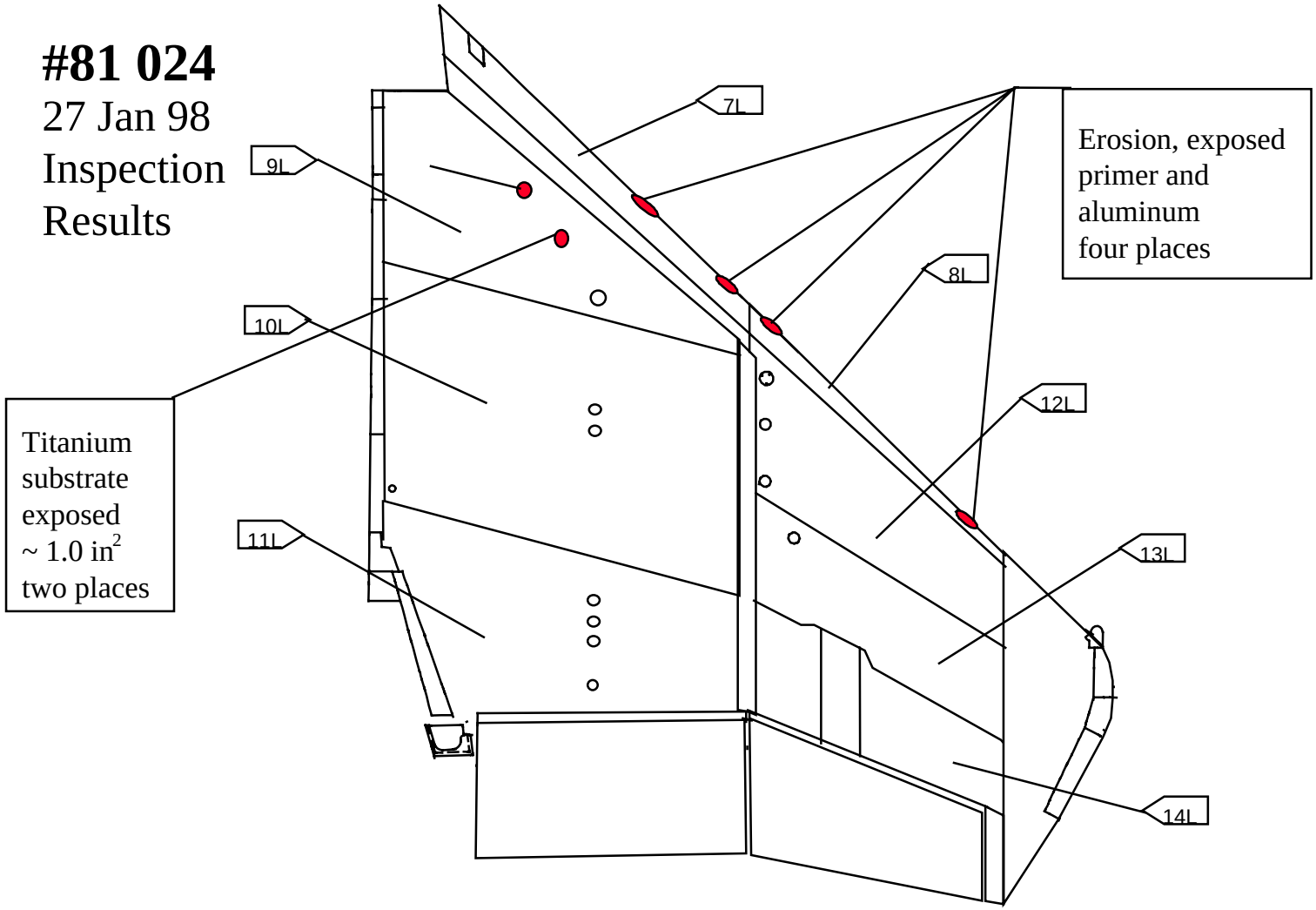
