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PROGRAM SUMMARY

UNICOAT

DEVELOPMENT

LABORATORY CHARACTERIZATION

AND FIELD EVALUATION



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BACKGROUND

BACKGROUND

The coating system currently used on Navy and Marine Corps aircraft normally consists of an epoxy primer (MIL-P-23377 or MIL-P-85853) for adhesion and corrosion inhibition, and a polyurethane topcoat (MIL-C-85285 or MIL-C-83286) for durability, flexibility, chemical and weather resistance. A self-priming topcoat has been developed at the Naval Air Development Center, which was designed to replace the current two-coat system with one coating, thus "UNICOAT."

UNICOAT is a two component polyurethane coating which is similar in chemistry to the standard Navy aircraft topcoat. However, the binder in this coating was specifically designed to adhere directly to metallic and polymeric (composite) substrates while still maintaining flexibility, chemical and weather resistance. The polyester component contains pigments contributing to color, opacity, gloss control, and corrosion inhibition, however it contains no chromium or lead.

Upon mixing the two components, UNICOAT can be applied by spray, brush, or roller to a clean surface with no special preparation. It has similar application properties (flow, wetting, leveling, and hiding characteristics) to the standard Navy topcoat. The recommended dry film thickness is 2 mils (50 microns) when applied to aircraft structures. Application to other surfaces may require slightly thinner or thicker films depending on the specific substrate, pretreatment, and intended use.

UNICOAT can be applied at a volatile organic content (VOC) of 420 g/l (3.5 lb/gal) which meets the current regulations for self-priming topcoats in the California Bay Area Air Quality Management District. By virtue of the self-priming nature of UNICOAT, or essentially the elimination of a priming step, the volatile emissions associated with a priming step (340 g/l) are also eliminated from the UNICOAT finishing system. However, UNICOAT currently has two application deficiencies: short pot life and slightly high viscosity. Most two-component coatings have a pot life of greater than 4 hours in order to minimize logistical and scheduling problems during paint application. Due to the chemistry of the coating, UNICOAT has an inherently short pot life. This short pot life characteristic is magnified when the coating is excessively milled during production, exposed to heat, or with the passage of time. These effects are believed to be irreversible. Due to these variables, the pot life can range from 0.5 to 1.5 hr. The viscosity of flat and gloss UNICOAT at 420 g/l is approximately 35 and 29 seconds through a Zahn #2 cup, respectively. This viscosity is greater than the viscosity of the standard topcoat but is comparable to that of many high-solid topcoats and effective application can be achieved using airless, air-assisted airless, or conventional air-atomizing spray equipment. The application transfer efficiency can be optimized by utilizing electrostatic application and the pot life deficiency can be negated by the use of plural component equipment with the standard application equipment mentioned above. However, efforts to increase the pot life through formulation modification continue.

In general, the physical properties evaluated in laboratory tests, meet or exceed the performance requirements of the standard coating system. The adhesion and corrosion resistance are particularly noteworthy. Tape adhesion of the coating after 5 days immersion in water at 65°C (150°F) far surpasses

the requirements of the standard primer and topcoat. The scrape adhesion following this exposure is greater than 5 kg compared to the 3 kg requirement of the epoxy primer with no exposure. Scribed aluminum specimens exposed to 5% NaCl salt spray for 2000 hours show no substantial substrate corrosion (no significant difference when compared to the standard coating system). UNICOAT also provides superior filiform (1000 hr) and SO₂/NaCl (500 hr) corrosion resistance compared to the standard coating system. UNICOAT also provides a superior barrier between the substrate and the environment compared to the standard system as evidenced after 24 hr and 1200 hr in a 3.5% NaCl salt solution using electrochemical impedance spectroscopy.

Following laboratory characterization of UNICOAT, thirteen active aircraft (four F-14's, three H-3's, one P-3 and five T-34's) were entirely painted with the self-priming topcoat. Production engineering personnel were informed of the pot life limitation in advance so that appropriate application procedures could be used to circumvent this problem. In all cases, production personnel were pleased with the application and appearance of UNICOAT. Similar to the laboratory results, the on-going field evaluations indicate that UNICOAT meets or exceeds the performance of the standard coating system.

In particular, the results confirm the durability and corrosion protection of UNICOAT in actual environmental conditions. Two years after application to the first F-14, including 9 months deployment at sea, the coating remains in excellent condition and evaluations from field personnel continue to be exceptionally high. Improved durability and cleanability of UNICOAT has been observed in combination with a decrease in required corrosion control maintenance on this aircraft as compared to an F-14 painted with the standard coating system. Field tests for the other three F-14's and the three H-3 aircraft are producing similar results.

Seven of the above thirteen aircraft were painted with UNICOAT on deoxidized (with no chromate conversion coating) aluminum in order to eliminate all of the chromates from the finishing system. One H-3 was chemically deoxidized using a solution of MIL-C-10578. The P-3 was chromate conversion coated on the starboard side and mechanically deoxidized on the port side with an abrasive pad. Performance on the H-3 and P-3 has been equivalent to standard conversion coated substrates. All five of the T-34's were entirely chemically deoxidized. A proprietary deoxidizer was used on the first three T-34's. An adhesion problem was discovered on these T-34's, but was determined by NADC and NADEP Pensacola to be a preparation and pretreatment deficiency rather than an intrinsic deficiency of UNICOAT. In response to this deficiency, Mil-C-38334 (chemical deoxidizer) was used on the next two T-34's, conforming to a specific surface preparation procedure provided by NADC. Preliminary tests indicate that this pretreatment is a significant improvement compared to the proprietary deoxidizer. Procedures for applying UNICOAT to a non-chromated surface have been developed and are provided in this report. The corrosion control maintenance data on all aircraft painted with UNICOAT continues to be collected and analyzed.

Current data strongly indicates that the advantages provided by UNICOAT include significant reductions in:

1. Paint application time, manpower, and materials.
2. Emissions of hazardous materials (chromates and volatile organics).
3. Aircraft maintenance.

The estimated annual cost savings for the Navy due to the application of one coating (UNICOAT) in lieu of the current two coating system for aircraft is \$5.3 million. These savings result from the elimination of applying a primer to an aircraft during the painting process at the organizational, intermediate, and depot maintenance levels. Emission of hazardous materials are reduced in that: (1) the VOC content of this self-priming topcoat is far less than that of the standard primer and topcoat system and (2) UNICOAT contains no chromates or other carcinogenic pigments.

UNICOAT, has been given a federal specification number (TT-C-2756) which is currently being prepared by the Naval Air Engineering Center. A patent has been issued for the low gloss version of UNICOAT and a patent application has been submitted for the high gloss version of UNICOAT.

This document is a compilation of laboratory reports, field evaluations, and general information on UNICOAT as generated by NADC, other Navy activities, aircraft manufacturers, and paint and paint equipment manufacturers.

**LABORATORY REPORTS
AND
PROPOSED SPECIFICATIONS**

REPORT NO. NADC-87016-60



DEVELOPMENT OF A PRIMER/TOPCOAT AND FLEXIBLE PRIMER FOR ALUMINUM

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<p>Two corrosion preventive organic coatings have been developed for use on aluminum and specifically for application on Navy aircraft. They provide two alternatives for improving aircraft paint systems. The first coating can be applied directly to an aluminum substrate and perform as a self-priming topcoat. It consists of a two component, aliphatic polyurethane resin with titanium dioxide, zinc molybdate, zinc phosphate, an organo-zinc salt, and titanium dioxide vesiculated bead pigments. This primer/topcoat meets or exceeds all of the critical performance requirements of the current Navy aircraft paint system: Mil-P-23377 epoxy primer and MIL-C-83286 polyurethane topcoat. It exhibits good adhesion, corrosion inhibition, flexibility, chemical and weather resistance. The primer/topcoat has been formulated in lusterless gray colors compatible on Navy tactical aircraft. The volatile organic content (VOC) of the primer/topcoat prior to thinning is 395 grams of organic solvent per liter of paint. The VOC after thinning with 1,1,1 trichloroethane, which is currently an exempt solvent, in a viscosity compatible with conventional air spray is 295 grams per liter. This is well within the current maximum limit set by South Coast Air Quality Control District Rule 1142 for aerospace equipment, 420 g/l. The use of this coating will reduce</p> <p style="text-align: right;">(continued on reverse)</p>			
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19. ABSTRACT (continued)

1. Paint application and removal time and manpower
2. Afterside weight
3. Aircraft downtime
4. Volatile organic component (VOC) and chlorine emissions

The second coating is a flexible primer which was developed using the above polyurethane binder. It contains strontium chromate, zinc chromate, barium chromate, and lead chromate corrosion inhibiting pigments. This primer meets or exceeds all of the performance requirements of MIL-PRF-8527 and has significantly more flexibility. Aluminum specimens coated with the NADC flexible primer remained in 5% salt spray for one year without any corrosion of the aluminum or damage to the coating. The NADC flexible primer can be used to increase the flexibility of a coating system and reduce the risk of paint cracking and substrate exposure. The VOC of the flexible primer prior to thinning is 442 grams of solvent per liter of paint. After thinning to meet the air spray viscosity with 1:1 trichloroethane, the VOC is 294 grams per liter which is well below the Rule 113 limit of 350 g/l for all spray equipment.

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1.0 INTRODUCTION

The objective of the investigation discussed herein was to develop a coating which could be applied directly to an aluminum substrate and also perform as a topcoat. In addition to developing this primer/topcoat, a flexible primer was formulated to improve the flexibility of the current Navy aircraft coating system.

U.S. Navy aircraft currently are painted with a high performance protective paint system consisting of an epoxy primer (MIL-P-23377 or MIL-P-85582) and a polyurethane topcoat (MIL-C-83286). Several types of aircraft also require a coat of spray sealant (MIL-S-8802, MIL-S-81733, or MIL-P-87122) between the primer and topcoat. The current paint system was designed to protect aluminum aircraft structures from the harsh aircraft carrier environment which contains corrosive sea water spray and, on non-nuclear powered carriers, sulfur dioxide stack gases. The epoxy primers are adherent and inhibit corrosion of the substrate. The polyurethane topcoat is chemical and weather resistant, flexible, and provides the desired optical properties. A sealant coat is occasionally applied to enhance the flexibility of the coating system and prevent cracking of the paint, especially around fasteners.

Although the current paint system performs well, the individual coatings exhibit several deficiencies. The primer is brittle, especially at low temperatures (-60° F), resulting in extensive cracking of the paint system in highly flexed areas of the aircraft. The sealants are soft and easily deformed and are difficult to apply and remove. In addition, increased awareness and concern for the environment and worker safety have caused local and state governments to limit volatile organic component (VOC) emissions from painting operations. These regulations have impacted Naval Air Rework Facilities (NARFs) and original equipment manufacturers (OEMs) by limiting the amount and types of paint which can be applied. Numerous facilities have been threatened with fines and closure for using the above paint system. The carcinogenic effects of chromates which are used in aircraft primers (Mil-P-23377 and Mil-P-85582) present another concern with current coating systems. Use of chromates has not been restricted to date but limiting regulations are expected in the near future.

The use of one coating, a primer/topcoat, which is adherent, corrosion inhibiting, flexible, chemical and weather resistant, will provide performance, time, and money-saving improvements. Application of one flexible coating reduces the risk of coating failure due to cracking and allows easy touch-up when required. Application of a primer/topcoat to replace two coatings decreases the amount of VOC emissions during the painting operation. In addition, the coatings developed during this effort were specifically formulated with the intent of minimizing VOC and eliminating chromates. Other advantages of the primer/topcoat are the amount of time and manpower saved when applying and removing the system. The current paint system requires the application of a primer and topcoat over the entire exterior surface of the aircraft and application of a spray sealant over certain designated areas. The primer/topcoat would permit the application of only one coating over the aircraft, thus reducing application time by at least 50%. In addition, the time required and the cost to strip the paint from the aircraft when rework is required would be significantly reduced. The use of a primer/topcoat would reduce the weight of the paint system on the external surface of an aircraft by

30 to 40%. For an F-14, this would be a weight reduction of approximately 55 pounds.

The initial objective of this investigation was to develop the primer/topcoat coating. During development, it became apparent that a flexible primer could be formulated using a similar binder and pigment system. The use of this primer would require the application of a conventional topcoat. The advantage of a flexible primer is elimination of the need for a sealant coat while improving the overall flexibility of the paint system. This also would decrease application time and coating system weight by eliminating the need for a sealant coat. Reference (1) discusses an evaluation of elastomeric primers and sealants for use on aircraft.

Although the primer/topcoat and flexible primer both were designed for use on Navy aircraft, they would not be used in conjunction. The advantages of both coatings are discussed above and although use of the primer/topcoat would be more beneficial, until extensive field testing is completed, full scale use cannot be recommended. Therefore, introduction of both coatings provides two alternative approaches to improve aircraft coating systems.

2.0 COATING PREPARATION AND EXPERIMENTAL PROCEDURES

During the three phases of coating development, paints were prepared and applied to aluminum panels for optical and physical testing. The formulated coatings were prepared in the following manner. The designated pigments were mixed with the desired resin system in a one quart glass jar half filled with glass shot (5 millimeters in diameter). This mixture was vigorously agitated on a paint shaker for approximately 30 minutes. The required fineness of grind of the pigment was a minimum of 5 according to ASTM D1210 using a Hegmen gauge.

