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

Field Evaluation Report XVI:

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

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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 for field evaluations on operating aircraft and missile canisters.

The primary objective of this test was to evaluate heat resistance of the PRC DeSoto EWAE118 waterborne nonchromate test primer, complying with MIL-PRF-85582 (Type II), on substrates that are likely to exceed a service temperature of 250°F. PRC DeSoto EWAE118 nonchromate primer was applied to selected portions of a single AV-8B aircraft at Marine Corp Air Station Cherry Point. This aircraft, AV-8B Bureau number 163858, is assigned to VMAT 203. The test components were scuff sanded and overcoated at Naval Aviation Depot – Cherry Point, North Carolina (NADEP Cherry Point) on August 12, 1998. Sanding exposed approximately ten percent or less of the substrate surface prior to application of the primer. The aircraft returned to flight status the following month. PRC DeSoto EWAE118 primer was applied on the left-hand strake and left-hand #60 door. The strakes are BMI composite structure and are slightly over ten feet in length located on the underside of the fuselage. The #60 door is titanium, approximately 2.5 feet x 1.5 feet, and is located just aft of the engine exhaust. The right-hand strake was primed with 44-GN-8A, Type II, Class C1 chromate (MIL-PRF-85582) primer. The topcoats applied were TT-P-2756 products manufactured by Deft. Color 36320 topcoat was applied on both strakes and 36231 topcoat on the #60 door.

This AV-8B was inspected on October 26, 1999. After thirteen months and 408 flight hours, there were no heat-related failures of the primer. In addition to the planned evaluation of heat resistance, the primer has also demonstrated adhesion to titanium and BMI substrates without failure.

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 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 for field evaluations on operating aircraft.

This field evaluation report documents the one-year inspection results of the AV-8B used for operational performance testing of the PRC DeSoto nonchromate primer. 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 text and sketches in Section 3 document the thirteen-month inspection results of nonchromate primer on the AV-8B aircraft at Marine Corp Air Station Cherry Point. This aircraft, AV-8B Bureau number 163858, is assigned to VMAT 203. The inspection was performed on October 26, 1999. The inspection team included:

- James Whitfield, Naval Aviation Depot (NADEP) Cherry Point
- Wesley Lamb, NADEP Cherry Point
- F.D. Kisor, Air Force Research Laboratory (AFRL-WL/MLSS)
- Thomas Kearney, PRC DeSoto International
- Larry Triplett, Boeing Aircraft and Missile Systems Group

The test components were scuff-sanded and overcoated at NADEP Cherry Point on August 12, 1998. Sanding exposed approximately ten percent or less of the substrate surface prior to application of the primer. The aircraft returned to flight status the following month. Flight time for the aircraft with nonchromate primer is 408 hours. PRC DeSoto EWAE118, Type II, Class N (MIL-PRF-85582) nonchromate primer was applied on the left-hand strake and left-hand #60 door. The strakes are BMI composite structure and are slightly over ten feet in length located on the underside of the fuselage. The #60 door is titanium, approximately 2.5 feet x 1.5 feet, and is located just aft of the engine exhaust. The right-hand strake was primed with 44-GN-8A, Type II, Class C1 chromate (MIL-PRF-85582) primer. The topcoats applied were TT-P-2756 products manufactured by Deft. Color 36320 topcoat was applied on both strakes and 36231 topcoat on the #60 door.

The inspection results and summary were prepared by Larry Triplett and reviewed for accuracy by the inspection team prior to public release.

3. INSPECTION RESULTS

No repainting or touch-up paint was noted on either of the components coated with nonchromate primer since they were painted in early August 1998. The right-hand strake, which had been primed with chromate primer, was not available for this inspection. Personnel at NADEP Cherry Point reported that the right-hand strake was replaced due to an unknown reason between August 1999 and this inspection on October 26, 1999. Since there were no significant defects found on the nonchromate test components, the lack of a chromate control does not detract from the value of the test results.

3.1 Inspection Results for Left-Hand Strake (Nonchromate Primer)

The left-hand strake showed no signs of coating failure except erosion on the leading edge. Erosion had removed all topcoat and primer and was beginning to erode the epoxy resin. As noted at the last inspection, after approximately 30 flight hours, the paint and primer erosion was more pronounced on the strake primed with chromate primer.

The outboard side of the left-hand strake was covered with JP-5 jet fuel and the inboard and outboard sides were both soiled with soot. There were no signs of peeling, blisters, or lifting of the coating. Reference Figure 1 for geometry of strake and location of erosion.