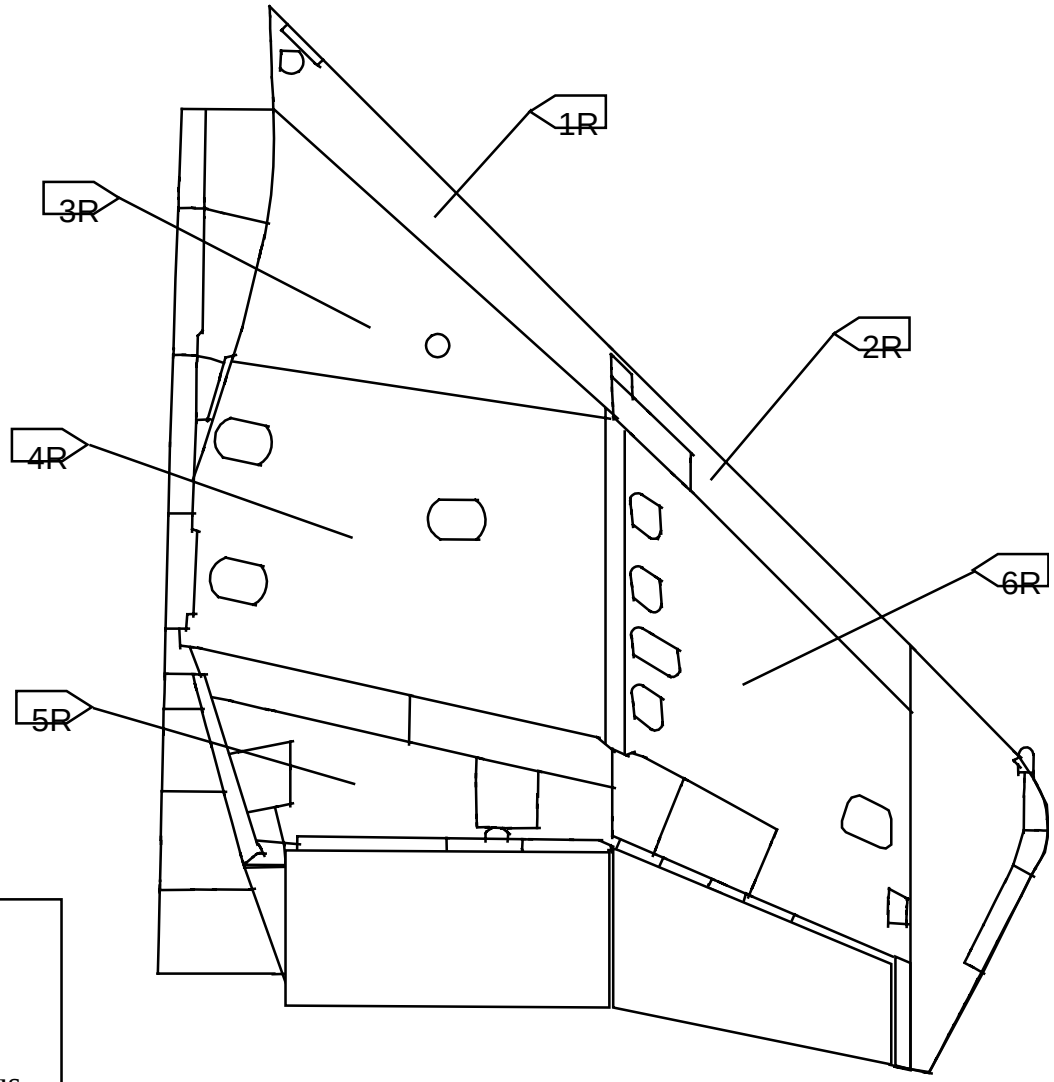