Following pigment milling and dispersion in the resin system, this mixture was added to the appropriate curing agent when necessary. The viscosity of the formulated coating was measured using a Zahn #2 cup. A viscosity ranging from 18 to 22 seconds was desired for application of the coating. If viscosity reduction was required, the admixed material was diluted with solvent specified by the resin manufacturer or appropriate substitutes. The resulting coatings were applied to aluminum specimens of 3.0 x 6.0 x 0.02 inches (7.62 x 15.24 x 0.05 cm) using conventional air spray. The specimens used in all tests, except the flexibility and filiform corrosion tests, were 2024-T3 bare aluminum alloy meeting specification QQ-A-250/4. The specimens were cleaned and chromated with materials conforming to MIL-C-81706 to produce a chemical conversion coating meeting MIL-C-5541. The filiform test specimens were 2024 - T3 Alclad chromate conversion coated per Mil-C-5541. The flexibility test specimens were 2024-0 temper aluminum alloy, anodized in accordance with MIL-A-8625, type 1.

While under development, the formulated coatings were tested against each other for comparison and illustration of the best formulation. When the optimum formulations were determined, they were tested against control materials, MIL-P-23377E epoxy primer and MIL-C-83286 polyurethane topcoat. Although the current revision of Mil-P-23377 is the "D" version, the "E" revision has been drafted. A control primer meeting the "E" revision requirements was used as a control in this study. Koroflex, a one-component, flexible primer manufactured by DeSoto, Inc. was used as the control for the flexible primer materials. The

conventional primers were applied to a thickness of 0.9 mils (22.9 μ m). Flexible primers were applied to a thickness of 1.1 to 1.5 mils (27.9 to 38.1 μ m). The conventional topcoats were applied one hour following primer application to a thickness of 1.8 to 2.0 mils (45.7 to 50.8 μ m). The primer/topcoats were applied to film thickness of 2.0 to 2.2 mils (50.8 to 55.9 μ m). In all tests, the primers were analyzed without a topcoat; for adhesion and corrosion, they also were tested with a topcoat. All coatings were allowed to cure for 7 days at ambient laboratory conditions prior to testing.

The set-to-touch time was measured as the time following application when the coating clung weakly to the finger when touched under gentle pressure, but none of the film transferred to the finger. The dry-hard time of the coatings was measured according to Method 4061 of Federal Test Method Standard 141B.

The method was performed by placing the coated panel between the thumb and forefinger, with the thumb on the coating, and applying maximum pressure. The impression left on the coating was then lightly polished with a soft cloth. The dry-hard time was recorded as the time following application when the impression left by the thumb could be completely removed.

The 60 and 85 degree gloss was measured according to ASTM Method D523 using a GG-7562 multi-angle glossmeter manufactured by Gardner Laboratory. Color of the primer/topcoats was characterized by measuring tristimulus and LAB values using the McBeth 1010S colorimeter with illuminant C.

Adhesion of the coating systems was measured by wet-tape test defined in ASTM D3359, Method A and the Scrape-Adhesion Test defined in ASTM D2197, Method B. The Wet-Tape Test was performed by immersing a coated specimen in distilled water at 75 \pm 5 $^{\circ}$ F (24 \pm 3 $^{\circ}$ C) for 24 hours. Upon removal, two parallel cuts were made, one inch apart, through the coating and into the substrate. Using firm pressure, a one-inch wide strip of 3M-250 masking tape (manufactured by Minnesota Mining and Manufacturing Company) was placed on the coating perpendicular to the direction of the cuts. Following this, the tape was removed in a quick and steady pull. The coating was then inspected and evaluated in accordance with the following system:

- 5A No peel or removal
- 4A Trace peeling or removal along the cut
- 3A Jagged removal along cuts up to 1/16 inch (1.6mm) on either side
- 2A Jagged removal along most of the cuts up to 1/8 inch (3.2mm) on either side
- 1A Removal from over 50% of the area under the tape
- 0A Removal of all the coating under the tape and/or beyond the tape

The adhesion of the primers and primer/topcoats to the substrate and the intercoat adhesion between the topcoats and the primer were evaluated using the SG-1605 Scrape-Adhesion Test Apparatus manufactured by Gardner Laboratory. The test was performed by guiding a weighted stylus at a 45-degree angle to the specimen along the substrate into the coating being tested. The scrape-adhesion was recorded as the heaviest weight used without the stylus shearing the coating from the underlying surface. For primers and primer/topcoats, this surface was the aluminum substrate, for topcoats, it was the primer coat.

The coatings were tested for resistance to hydraulic fluids conforming to

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specifications MIL-H-5606, MIL-H-83282, and MIL-H-83306 Monsanto Skydrol 500B and a lubricating oil conforming to Specification MIL-L-23699. Coated specimens were immersed in the MIL-H-5606 and MIL-H-83282 hydraulic fluids at 150° F (66° C) for 24 hours, in MIL-L-23699 lubricating oil at 250° F (121° C) for 24 hours, and in MIL-H-83306 hydraulic fluid at 70° F (21° C) for 7 days. Upon removal, the coatings were examined for softening, blistering, loss of adhesion, and any other coating defects.

Salt-spray tests were conducted according to ASTM Method B117. Specimens were scribed with an "X" through the coating system and into the substrate prior to the exposure period. Although the specified exposure period for Mil-P-23377E and Mil-C-83286B are 1000 and 500 hours, respectively, additional specimens were exposed for 2000 hours and for one year. The specimens were subsequently examined for corrosion deposits in the scribe and blistering and uplifting of the coating.

Additional salt spray tests were performed using a specimen consisting of an aluminum panel attached to a graphite/epoxy composite as illustrated in Figure 1. A 6 x 6 x 0.125 inch (15.24 x 15.24 x 0.32 cm) aluminum specimen conforming to QQ-A-250/12 (T6 temper), anodized per Mil-A-8625, Type I was primed. Two diagonal intersecting scribes were made through the primer and into the substrate. A 3 x 3 x 0.09 inch (7.62 x 7.62 x 0.24 cm) graphite/epoxy panel with 0, 90 orientation of approximately 16 plies was attached to the center of the aluminum specimen with four nylon fasteners. Four 2 inch lines were scribed along the edge of the composite into the aluminum. The specimen was then exposed to 5 % salt spray for 500 hours, removed, disassembled and analyzed for coating defects and corrosion of the aluminum.

The filiform corrosion test was performed by scribing an "X" through the applied coating and into the aluminum substrate. The panel was then placed in a desiccator approximately 2 inches above concentrated (12 normal) hydrochloric acid for 65 minutes. Without rinsing the specimen, it then was placed in a chamber at 102° F (39° C) and 80 percent relative humidity for 1000 hours. The specimens were then examined for deformities in the coating and corrosion of the aluminum, especially thread like defects in the film stemming from the scribe.

The coatings were evaluated for strippability by placing a painted specimen at a 60° angle with the horizontal. Mil-R-81294 paint remover was poured along the upper edge to completely cover the surface. After 15 minutes, the specimen was brushed and rinsed with water, removing the loosened coating. The area of the specimen in which the coating was removed was recorded.

Humidity resistance tests were performed by exposing painted specimens to 95% relative humidity and 120° F (49° C) for 30 days. The coatings were then examined for blistering, softening, and loss of adhesion.

The coating systems were tested for flexibility according to ASTM Method D1737. Specimens at -60° F (-51° C) were bent around 1/8, 1/4, 1/2, and 1 inch mandrels. After returning to room temperature, the coating systems were examined for cracking along the bend.

The coating systems were tested for impact flexibility as defined in Method 6226 of Federal Test Method Standard 141B. The test instrument consisted of a solid steel cylinder with spherical knobs protruding from the end. These knobs

were designed such that the coating system could be subjected to elongations of 0.5, 1, 2, 5, 10, 20, 40, and 60 percent. The steel cylinder was allowed to fall freely from a height of 42 inches (1.05 meters) through a hollow guide cylinder, striking the reverse side of a coated specimen. The imprints formed from the knobs were then examined for cracking. The imprint causing the highest elongation which did not cause cracking of the coating was recorded as the impact flexibility.

Painted specimens were exposed for 500 hours in a 6000-watt, xenon-arc weatherometer. The continuous cycle consisted of 102 minutes of high-intensity light only and 18 minutes of light and water spray. The specimens were tested according to ASTM Method G26, Type BF with the conditions in the chamber as follows:

Black body temperature	$140 \pm 5^\circ \text{ F}(60 \pm 3^\circ \text{ C})$
Relative humidity	$50 \pm 5\%$
Intensity of the xenon arc	0.55 ± 0.05 watts per square meter at 340 nanometers wavelength

After 500 hours exposure, the specimens were examined for substrate corrosion and coating color, gloss, and impact flexibility changes. Although Mil-C-83286B specifies the use of a carbon-arc weatherometer, the xenon-arc exposure has been demonstrated to be as severe.

The topcoats were tested for heat resistance by subjecting coated specimens to $400^\circ \text{ F}(149^\circ \text{ C})$ for four hours. The coatings were then examined for changes in color, gloss, and impact flexibility.

3.0 COATING FORMULATION

The primer/topcoat development was completed in three phases. In the first phase, various polymeric binders were screened for adhesion, flexibility, chemical and weather resistance according to the methods previously described. Due to the stringent requirements for the desired coating, many resin systems were immediately eliminated from consideration. In general, epoxy polymers have poor weather resistance, alkyds do not have the required chemical or weather resistance, and acrylics lack adhesion, durability, and chemical resistance. Polyurethane resins were the primary binder candidates. After analyzing a number of polyurethane resins, the most promising material based on the above properties was a polyurethane which was obtained by reacting a blend of polyester polyols (X3009-Part A manufactured by Coatings for Industry) with hexamethylene diisocyanate (X3009 part B). Table I lists the resin characteristics and Figures 2 and 3 illustrate the infrared spectra of the two resins, respectively.

The objective of the second phase of the primer/topcoat development was to formulate a pigment system which would provide opacity, low gloss, corrosion protection, and a gray coating. The pigments also were evaluated for effects on coating flexibility and adhesion. This phase was performed by selecting and combining corrosion inhibitive, opaque, and extender pigments and incorporating them into the selected polyurethane resin at various concentrations. A theoretical prediction and statistically designed experimental verification approach outlined in references (2) and (3) was used to determine the most

likely optimum component concentrations and the compositions to be tested to verify these predictions. Since the objective was to develop white and camouflage gray coatings, candidate pigments had to be white, gray, or black. Extender pigments reduce gloss but provide little or no opacity to the dry film.

The most promising pigment system consisted of titanium dioxide, zinc phosphate, zinc molybdate, titanium dioxide vesiculated beads, and an organic zinc salt (SICORIN RZ manufactured by BASF). Titanium dioxide and titanium dioxide vesiculated beads are the primary pigments for providing opacity. The vesiculated beads also assist in reducing gloss due to their high oil absorption characteristics (2). Zinc molybdate, zinc phosphate, and Sicorin RZ are corrosion inhibitors. Table II lists the characteristics of these pigments.

After defining the binder/pigment system, the final phase of the development effort was completed by optimizing the solvent and pigment concentrations to obtain a material that exceeded the performance requirements of the primer (MIL-P-23377E) and the topcoat (MIL-C-83286B). The optimized composition of a lusterless white and a gray primer/topcoat along with critical compositional properties are provided in Table III. Physical and optical properties of these materials will be presented and discussed in the next section of this report. Initially, the candidate binder systems were thinned using solvents recommended by the polymer resin manufacturer. After it was determined that the X3009 polyurethane resin system manufactured by Coating For Industry was the prime candidate, Mil-T-81772, a standard urethane thinner, was used. In this final phase of development and optimization, 1,1,1 trichloroethane was substituted for the Mil-T-81772. This was done because 1,1,1 trichloroethane currently is an exempt solvent and thinning viscosity can be obtained without increasing the measured volatile organic content (VOC).

During the primer/topcoat development, it became apparent that the raw materials being used could also be applied to formulate flexible primers, with and without chromates. As a coinciding effort, an investigation was undertaken to develop these primers. Corrosion inhibiting pigments, including zinc chromate, strontium chromate, barium chromate, along with those previously identified, were combined with the x3009 polyurethane using an extreme vertices statistical design (4). The three critical properties evaluated were adhesion, flexibility, and corrosion inhibition. Table IV list the composition of the NADC flexible primer. The properties of this material are presented and discussed in the following section.

4.0 COATING TEST RESULTS AND DISCUSSION

The properties of the developed primer/topcoat and flexible primers are listed in Table V along with critical performance requirements of Mil-P-23377E epoxy primer and Mil-C-83286B topcoat.

4.1 Primer/Topcoat Analysis

From the data in Table V, it is evident that the primer/topcoat meets all of the critical requirements for both specifications. Although the Mil-C-83286B 60° gloss requirements for camouflage topcoats is 7 to 12, Navy aircraft are painted with a special designation Mil-C-83286B, "gunship quality" which has 60° and 85° gloss requirements of less than 3. Gloss is partially dependent upon

pigment milling and paint application procedures, therefore slight formulation modification may be necessary to obtain the desired gloss. The formulation concentrations listed in Table III are approximate and reduction of gloss may be accomplished by using a high oil absorption flattening agent such as amorphous silica. However, because addition of flattening agents also can cause loss in flexibility, large amounts of these agents are not recommended. In addition, it is believed that a 60° gloss of below 5 and an 85° gloss of below 10 are not significant increases and will not impact aircraft camouflage and vulnerability.