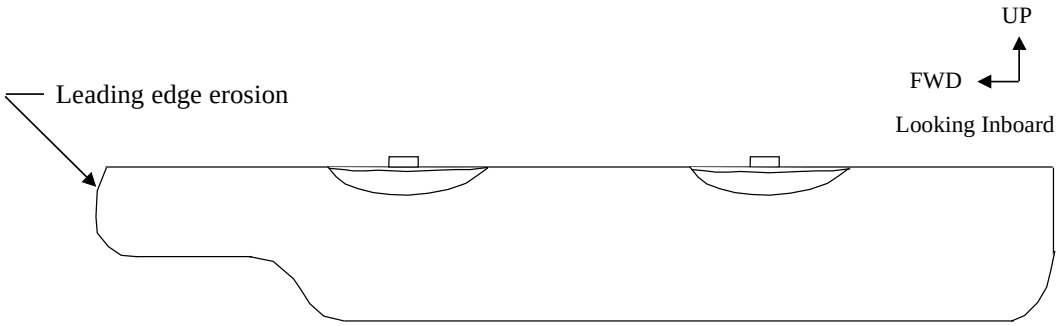

Figure 1. Left-Hand Strake Looking Inboard

3.2 Inspection Results for the #60 Door

The #60 door was heavily soiled with engine soot and required cleaning before inspection. There were no signs of blisters, adhesion failures or other defects except one area (~0.2-inch diameter) where the paint was chipped and the substrate exposed. The topcoat on the lower portion of the door had heat-related discoloration but no blisters, cracking or lifting.

Thickness measurements verified that additional paint had not been applied and mapped areas where the primer was applied on bare titanium. Reference Figure 2 for defect location and paint thickness.

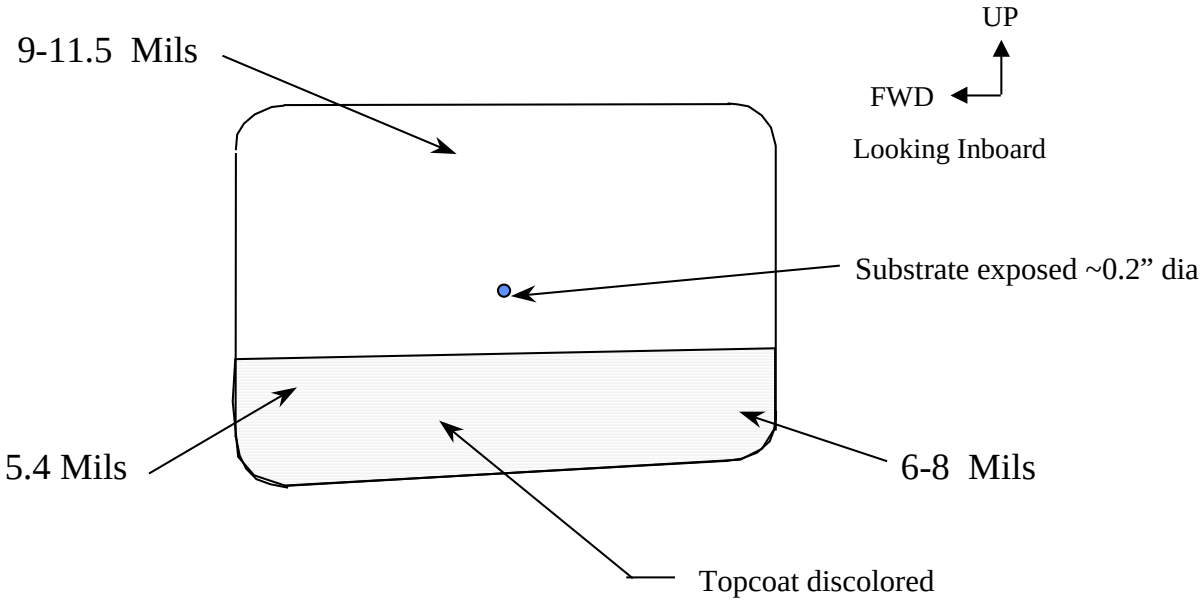

Figure 2. Left-Hand #60 Door Looking Inboard

4. SUMMARY

The primary objective of this test was to evaluate heat resistance of the PRC DeSoto EWAE118 nonchromate test primer on substrates that are likely to exceed a service temperature of 250°F. After thirteen months and over 400 flight hours, there were no heat-related failures of the primer. In addition to the planned evaluation of heat resistance, the primer has also demonstrated adhesion to titanium and BMI substrates without failure.

The nonchromate test primer has successfully fulfilled the AV-8B requirements specified in the JG-PP Joint Test Protocol. If the primer continues to perform successfully in corrosion resistance evaluations on other Navy aircraft, nonchromate primer could be implemented on the AV-8B near the end of 2001.