Figure 2. F-15 #81 024, View Looking Up, Left Wing

#81 024
27 Jan 98
Inspection
Results



Paint and primer missing on several fastener heads. Many due to obvious fastener removal

Figure 3. F-15 #81 024, View Looking Down, Right Wing

#81 024
7 Jan 98
Inspection Results

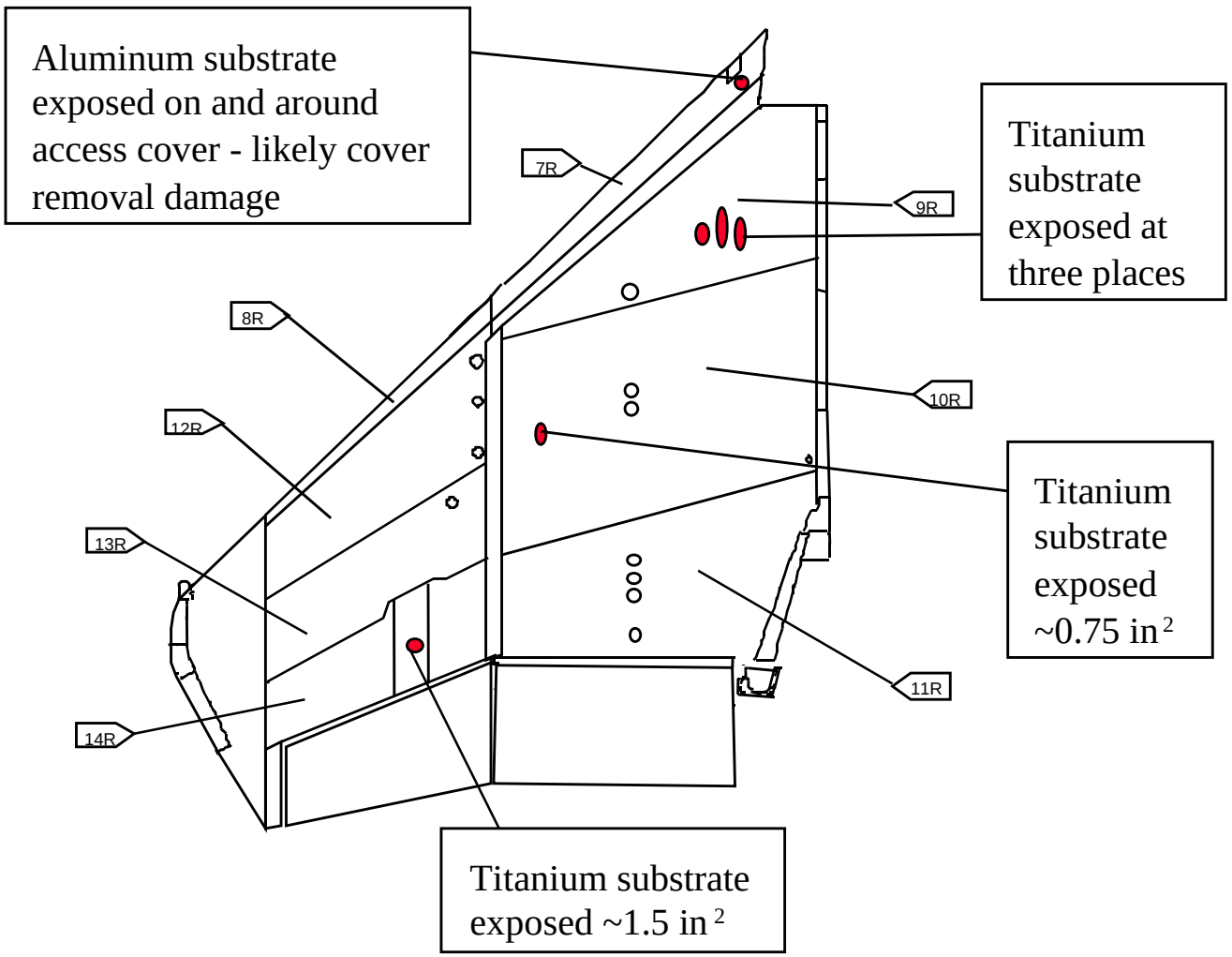
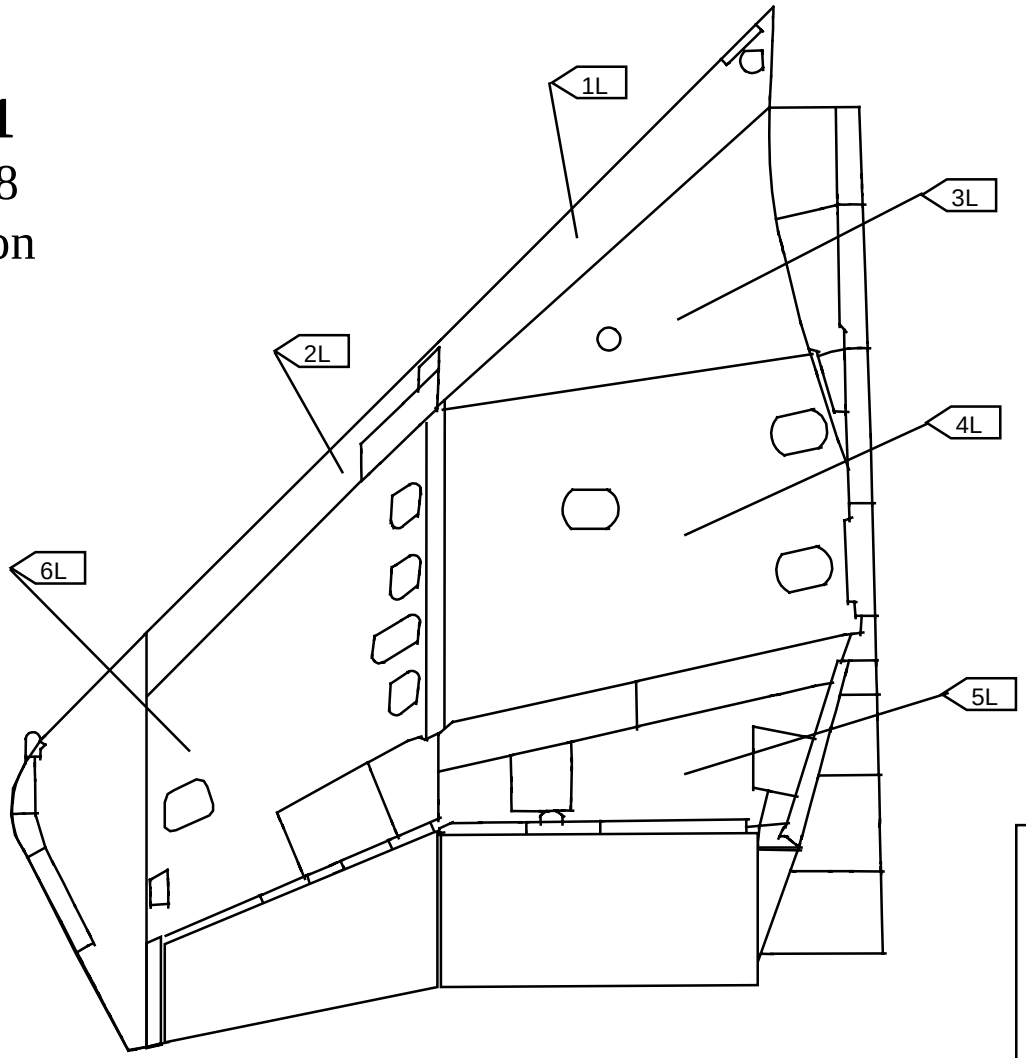