The specified exposure period for Mil-P-23377E and Mil-C-83286B on 2024-T3 in salt spray is 1000 and 500 hours, respectively. However, the primer/topcoat passed this requirement and the exposure period was continued for one year. Figure 4 is a photograph of Mil-P-23377E specimens, Figure 5 is Mil-P-23377E topcoated with Mil-C-83286B, and Figure 6 is the lusterless white primer/topcoat following 2000 hours in 5% salt spray. These specimens exhibited no substrate corrosion or blistering of the coatings. Figure 7 illustrates primer/topcoat specimens following one year in salt spray. Prior to chemically removing the coating in order to analyze the substrate, it was observed that the coating had blistered but was not punctured along the bottom edge of the exposed specimens and at one small area at the upper tip of one of the scribes. On both specimens, corrosion was observed at the areas where the coating had blistered. Due to the extent and location of the corrosion and the duration in salt spray, these results indicate good corrosion protection of the aluminum.

Yellowish deposits were observed in the circular corrosion areas and in the scribe as shown in Figures 9 and 10. These deposits are not grain-like as is usually observed with sodium chloride and aluminum oxide deposits. Chemical analysis of these deposits indicates a large concentration of aluminum and smaller concentrations of chromium, zinc, and molybdenum. Figure 10 is the scribe area of a primer/topcoat specimen after 2000 hours in salt spray. Although the deposits are present on the specimens, they do not cover the entire scribe area, indicating that a build-up of these deposits occurs with exposure in salt spray. Upon further examination, it was determined that there were no pits under these deposits in the scribe area. For comparison, Figure 11 is an NADC flexible primer specimen exposed to salt spray for one year which had no deposits in the scribe. The scribe area of this specimen was shiny, revealing the aluminum substrate.

The volatile organic content (VOC) of the primer/topcoat prior to thinning is 395 grams of organic solvent per liter of paint. After thinning to spray viscosity (20 - 22 seconds with a Zahn 2 cup) with 1,1,1 trichloroethane, which is currently an exempt solvent, the VOC of the primer/topcoat is 295 g/l. Currently, the most stringent solvent emission requirements are set by the South Coast Air Quality Control District in California. The limitations for topcoats are 420 g/l for aerospace equipment and 350 g/l for miscellaneous metal parts. The primer/topcoat meets both of these regulations and has the added advantage of not requiring a primer coat, further minimizing solvent emissions.

As stated previously, adhesion, flexibility, strippability, corrosion resistance, fluid resistance, heat resistance, and weatherability of the primer/topcoat meet or exceed the appropriate primer and topcoat specification requirements. The benefits of this material are:

1. Decreased paint application time and manpower

2. Less applied paint and lower aircraft weight
3. Reduced aircraft downtime
4. Less volatile organic solvent emissions
5. No chromate emissions

The cost of aircraft painting and stripping subsequently can be reduced due to less manpower and material requirements. Lower VOC and the absence of chromates in the coating are beneficial for worker safety and environmental concerns which also lessens the burden on painting facilities such as NARFs and OEMs in conforming with emission regulations.

4.2 NADC Flexible Primer Analysis

The NADC flexible primer meets or exceeds all the requirements of Mil-P-23377E except the set-to-touch time which is less than 30 minutes; the flexible primer is set-to-touch in less than 45 minutes. This is not considered significant because the set-to-touch and dry hard times of the flexible primer are far less than that for the topcoat, which would normally be applied over the primer. Therefore, the additional 15 minutes required for the set-to-touch time for the flexible primer would not add a significant amount of time to apply the entire coating system to an aircraft. It should also be noted that the polyurethane binder system of this flexible primer is similar to that of the MIL-C-85286. Overcoating with MIL-C-83286 shortly after application of this primer will improve the intercoat adhesion of the paint system. The main reason for delay between priming and topcoating is to allow most of the primer solvent to evaporate. This will occur within 30 minutes.

One objective in developing this coating was to meet the requirements for a proposed specification for a flexible primer (Table VI). To date, the only material known to meet these requirements is Koroflex (DeSoto, Inc.). The NADC flexible primer meets or exceeds all of these requirements except elongation at break. The elongation at break of the NADC primer is 31%. Although this is significantly less than the 100% requirement, the flexibility required of a primer to prohibit coating failure on an aircraft is unknown. Koroflex has performed well in field tests on operational aircraft. Field testing of the NADC primer is currently being performed to determine if its flexibility is adequate to significantly reduce cracking of the aircraft paint system. Increasing the flexibility of the NADC primer may be possible by blending the polyurethane binder with a more flexible resin and by incorporating elastomeric fillers into the coating. Both of these techniques would cause the addition of elastomeric domains in the cured coating which would relieve stresses, prohibiting cracking of the coating (5).

The corrosion properties of the NADC flexible primer are notable. Figures 12 and 13 illustrate the NADC primer with and without a topcoat after 2000 hours in salt spray. Figure 14 illustrate Koroflex specimens after 2000 hours salt spray. All of the specimens had no corrosion of the substrate or uplifting of the coating. Figure 14 shows some surface staining of the Koroflex due to inadvertent splashing of a contaminant; however, no damage of the coating was observed. Figure 15 illustrates the NADC flexible primer after 1 year exposure to 5% salt spray. There was no corrosion or uplifting and the scribe area was shiny, indicating excellent corrosion inhibition. Figure 11 further illustrates the corrosion protection provided by the NADC flexible primer.

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The corrosion inhibiting pigments utilized in the flexible primer, as indicated in Table IV, are a combination of strontium chromate, barium chromate, zinc chromate, and zinc molybdate. These pigments and their concentrations were determined using a statistical experimental design to determine the most effective inhibiting system for this primer. It must be noted that in the X3009 polyurethane resin system, this exact pigment formulation provided corrosion protection superior to any single pigment, including strontium chromate.

A second objective in the primer formulation effort was to develop a non-lead, non-chromate primer for aluminum which will provide all of the desired properties, especially corrosion inhibition. It is obvious from the primer/topcoat formulation that non-lead, non-chromate, corrosion preventive coatings for aluminum can be developed. Currently, there are two military specifications, Mil-P-52995 and Mil-P-53030, for lead and chrome free corrosion preventive primers for ferrous and non-ferrous substrates. The pigment system in these primers contains iron oxide, zinc phosphate, and Sicoria RZ. Mil-P-52995 is a phthalic alkyd binder and Mil-P-53030 is an epoxy binder. Several preliminary in-house primers were developed which had fair corrosion protection. This investigation is continuing in order to develop an optimum coating without lead or chrome pigments.

The VOC of the NADC flexible primer is 442 g/l prior to thinning and 294 g/l after thinning to spray viscosity with 1,1,1 trichloroethane. The current South Coast Air Quality Control District Regulations for primers are 350 g/l for aerospace equipment and 340 g/l for metal parts. The thinned flexible primer meets both of these requirements.

5.0 CONCLUSIONS

A coating has been developed which can be applied directly to an aluminum substrate and provide the properties of both a primer and a topcoat. This coating meets all of the critical performance requirements of the primer and topcoat currently used on Navy aircraft. The primer/topcoat coating provided corrosion protection for an aluminum substrate for over 2000 hours in salt spray with a non-lead and non-chrome pigment system. When used to replace the primer and topcoat coating system on Navy aircraft, the primer/topcoat will reduce paint application cost and time, aircraft downtime, and volatile organic and chromate emissions.

A flexible primer has been developed which meets the requirements for Mil-P-23377E. This primer also passes all of the requirements of a proposed flexible primer specification except elongation at break. It does pass other stringent low and ambient temperature flexibility requirements.

6.0 FUTURE EFFORTS

Field tests on operational F-14 aircraft are planned for the primer/topcoat and flexible primer discussed in this report. These coatings also are being analyzed in the laboratory for their performance on graphite/epoxy composites common on tactical military aircraft. Additional coating development is being performed to obtain a non-lead, non-chrome primer for aluminum and to develop a more flexible primer.

Table I: Characteristics of Polyurethane Resin X3009.

X3009 Component A	
Percent Solids	46.2
Hydroxyl Number	71
Acid Number	9
Average Equivalent Weight	790
Density	1.06

X3009 Component B	
Percent Solids	75.4
Percent Isocyanate (NCO) Content	16.5
Average Equivalent Weight	255
Density	1.07

7.0 REFERENCES

1. D. F. Pulley and S. J. Spadafora, "Elastomeric Primers and Sealants", Naval Air Development Report NADC-83140-60, Warminster, PA, November 1983.
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5. J. A. Manson and L.H. Sperling, POLYMER BLENDS AND COMPOSITES, Plenum Press, New York, 1976.

8.0 ACKNOWLEDGEMENT

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Table II: Properties of Pigments

	<u>Titanium Dioxide</u>	<u>Zinc Molybdate</u>	<u>Zinc Phosphate</u>	<u>Sicorin RZ</u>	<u>TiVs80</u>
Appearance	White	White	White	White	White
Shape	Spherical	Spherical	Rectangular	Platelet	Spherical
Density (g/ml)	4.0	5.0	3.6	2.5	0.6
Oil Absorption (ASTM D281)	29.3	16.0	23.2	57.2	146.8
Particle Size, Average, in microns	0.2	4.0	6.0	2.5	5.0

Table II: Properties of Pigments

	<u>Titanium Dioxide</u>	<u>Zinc Molybdate</u>	<u>Zinc Phosphate</u>	<u>Sicorin RZ</u>	<u>TiVsBD</u>
Appearance	White	White	White	White	White
Shape	Spherical	Spherical	Rectangular	Platelet	Spherical
Density (g/ml)	4.0	5.0	3.6	2.5	0.6
Oil Absorption (ASTM D281)	29.3	16.0	23.2	57.2	146.8
Particle Size, Average, in microns	0.2	4.0	6.0	2.5	5.0

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Table III: Composition of Lusterless White Primer/Topcoat

Component A	Percent by Weight
-------------	-------------------

X3009 A	37.8
Titanium dioxide	1.1
Titanium dioxide ves. bds.	0.4
Zinc Phosphate	17.1
Sicorin RZ	1.7
Zinc molybdate	<u>30.1</u>
Sub-total	88.2

Component B	
-------------	--

X1009B	<u>11.8</u>
Total	100.0

These materials are mixed approximately 4 parts of Component A to 1 part of Component B by volume. 26 grams (20 milliliters) of 1,1,1 trichloroethane were added to obtain a spray viscosity of 20 to 22 seconds using a Zahn 2 cup.

Pigment Volume Concentration	33.3
Pigment-To-Binder Ratio	1.9
Wet Density (g/ml)	1.7
Dry Density (g/ml)	2.1
Volatile Organic Content (g/liter of paint)	
After thinning with 1,1,1 trichloroethane	295
Prior to thinning	395

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Table IV: Composition of NADC Polyurethane Flexible Primer

Component A	Weight Percent
X3009-A	53.2
Strontium chromate	4.4
Zinc chromate	4.4
Barium chromate	5.0
Zinc molybdate	5.4
Titanium dioxide	3.1
Magnesium silicate	5.6
Sub-total	81.1
Component B	
X3009-B	18.9
Total	100.0

These materials are mixed approximately 4 parts of Component A to 1 part of Component B by volume. 40 grams (37.8 milliliters) of 1,1,1 trichloroethane were added to obtain a spray viscosity of 20 to 22 seconds using a Zahn 2 cup.

Pigment Volume Concentration	20.4
Pigment-To-Binder Ratio	.7
wet Density (g/ml)	1.3
Dry Density (g/ml)	1.6
Volatile Organic Content (g/liter of paint)	
After thinning with 1,1,1 trichloroethane	294
Prior to thinning	395

Table VI: Proposed Flexible Primer Specification Requirements

<u>COATING PROPERTIES</u>	<u>PROPOSED REQUIREMENT</u>
60° gloss	20
Adhesion - wet tape test	No uplifting
Adhesion - scrape test	2 Kg
Impact flexibility	60% elongation
Mandrel bend @ -60F	0.125 inches
Tensile strength	2500 PSI
Elongation at break	100%
Water resistance	No coating defects
Humidity resistance	No coating defects
Mil-L-23699 resistance	No coating defects
Mil-H-83282 resistance	No coating defects
Corrosion - salt spray Aluminum	No corrosion or blistering
Aluminum/graphite	No pitting greater than 1 mm in depth
Corrosion - filiform	No filiform extending beyond 0.25" from scribe and majority of filament less than 0.125"
Solvent resistance	No coating removal
Strippability	90% surface area stripped

Table V: Mil-P-23377E and Mil-C-83286B Requirements and Primer/Topcoat and Flexible Primer Properties.

