

Waterborne Primer Systems Improvements

Background:

Technical problems with waterborne primer, Mil-C-85582, "Primer Coatings: Epoxy, Waterborne." have been experienced at OC-ALC, OO-ALC, and SM-ALC. Technical problems were vaguely defined and poorly documented with the currently used waterborne primer, Mil-C-85582, "Primer Coatings: Epoxy, Waterborne". These problems were creating a barrier to more extensive integration into AF wide utilization. The Air Logistics Centers reported the following problems;

OC-ALC: adhesion problems overall and specifically in high shear areas, leading edge slats on wings and other parts of the wing, and mixing concerns

OO-ALC: flexibility and elongation problems, mixing problems, temperature sensitive problems for storage, sprayability and cure time, surface contamination, quality control problems between batches, imperfect drying, clean-up, viscosity and pot-life, flash corrosion of steel fasteners, and compatibility problems with specialty coatings

SM-ALC: peeling, extensive surface preparation

In June 1997, the CTIO began a multi-phase project to identify, verify, and correct problems and issues associated with the application and performance of waterborne primers.

Project Sponsor/Customer: OC-ALC, OO-ALC, SM-ALC (AF wide)

Period of Performance: Jun 97 – Summer 01

Phase 1 Objective:

The objectives of the first phase of this project were to perform a detailed technical assessment of the problems related to performance and integration of waterborne primers and to determine an appropriate laboratory-testing program to clarify and correct these problems

Phase 1 Status:

First, CTIO needed to more accurately define the reported waterborne problems. A survey was conducted to determine the underlying technical issues. This survey involved the development of a questionnaire, visits to each ALC, and compilation of the survey findings. The questionnaire consisted of a series of forms that included inquiries

about the surface preparation process, application process and equipment, application conditions, products and materials used, failure modes, and worker preferences. Both quantitative and qualitative information was obtained.

The collected information related to the problems being observed with waterborne primers and why they were not being used. Main problems identified in the survey were surface preparation and cleanliness; these are important determinants of waterborne adhesion performance. Two problematic surface contaminants are fluids seeping out of the aircraft and Type-V acrylic polymer media residue left on the aircraft skin after stripping. Laboratory project work focused on adhesion performance due to surface preparation procedures, product selection, and common surface contaminants.

Surface preparation and adhesion were the overwhelming concerns expressed by the ALCs, and the surveys yielded problems/concerns identified in 14 different categories:

- Surface Preparation
- Mixing Characteristics
- Water Quality Effects
- Potlife
- Sprayability
- Application Condition Effects
- Equipment Requirements
- Drying/Cure Times
- Equipment Cleanup
- Compatibility with Topcoats
- Adhesion
- Long Term Durability
- Strippability
- Waste Handling Issues

Based on the findings, the following conclusions and recommendations were made:

- Adhesion performance is the most crucial problem facing waterborne coatings. The impact of contaminants such as hydraulic fluids and plastic media blasting (PMB) smearing needs to be determined.
- The surface preparation process and procedure should be evaluated for compatibility with waterborne primers. The specific items to be included are the PMB residue removal, adhesion to contaminated surfaces, and the final step prior to painting.
- Need tests to examine the compatibility of chemical and PMB surfaces with waterborne coatings.
- Forgiveness of waterborne coatings to dirty and contaminated surfaces must be determined.

Long term recommendations:

- Waterborne primers may need to be optimized for different topcoats and different coating systems (i.e. the combination of cleaners, etchants and conversion coatings)
- Testing should be done on waterborne primers to establish the impact of temperature and humidity on the drying time.
- Determine the compatibility of waterborne primers to specialty coatings.
- The viscosity profile over the waterborne potlife duration should be documented.
- Maintain current properties with clean up and the waterborne primer's compatibility with different topcoats.
- The window of acceptable conditions under which waterborne coatings can be applied should be established. These conditions can then be correlated to the actual conditions encountered at Air Force bases.
- Contact waterborne paint vendors to make them aware of leveling problems.
- Although normal washing and the aging impacts of the waterborne primer beyond two years doesn't appear to be a problem, more quantitative information is needed to determine the long-term field use durability. Long term durability on bare aircraft needs to be established.
- Any new or modified waterborne primer specifications should include pre-packaged water.
- Tinker AFB should use a Devilbiss HVLP gun until an adapter is purchased to allow their electrostatic equipment to be effective with waterborne primers.
- The following stainless steel guns can be used to apply waterborne primers without any potential rusting problems:
 - Binks-2001 and Mach 1
 - Graco-600N SST, 700N SST, 800N SST and A800N SST
 - Kremlin-Airmix MX, and M21G VLP
 - Devilbiss-JGV 560, MSA 503, V3 HVLP, MSV HVLP, GFHV 501, EGHV, JGHV-530-57D, and MSV-557-4-D
- During laboratory validation of the waterborne primers, attention to the appearance of the test specimen during surface preparation should be done.
- Any new waterborne coatings and/or formulations should be monitored for their impact on strippability.
- An adhesion limit should be established to ensure the waterborne primer does not strip easily.
- Assess the flexibility and elongation properties of waterborne primers

- Assess corrosion control performance of waterborne primers formulated for improved adhesion.
- Conduct tests to determine the effects of quality of water on waterborne primers

Phase 1 Project Plan: Dated Jul 97

Phase 1 Test Plan: Dated Sep 98

Phase 1 Interim Report: Titled: " Waterborne Primers – Problem Identification Report"

Dated: Mar 99

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Phase 2 Objective:

The first objective (2a) is to develop a test fixture to simulate the seepage of "pooled" contaminants at seams and around fasteners and to develop a procedure for using the text fixture. The second objective (2b) is to use the text fixture to help in developing a procedure or process to allow the successful application of waterborne primers at seepage-prone areas of aircraft.

Phase 2 Status:

The test fixture has been developed and testing has begun. To date tests have been conducted on seepage around fasteners using hydraulic fluid and jet fuel. Additional test data from phase 1 laboratory tests have been evaluated. Two methods are being explored to reduce the seepage of hydraulic fluids through the aircraft lower surface seams. In the first method the seam between the panels of the fixture will be filled with a sealant prior to application of the primer. In the second, a solvent-soaked rag will be placed over the seam during the application of the primer to the non-seam surfaces. After the primer is allowed to dry for a period of time, the solvent rag will be removed from the seam and the seam primed. In both methods the primer will be allowed to dry within the guidelines of T.O. 1-1-8 and then given a topcoat. The adhesive performance will be measured using ASTM D 3359-97, "Standard Test Methods for Measuring Adhesion by Tape Test." Before further testing the contractor has suggested six modifications to the test fixture. After modification the testing will be completed by late May 01 and a final report written.

Phase 2a Test Plan: Dated Mar 00

Phase 2b Project Plan: Dated Dec 00

Phase 2b Test Plan: Delivered to AF on 13 Mar 01

Final Report: Projected completion Summer 01

As of Date: Apr 01