Figure 4. F-15 #81 024, View Looking Up, Right Wing

#79 011
27 Jan 98
Inspection
Results



Paint and primer missing on several fastener heads. Many due to obvious fastener removal

Figure 5. F-15 #79 011, View Looking Down, Left Wing

#79 011
27 Jan 98
Inspection
Results

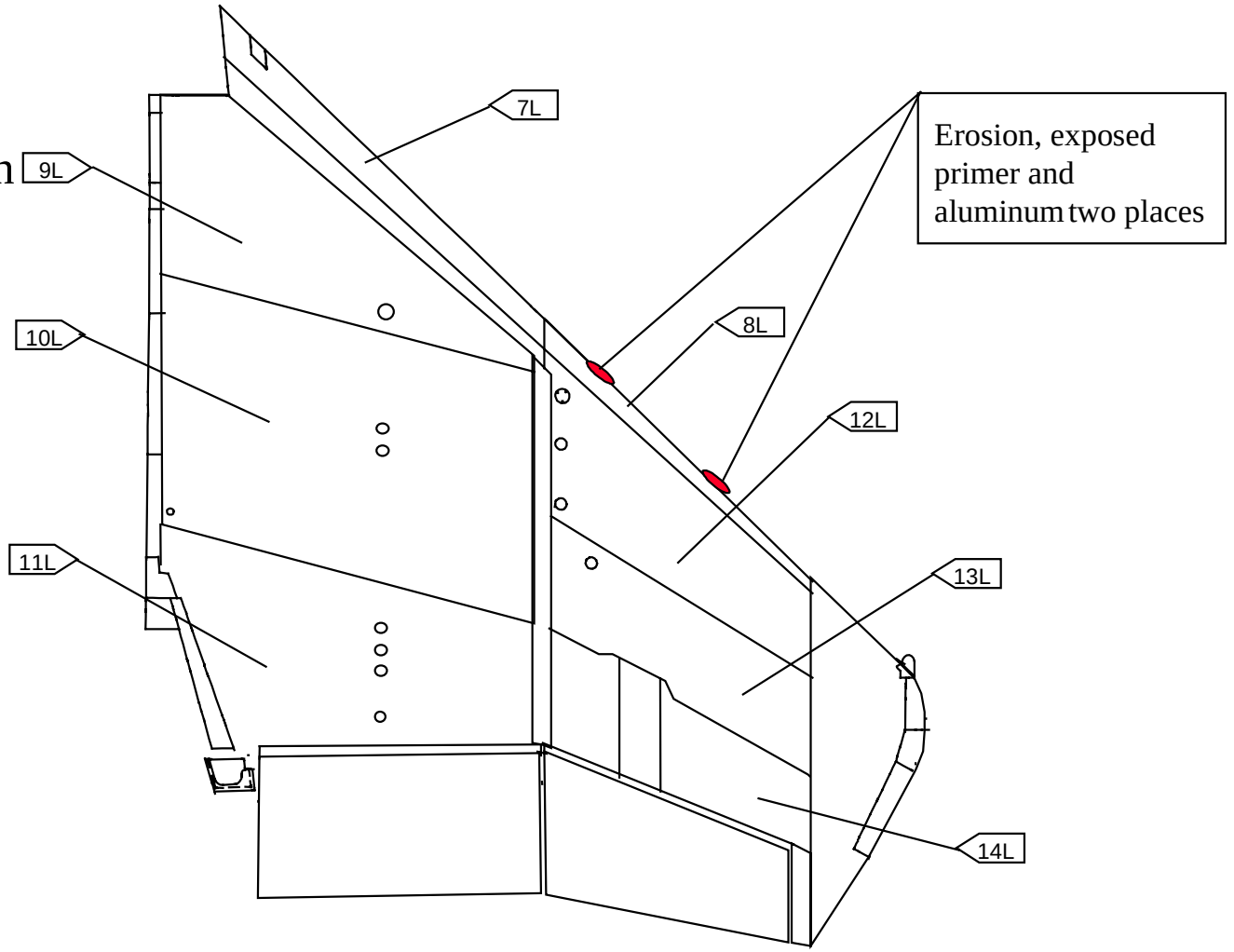


Figure 6. F-15 #79 011, View Looking Up, Left Wing

#79 011
27 Jan 98
Inspection
Results

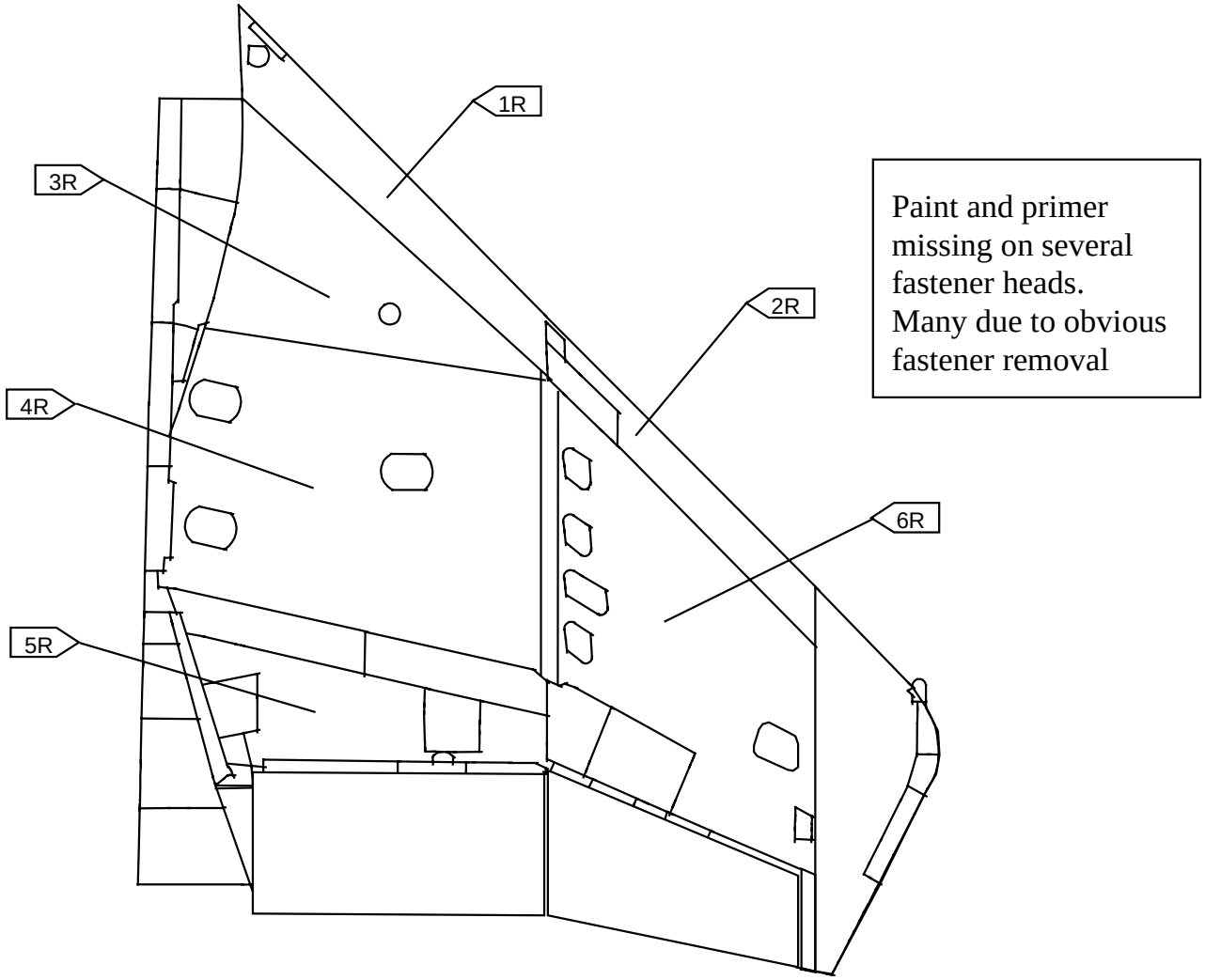


Figure 7. F-15 #79 011, View Looking Down, Right Wing

#79 011
27 Jan 98
Inspection
Results

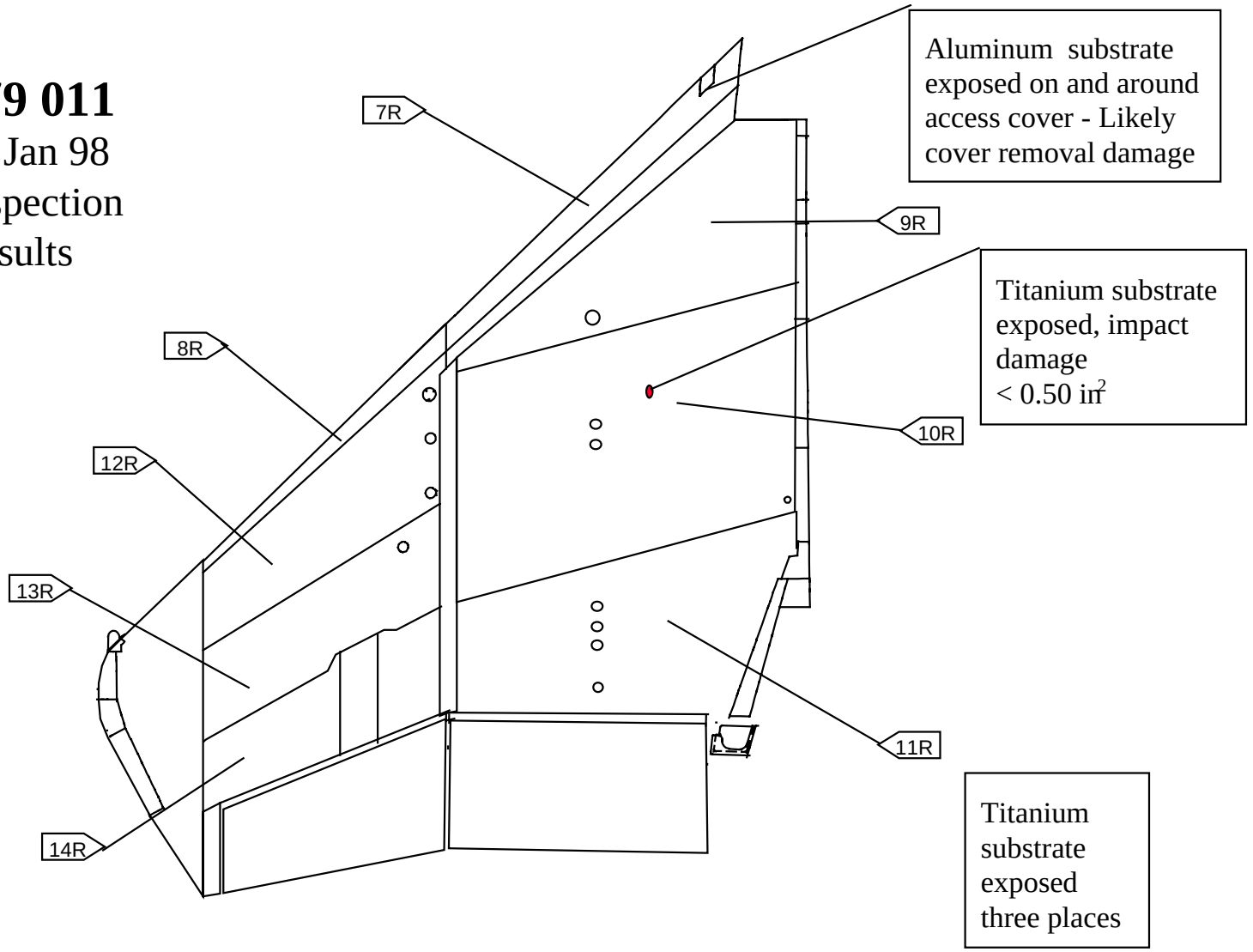


Figure 8. F-15 #79 011, View Looking Up, Right Wing

4. SUMMARY

Based on the initial inspection of #81 024, a simple analysis of the defects would indicate that the adhesion of the waterborne nonchromate primer to the titanium surfaces is not as good as the solventborne control primer. Preparation of the substrate, particularly titanium, is known to be more of a factor for good adhesion with waterborne primers than with solventborne primer and is not a function of chromate versus nonchromate primers. The primer failures identified during this inspection were localized, leading to the conclusion that the failures may be due to factors other than a poorly performing primer. If primer failures were widely dispersed over the titanium surfaces it would be more indicative of a poorly performing primer.

Aircraft #79 011 had very little adhesion problems. This aircraft was painted less than two months later than #81 024 but it had less than half as many flight hours since painting.

It is too early to categorize the nonchromate primer performance on either aircraft as pass or fail after six months. Another inspection will be made in approximately six months.