<u>CURTAIN PROPERTIES</u>	<u>MIL-P-23377E PRIMER REQUIREMENTS</u>	<u>MIL-C-83286B TOPCOAT REQUIREMENTS</u>	<u>PRIMER/TOPCOAT PROPERTIES</u>	<u>FLEXIBLE PRIMER PROPERTIES</u>
Set-to-touch time (hour)	≤ 0.6	≤ 2	≤ 0.75	≤ 0.75
Dry hard time (hour)	≤ 6	≤ 6	≤ 3	≤ 3
40 gloss	≥ 10	Camouflage ≤ 12 & ≥ 7	≤ 3	≤ 10
65 gloss	--	--	≤ 3	--
Adhesion - wet tape test	No uplifting, SA	No uplifting, SA	No uplifting, SA	No uplifting, SA
Adhesion - scrape test (kg)	≥ 3	--	3	3.5
flexibility - impact (% elongation)	≥ 60	Camouflage ≥ 20	20	60
flexibility - sandral band	--	Camouflage ≤ 0.5 inches	0.125 inches	0.125 inches
Scrippability (% surface area stripped)	≥ 90	--	100	100
Water resistance	No coating defects	No coating defects	No coating defects	No coating defects
Corrosion - salt spray aluminum	No substrate corrosion or coating blisters	No substrate corrosion or coating blisters	No substrate corrosion or coating blisters	No substrate corrosion or coating blisters
aluminum/composite	No pitting greater than 1mm in depth	--	No substrate corrosion or coating blisters	No substrate corrosion or coating blisters
Corrosion - filiform	No filiform corrosion extending beyond 0.25" from scribe and majority of filiforms less than 0.125"	--	No substrate corrosion or coating blisters	No substrate corrosion or coating blisters
Fluid resistance	No coating defects	No coating defects	No coating defects	No coating defects
Mil-L-23599	--	--	Pass Mil-P-23377E requirements	Pass Mil-P-23377E requirements
Mil-N-5606	No coating defects	No coating defects	No coating defects	No coating defects
Mil-N-83282	No coating defects	--	No coating defects	No coating defects
Mil-N-83306 (Sky, 5000)	--	No coating defects	No coating defects	No coating defects
Humidity resistance	--	No coating defects	No coating defects	No coating defects
Heat resistance	--	Maintain gloss, color and flexibility requirements	Pass Mil-C-83286B requirements	--
Accelerated weathering	--	Maintain gloss, color, and flexibility requirements	Pass Mil-C-83286B requirements	--

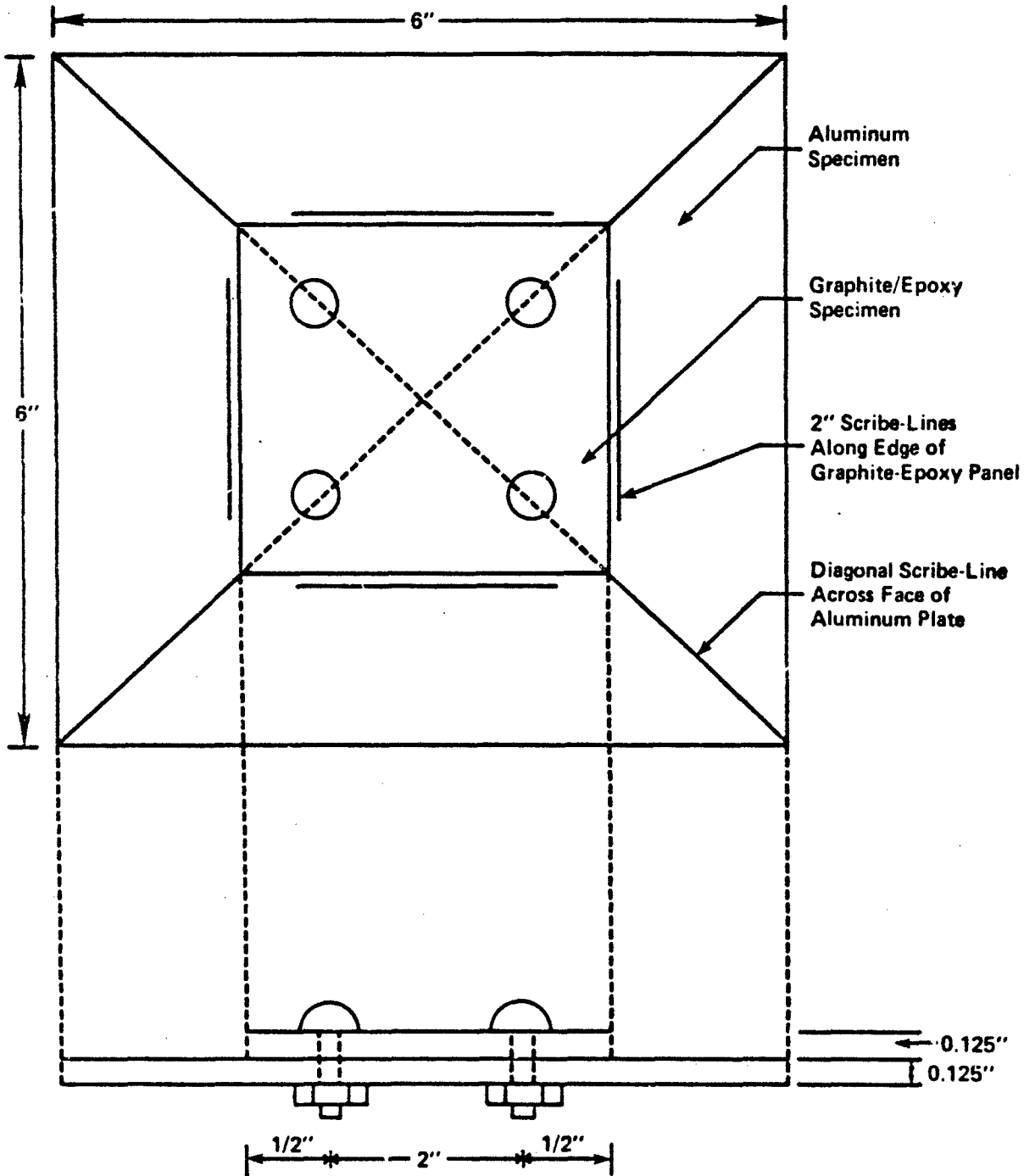


Figure 1: Aluminum/Graphite-Epoxy Corrosion Test Specimen

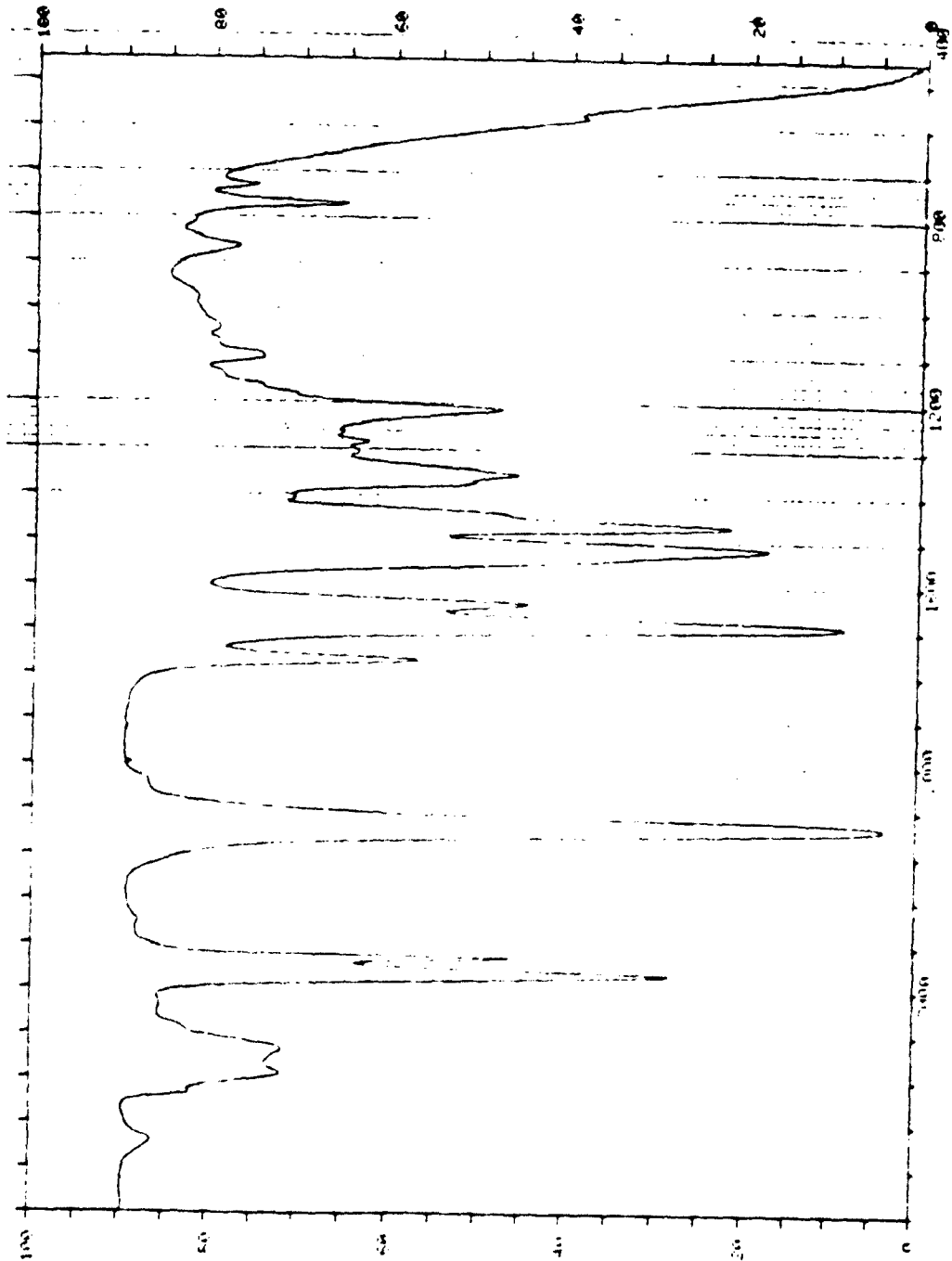


Figure 3: Infrared Spectra of X3009, Part B, Hexamethylene Diisocyanate

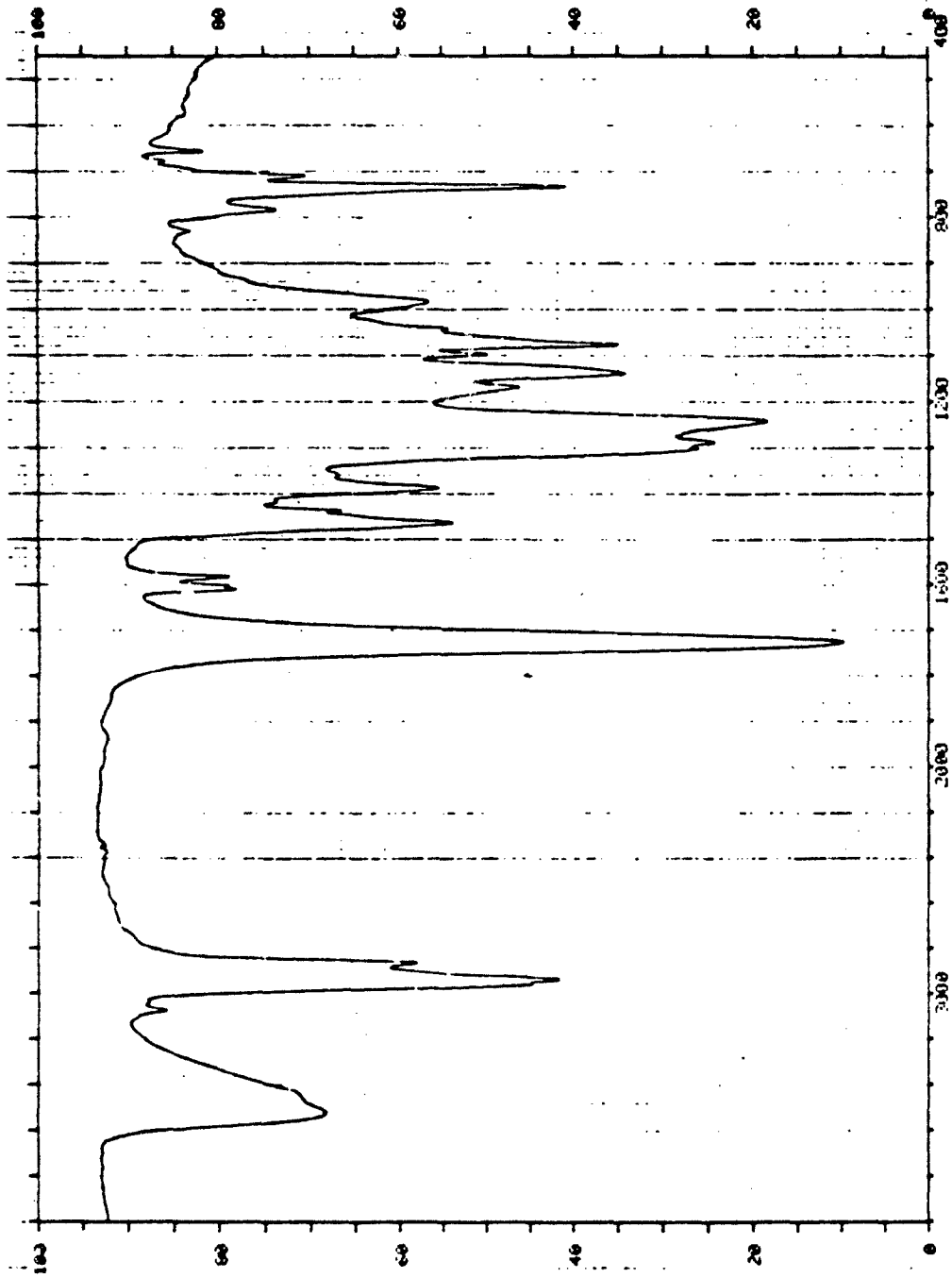


Figure 2: Infrared Spectra of X3009, Part A, Polyester Polyol

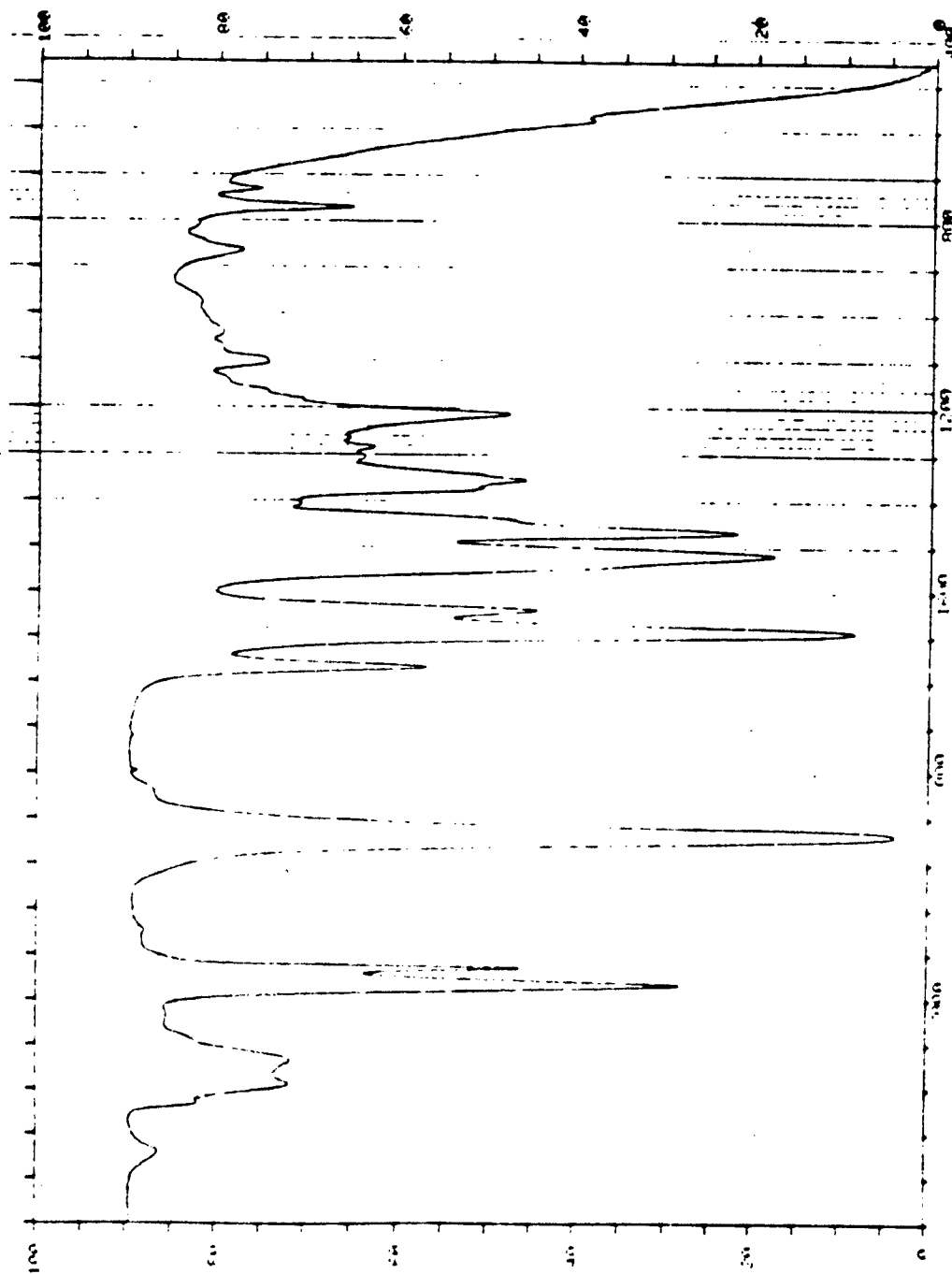
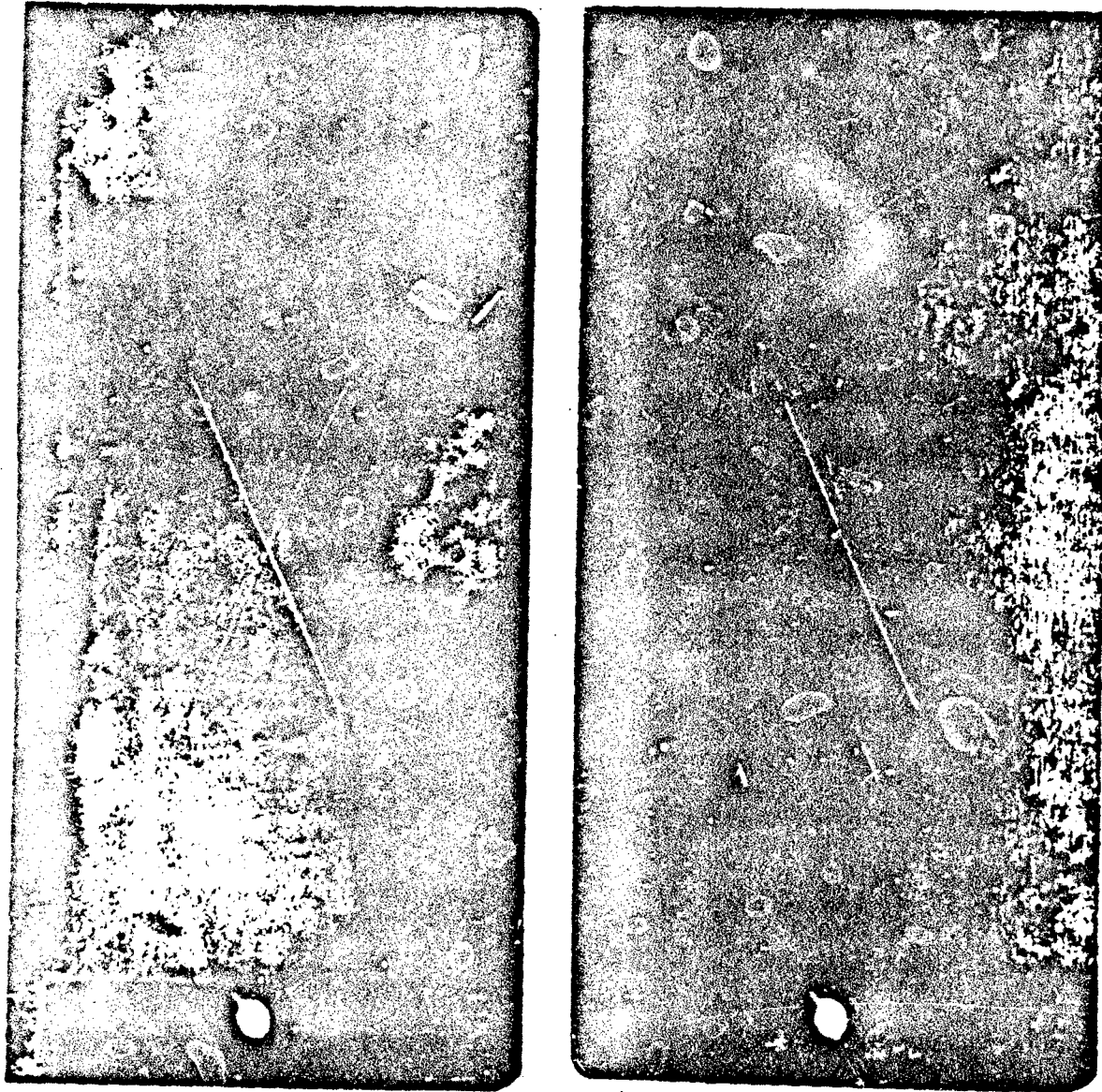


Figure 1: Infrared Spectra of X3009, Part B, Hexamethylene Diisocyanate

2000 HOURS SALT SPRAY



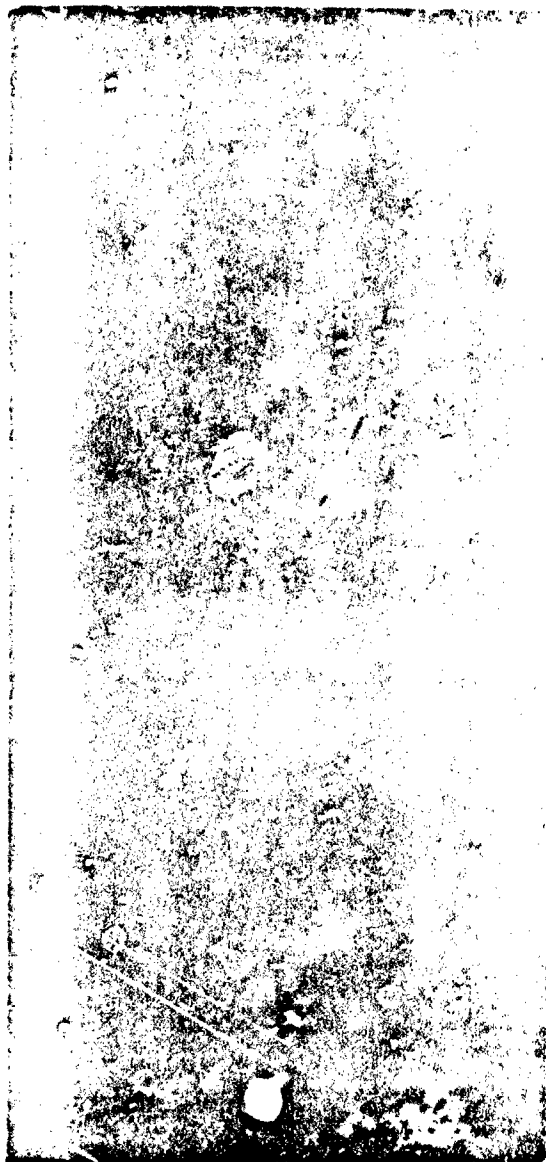
AFTER EXPOSURE

COATING REMOVED

MIL-P-23377E

Figure 4: MIL-P-23377E Exposed to Salt Spray for 2000 Hours

2000 HOURS SALT SPRAY



-3

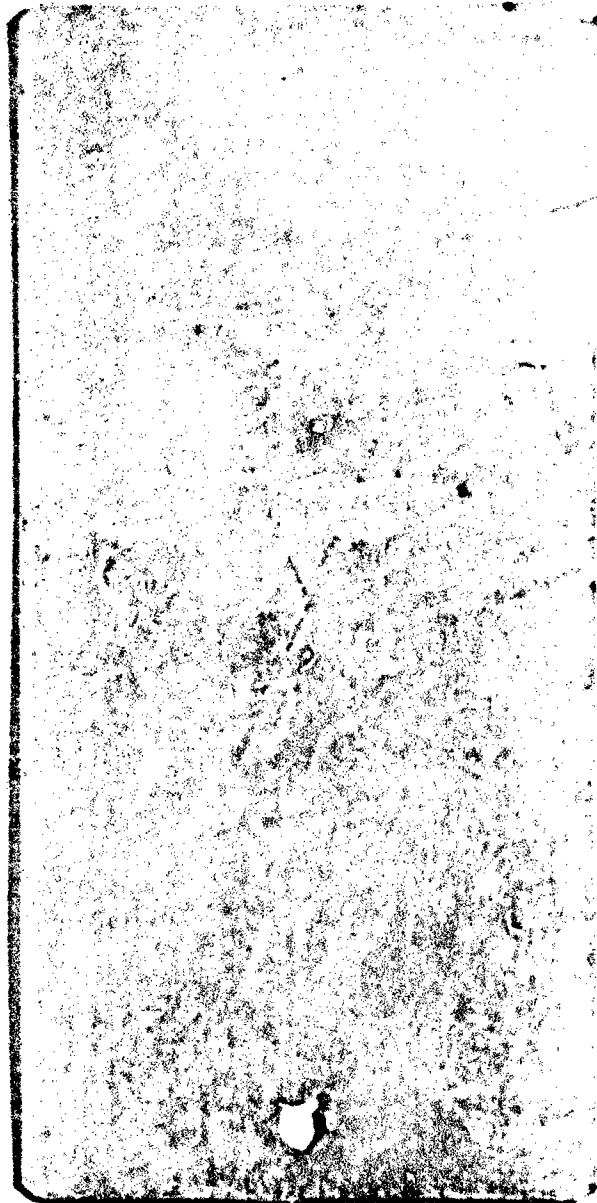
AFTER EXPOSURE

COATING REMOVED

MIL-P-23377E/MIL-C-83286B

Figure 5: MIL-P-23377E/MIL-C-83286B Specimens Exposed to Salt Spray for 2000 hours

2000 HOURS SALT SPRAY



3

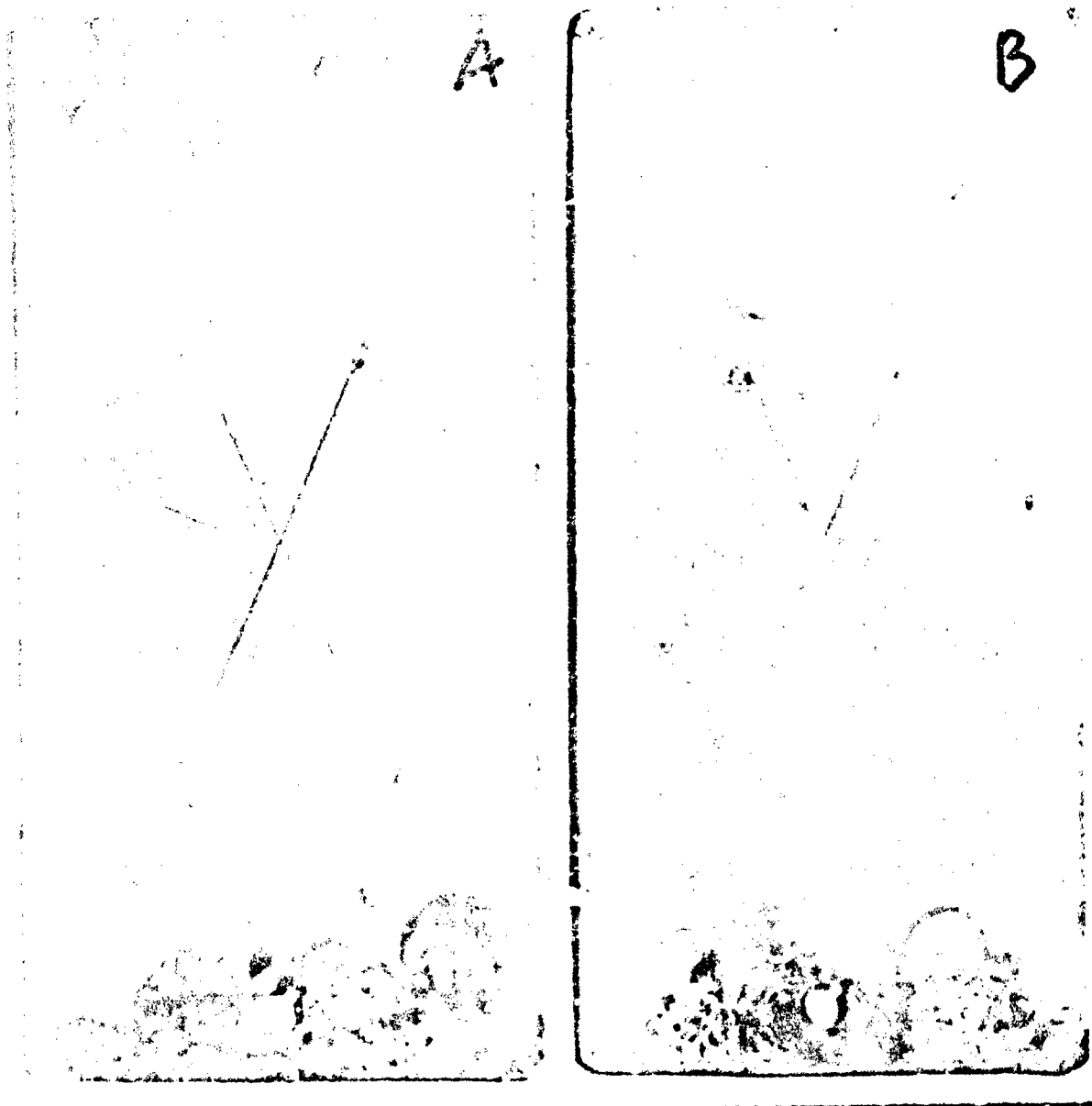
AFTER EXPOSURE

COATING REMOVED

PRIMER/TOPCOAT

Figure 6: Primer/Topcoat Specimens Exposed to Salt Spray for 2000 Hours

ONE YEAR SALT SPRAY



COATING REMOVED

PRIMER/TOPCOAT

Figure 1: Primer/Topcoat Specimens Exposed to Salt Spray for One Year

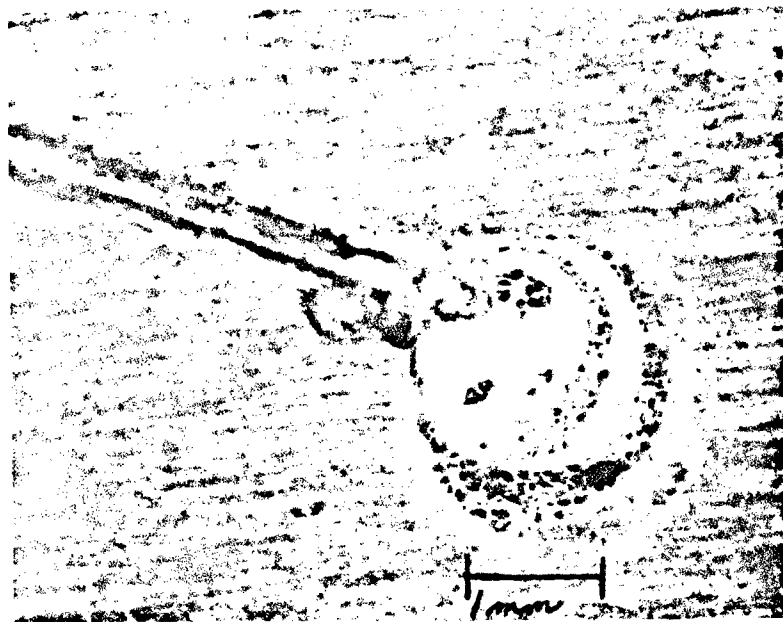


FIGURE . CIRCULAR AREA ON PRIMER/TOPCOAT SPECIMEN
EXPOSED TO SALT SPRAY FOR ONE YEAR (20X)

┌ 1mm ─



FIGURE . SCRIBE AREA ON PRIMER/TOPCOAT SPECIMEN
EXPOSED TO SALT SPRAY FOR ONE YEAR (20X)

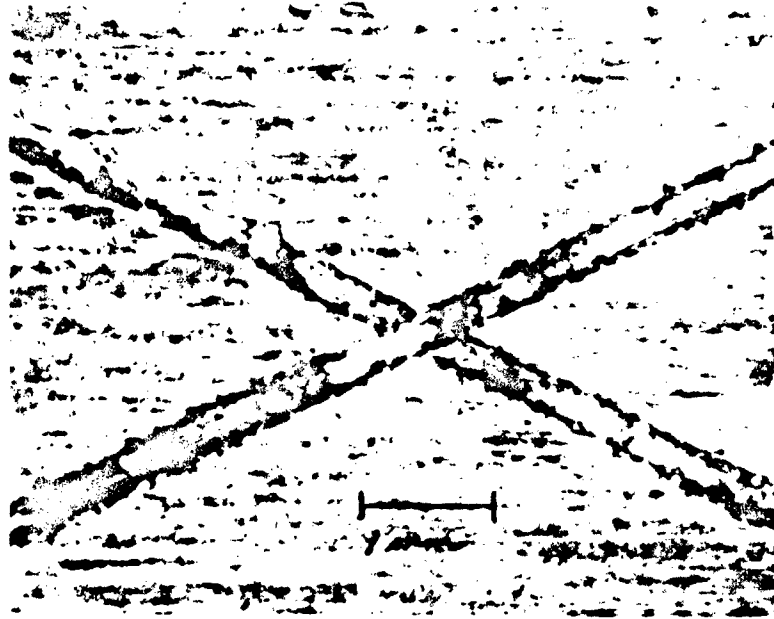


FIGURE . SCRIBE AREA ON PRIMER/TOPCOAT SPECIMEN
EXPOSED TO SALT SPRAY FOR 2000 HOURS (20X)

← 1mm →

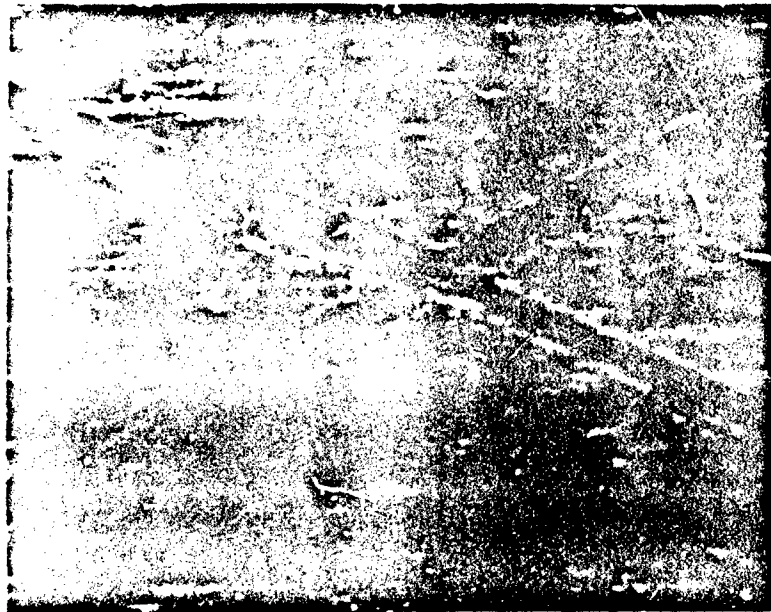
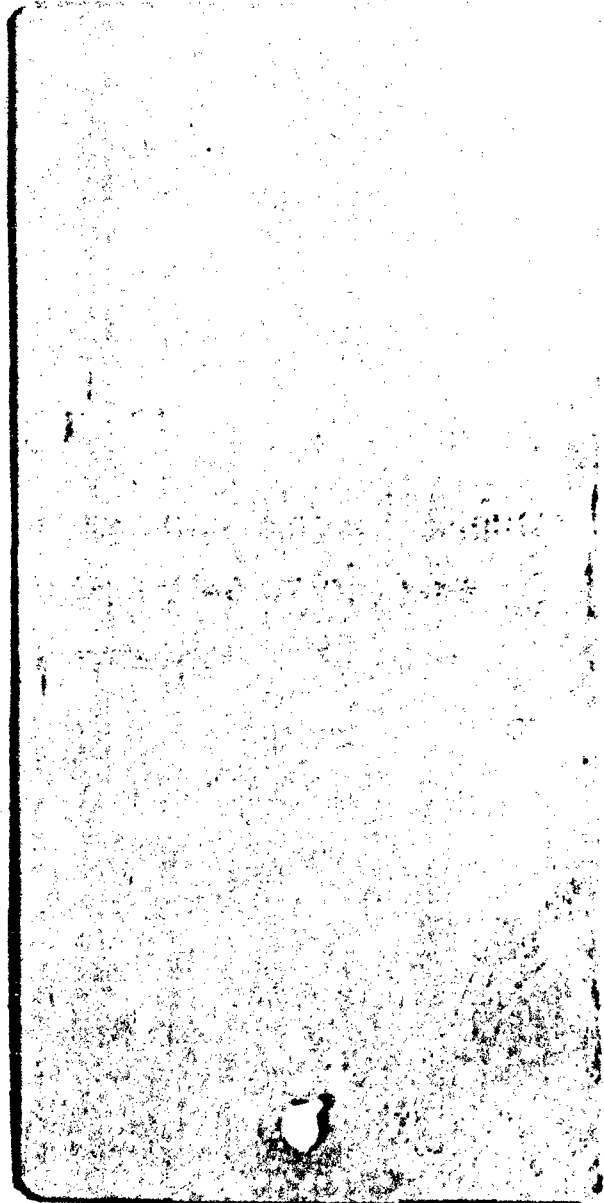


FIGURE . SCRIBE AREA ON THE NADC FLEXIBLE PRIMER
EXPOSED TO SALT SPRAY FOR ONE YEAR (20X)

B 3 6

NADC-87016-60

2000 HOURS SALT SPRAY



AFTER EXPOSURE

COATING REMOVED

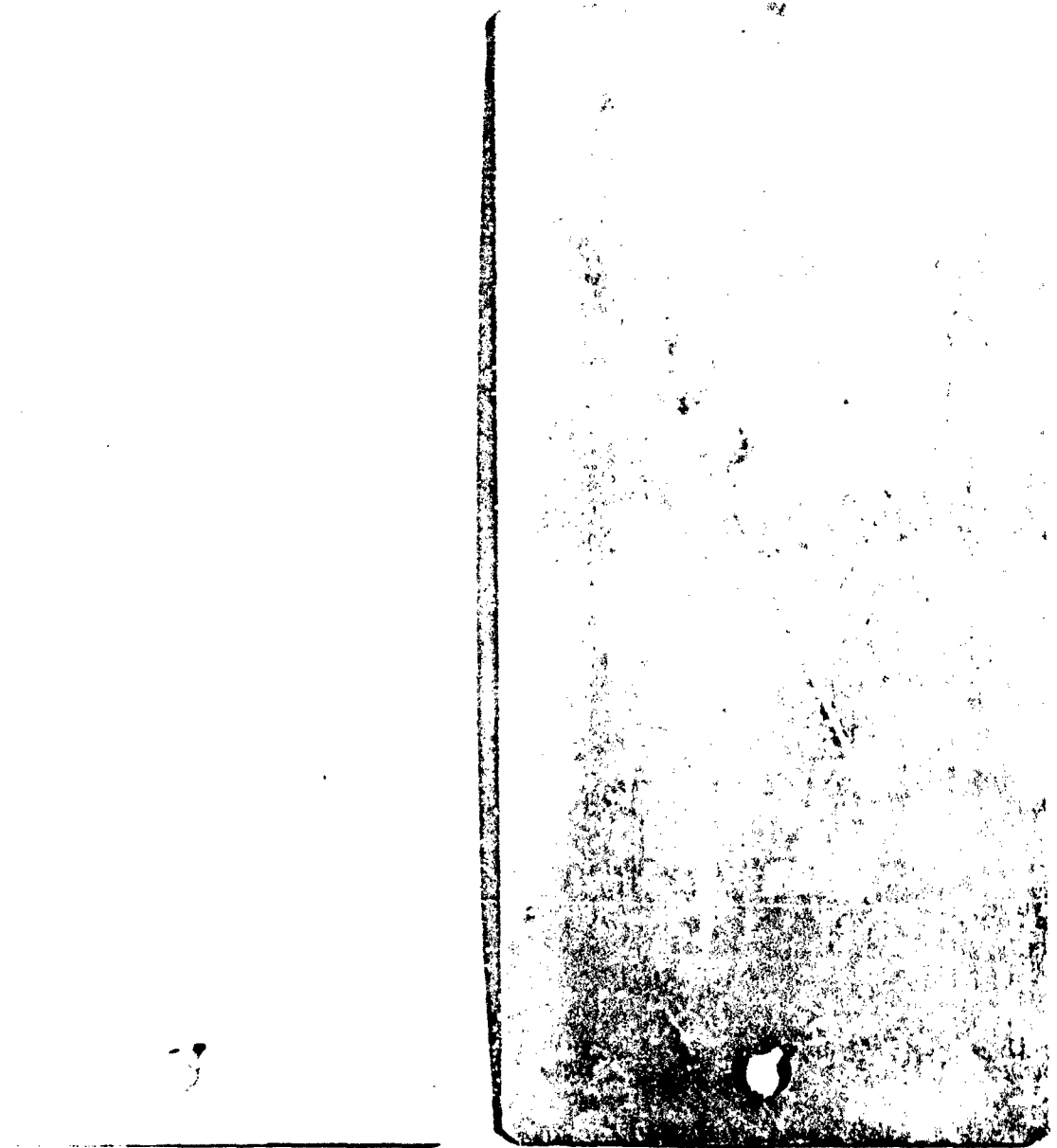
NADC FLEXIBLE PRIMER

Figure 12: NADC Flexible Primer Exposed to Salt Spray for 2000 Hours

B37

NADC-87016-60

2000 HOURS SALT SPRAY



AFTER EXPOSURE

COATING REMOVED

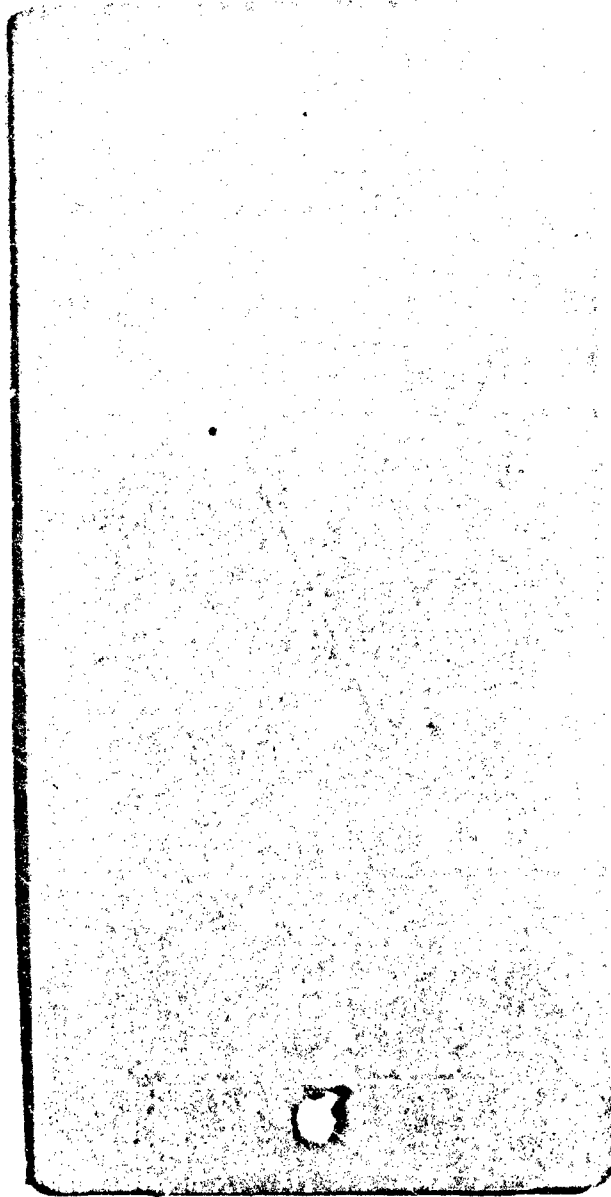
NADC FLEXIBLE PRIMER/MIL-C-83286B

Figure 13: NADC Flexible Primer/Mil-C-83286 Exposed to Salt Spray for One Year

B 3 8

NADC-87016-60

2000 HOURS SALT SPRAY



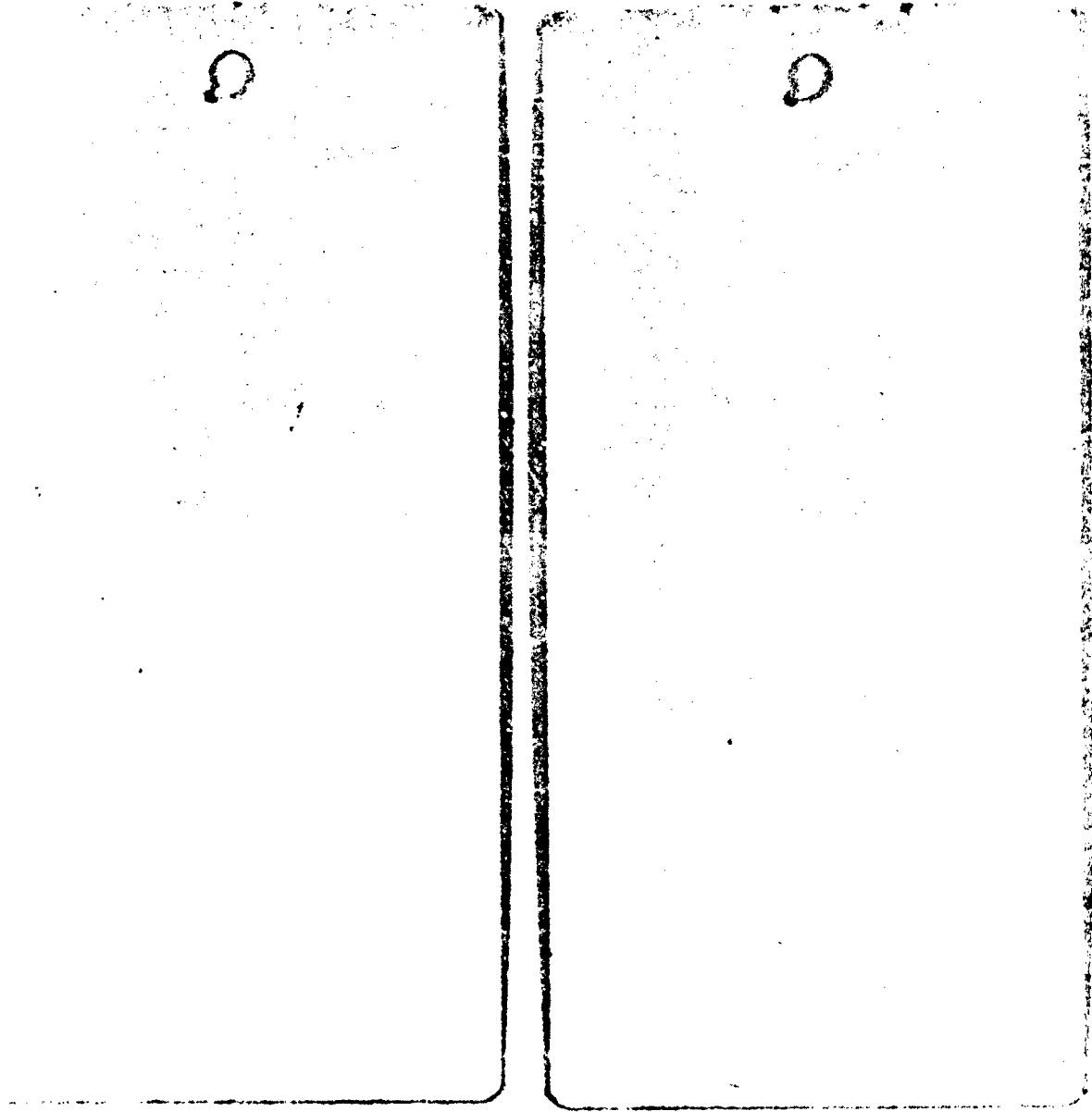
AFTER EXPOSURE

COATING REMOVED

KOROFLEX PRIMER

Figure 14: Koroflex Primer Exposed to Salt Spray for 2000 Hours

AFTER 1 YEAR 5% NaCL EXPOSURE



COATING REMOVED

Figure 15: NADC Flexible Primer Exposed to Salt Spray for one year.

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REPORT NO. NADC-88102-60



**ANALYSIS OF THE NAVAIRDEVCCEN SELF-PRIMING TOPCOAT
ON GRAPHITE/EPOXY COMPOSITES**

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15 AUGUST 1988

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INTRODUCTION

The standard paint system for naval aircraft consists of a polyurethane topcoat (MIL-C-83286 or MIL-C-85285) over a epoxy-polyamide primer (MIL-P-23377 or MIL-P-85582). Occasionally, a polysulfide sealant (MIL-S-8802 or MIL-S-81733) is applied between the primer and the topcoat to increase the flexibility of this coating system in highly stressed areas such as fastener patterns. The topcoat provides the weather, abrasion, and fluid resistance, and the optical properties such as color, opacity, and gloss. The primer, which currently contains carcinogenic pigments (chromates), acts as a corrosion inhibitor and an adhesion promoter.

In September of 1986, the Naval Air Development Center developed a single coating system to replace the standard two or three coating systems described above. In effect, a self-priming topcoat (SPTC) was produced (1). Equivalent or superior paint properties were achieved with potential weight, material, and labor savings. This SPTC was developed for use on aluminum-skinned aircraft. Since the amount of graphite fiber reinforced epoxy (Gr/Ep) composite components used on Navy aircraft is rapidly increasing, the current effort was undertaken to determine the compatibility of the SPTC with Gr/Ep composite substrates.

EXPERIMENTAL**MATERIALS**

The materials analyzed in this effort were the SPTC and the control coating system (MIL-P-23377/MIL-C-83286) on Gr/Ep substrates. The SPTC consisted of a two component aliphatic polyurethane resin with a non-lead, non-chromate pigment system (Table I). Specifically, the resin components are a polyester diol reacted with a hexamethylene diisocyanate. The pigment system consisted of titanium dioxide vesticulated beads (2), titanium dioxide, a proprietary organo-zinc complex, zinc molybdate, and zinc phosphate. The titanium dioxide vesticulated beads and the titanium dioxide impart the opacity and color to the SPTC while the three other pigments mainly provide corrosion inhibition but also contribute to the opacity and color. The solvent system, excluding the solvents in the resin system, consisted solely of 1,1,1-trichloroethane which is currently classified as a volatile organic compound (VOC) exempt solvent.

The control coating system consisted of an epoxy-polyamide primer (MIL-P-23377 type I) under an aliphatic polyurethane topcoat (MIL-C-83286). The primer used in this analysis contained approximately 27% strontium chromate by weight in the dry film.

The substrate material consisted of the Hercules AS/3501-6 graphite fiber/epoxy matrix composite system.

PROCEDURES**Application**

The surfaces of the Gr/Ep substrates were prepared by gently wiping using non-oil extractable wipes moistened with reagent grade methyl ethyl ketone. The coating were applied using conventional air spray equipment at the desired coating thicknesses: 0.6 mils (15.4 micron) to 0.9 mils (22.86 micron) for MIL-P-23377, and 1.7 mils (43.18 micron) to 2.3 mils (58.42 micron) for both MIL-C-83286 and the SPTC. The coatings were allowed to cure for one week at ambient laboratory conditions prior to testing.

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The two coating systems were analyzed based on adhesion, fluid immersion, and accelerated environmental exposure properties. In the tests involving fluid and/or environmental acrylic lacquer to prevent moisture diffusion through the composite specimen to the coating/substrate interface. Also, the perimeter of the coated test panels were sealed with wax to prevent edge effects.

Adhesion

The X-cut tape and the cross-hatch tape tests (ASTM D3359, Methods A and B) were used to analyze the adhesion of the coatings to the Gr/Ep substrates (three trials per coating per test). Wet tape adhesion tests (Fed. Test Method Std. 141C, Method 6301.2) were also conducted in which the coated substrates were first subjected to 24 hours static immersion in distilled water at room temperature ($75 \pm 5^\circ\text{F}$) before using X-cut and cross-hatch test procedures. Accelerated wet tape adhesion tests were performed in which the temperature was $120 \pm 5^\circ\text{F}$ at 4 and 10 days. The dry and wet tape tests were evaluated using the classifications listed in ASTM D3359 (Tables II & III).

Fluid Immersion

The coated Gr/Ep specimens (two trials per coating per test) were exposed to a variety of fluids, at various temperatures and durations: hydraulic fluid (MIL-H-83282) at $150 \pm 5^\circ\text{F}$ for 1 day, lubricating oil (MIL-L-23699) at $250 \pm 5^\circ\text{F}$ for 1 day, jet fuel at $75 \pm 5^\circ\text{F}$ for 14 days, distilled water at $75 \pm 5^\circ\text{F}$ for 4 and 10 days. After the specimens were subjected to the appropriate test conditions, the coatings were examined for softening, blistering, uplifting or any other defects.

Accelerated Environmental Exposure

Accelerated weathering, 95% relative humidity, and 5% NaCl salt fog tests were used to determine coating/substrate resistance to these accelerated environmental conditions. In all three tests (2 trials per coating per test), the coatings were examined for blistering, uplifting, or any other coating delamination defect after being subjected to the designated test conditions. For 500 and 1000 hr xenon-arc accelerated weathering (ASTM G26), the test specimens were subjected to a constant 6000 watt light source with a water spray being introduced the last 18 minutes of every two hours. Other cabinet conditions include a black body temperature of $140 \pm 5^\circ\text{F}$, a relative humidity of $50 \pm 5\%$, and a Xe-arc intensity of 0.3 to 0.4 watt/sq meter at 340 nm wavelength. For humidity resistance (ASTM B117), the specimens were subjected to 95% relative humidity at $120 \pm 2^\circ\text{F}$ for 30 days. For 2000 hr salt fog resistance (ASTM B117), the test specimens were subjected to a 5% NaCl salt fog at an orientation of 15 degrees from vertical and examined every 500 hours for coating defects and also for delamination by tape test.

RESULTS AND DISCUSSION

The objective of the current effort was to determine the compatibility of the SPTC with Gr/Ep composite substrates. The SPTC was analyzed and comparatively rated against the standard Navy coating system on Gr/Ep substrates based on three main properties: adhesion, fluid immersion resistance, and accelerated environmental resistance. Due to the inherent structural properties of Gr/Ep composites, several common physical tests were not conducted. For example, impact resistance (toughness), impact flexibility, and mandril bend flexibility tests could not be performed due to the rigidity of the Gr/Ep panels. The common corrosion resistance tests (5% NaCl salt fog, SO₂/NaCl salt fog, and filiform) do not yield substrate corrosion data since polymers degrade rather than corrode. However, the SPTC has been analyzed for flexibility and corrosion protection on aluminum (1). A summary of the test results for the coatings on Gr/Ep substrates is provided in Table IV.

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Adhesion can be defined (as in ASTM D907) as "the state in which two surfaces are held together by interfacial forces which consist of valence forces or interlocking forces, or both." The force of removal can be determined by using the X-cut and cross-hatch which combine two mechanisms of removal: scraping and peeling. These two tests showed that the control coating and SPTC both possess good substrate/coating adhesion to Gr/Ep. Both coatings passed the dry and wet tape adhesion tests at the standard and accelerated conditions. The values obtained were 4A by the X-cut method and 4B by the cross-hatch method. Small areas at the fringe of the incision were removed, causing the rating to be slightly less than perfect but still passing (Figure 1).

The solutions used in the fluid immersion tests are indicative of common Navy aircraft operational fluids that may come in contact with coated Gr/Ep substrates. In an earlier study, these solutions were determined to be non-deleterious (with respect to tensile strength) to bare Gr/Ep substrates immersed for over two months at approximately 212°F (3). Also, the SPTC on aluminum was found to be resistant to these fluids at conditions identical to the current study (1). Thus the current fluid immersion tests actually indicate the permeability (or the non-permeability) of the coating to these fluids. These exposures also further test adhesion since the permeability of these fluids in these coatings may affect the coating/substrate interface. Other than some discoloration, the control coating and the SPTC were not affected by the test fluids. They showed good barrier resistance (no softening) and good adhesion (no blistering or any other coating delamination).

The xenon-arc accelerated weathering, 95% humidity, and 5% NaCl salt fog resistance tests are designed to simulate environmental conditions but at highly accelerated rates. Since Gr/Ep substrates produce no corrosion products in these environments, these tests are actually being used to determine the resistance of the coating to degradation, permeability, and its related adhesion properties. The SPTC and the control coating system showed no signs of blistering, uplifting, or any other type of coating delamination after exposure to these test conditions. Tape adhesion testing, performed on the specimens exposed to salt fog, produced no removal of the coatings.

CONCLUSIONS AND RECOMMENDATIONS

The SPTC performed as well as the control coating (MIL-P-22337/MIL-C-83286) on Gr/Ep substrates in controlled laboratory tests. After the anticipated successful completion of fleet testing (currently on Gr/Ep panels on one F-14 and three H-3's), this coating can be effectively transitioned into the fleet for use on Gr/Ep components on Navy aircraft.

It is recommended that an optimized self-priming topcoat with primary and/or barrier pigments alone be developed for use on Gr/Ep or other non-metal substrates at a future date. Since, corrosion inhibitive pigments (in general) are heavier and more expensive than barrier pigments, a reduction in coating weight and raw materials expense can be achieved. Also, a study of the disbondment characteristics of organic coatings on polymeric substrates would be beneficial to future coatings development.

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3. K.G. Clark, 'Compatibility of Aircraft Operational Fluids With a Graphite/Epoxy Composite-Development of an Exterior Coating System and Remover,' NADC-80046-60, Warminster, PA, June 1980.

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Table I: Composition Of Lusterless White Self-Priming Topcoat

<u>Component A</u>	<u>Formulation Wt%</u>
X3009-A (Coatings For Industry)	37.6
Titanium Dioxide (DuPont)	1.1
Titanium Dioxide Vesticulated Beads (Enterprise)	0.4
Zinc Molybdate (Sherwin Williams)	29.9
Zinc Phosphate (Mineral Pigments)	17.0
Sicorin RZ, an organo-zinc complex (BASF)	1.7
Anti-Terra-204 (Byk Chemie)	<u>0.5</u>
Sub-Total	88.2
<u>Component B</u>	
X3009-B (Coatings For Industry)	<u>11.8</u>
Total	100.0

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Table II: X-Cut (Method A) Adhesion Rating

<u>Rating</u>	<u>Description</u>
5A	No peeling or removal
4A	Trace peeling or removal along incisions.
3A	Jagged removal along incisions up to 1/16 inch (1.6 mm) on either side.
2A	Jagged removal along most of incisions up to 1/8 inch (3.2 mm) on either side.
1A	Removal from most of the area of the X under the tape.
0A	Removal beyond the area of the X.

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Table III: Cross-Hatch (Method B) Adhesion Rating

<u>Rating</u>	<u>Description</u>
5B	The edge of the cuts are completely smooth; none of the squares of the lattice is detached.
4B	Small flakes of the coating are detached at intersections; less than 5% of the area is affected.
3B	Small flakes of the coating are detached along edges and at intersections of cuts. The area affected is 5 to 15% of the lattice.
2B	The coating has flaked along the edges and on parts of the squares. The area affected is 15 to 35% of the lattice.
1B	The coating has flaked along the edges of cuts in large ribbons and whole squares have detached. The area affected is 35 to 65% of the lattice.
0B	Flaking and detachment worse than Rating 1B.

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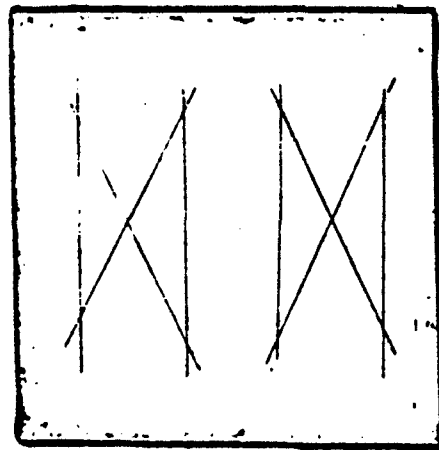
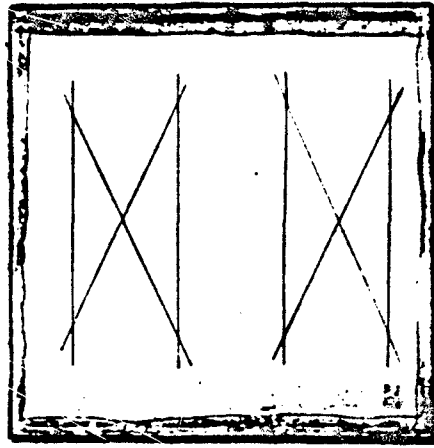
Table IV: Summary Of Results On Gr/Ep

Test Conditions	MIL-P-23377/ MIL-C-83286	Self-Priming Topcoat	
	ADHESION		
X-Cut:	Dry, 75°F	4A	4A
	H ₂ O, 75°F, 1 day	4A	4A
	H ₂ O, 120°F, 4 day	4A	4A
	H ₂ O, 120°F, 10 day	4A	4A
Cross-Hatch:	Dry, 75°F	4B	4B
	H ₂ O, 75°F, 1 day	4B	4B
	H ₂ O, 120°F, 4 day	4B	4B
	H ₂ O, 120°F, 10 day	4B	4B
FLUID IMMERSION			
MIL-H-83282:	150°F, 1 day	ND	ND
MIL-L-23699:	250°F, 1 day	ND	ND
JP-5:	75°F, 1 day	ND	ND
H ₂ O:	75°F, 1 day	ND	ND
	120°F, 4 day	ND	ND
	120°F, 10 day	ND	ND
Break Free:	75°F, 14 day	ND	ND
ACCELERATED ENVIRONMENTAL EXPOSURE			
Weatherometer:	Xe-arc, H ₂ O spray, 500 hr	ND	ND
	Xe-arc, H ₂ O spray, 1000hr	ND	ND
Humidity:	95% RH, 120°F, 30 day	ND	ND
Salt Fog:	5% NaCl, 2000 hr, tape adhesion	ND	ND

ND - No coating defects

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Figure 1: X-Cut Adhesion Test On Coated Gr/Ep Subs rates



SELF-PRIMING TOPCOAT

MIL-P-23377/MIL-C-83286



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**PRIMERLESS FINISHING SYSTEMS FOR THE
CORROSION PROTECTION OF ALUMINUM**

Donald J. Hirst, Charles R. Hegedus, Stephen J. Spadafora,
and Anthony T. Eng

Air Vehicle and Crew Systems Technology Department
NAVAL AIR DEVELOPMENT CENTER
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19 ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>A trend to develop primerless systems for military equipment has begun in which a topcoat can be applied directly to surface treated aluminum. Two approaches to obtain a primerless system are currently available and were investigated. In the first approach, a standard sulfuric acid anodized surface was sealed with a polyurethane colloidal suspension. The resulting pretreatment can be directly topcoated. The second approach involved the application of a primerless or self-priming topcoat applied directly to a surface pretreatment. Adhesion, electrochemical impedance spectroscopy, flexibility and corrosion resistance tests were performed on several aluminum substrates to determine the physical properties of the coating-pretreatment systems. The results of this analysis indicate that these primerless systems show promise and should be considered for specific finishing system applications.</p>					
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INTRODUCTION

The use of aluminum in the construction of military equipment is widespread due to its high specific strength compared to other structural alloys. This is vividly illustrated in airframe and aerospace structures where aluminum is by far the most commonly used material. Although structural and operational requirements are the primary concerns during design and construction of military equipment, component reliability and maximum lifetime with minimum maintenance are also required. A major influence on component performance is material properties. Materials, processing methods and protective pretreatments which minimize service failures must be utilized. Nowhere is this more apparent than with Navy aircraft which are usually stationed in highly corrosive environments.

In order to minimize the threat of deterioration, aluminum alloys are selected which have the required mechanical properties and exhibit less susceptibility to corrosive attack. Nonetheless, these alloys, if left unprotected, would rapidly corrode and cause the aircraft to be grounded. Therefore, inorganic surface treatments and organic coatings are specified for virtually all military equipment and especially aerospace systems. MIL-S-5002C, "Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems" describes cleaning requirements and surface treatments for aluminum alloys. MIL-F-7179, "Finish, Coatings and Sealants for the Protection of Aerospace Weapons Systems" provides the requirements for paint and organic coatings used on U.S. military aircraft. References (1, 2) provide more detailed descriptions of corrosion control documents and finishing systems for military equipment.

In general, Navy aircraft finishing systems for aluminum consist of an inorganic surface treatment followed by a series of organic coatings. The surface treatment can produce either an anodized film or chromate conversion coating. The former is the product of an anodization and seal process which is performed in accordance with MIL-A-8625. The chromate conversion coating is achieved by applying materials conforming to MIL-C-81706 to produce a conversion coating meeting MIL-C-5541. The organic coating system consists of an epoxy primer (MIL-P-23377 or MIL-P-85582) and a polyurethane topcoat (MIL-C-83286 or MIL-C-85285). Several types of aircraft also require a coat of spray sealant (MIL-S-8802, MIL-S-81733, or MIL-P-87112) between the primer and topcoat. This finishing system was specifically designed to protect aluminum aircraft structures from the harsh aircraft carrier environment. The surface treatments enhance corrosion inhibition and adhesion of the subsequent coatings. The primers are adherent, and they inhibit corrosion of the substrata due to a high concentration of strontium chromate (3). The polyurethane topcoats are chemical and weather resistant, flexible and provide the required optical properties. A sealant coat is occasionally applied to enhance the flexibility of the coating system and prevent cracking of the paint, especially around fasteners and areas of excessive flexing.

Although the finishing system described above has been the premier finishing system on aircraft for 20 years, it has several deficiencies. The primer is brittle, especially at low operating temperatures (-51°C), resulting in cracking of the paint system on highly flexed areas. Sealants are soft and easily deformed and are difficult to apply and remove. In addition increased awareness and concern for environmental preservation and worker safety have caused local and state governments to limit volatile organic compound (VOC) emissions during painting operations. These regulations have impacted equipment manufacturers and rework depots by limiting the amount and types of paints which can be applied. The carcinogenic effects of chromates, which are used in conversion coatings and primers, present another concern about the current finishing system.

The issues listed above have prompted a recent trend to develop finishing systems which essentially consist of a surface pretreatment and one organic coating (4-7). This has been accomplished by using either a pretreatment, which can be directly coated with conventional topcoats (4), or a topcoat which can be applied to conventional inorganic pretreatments (5-6). In either case, the application of a primer is

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eliminated saving application time, manhours, and materials. The objective of this effort was to investigate the effectiveness of these systems to protect aluminum substrates.

DESCRIPTION OF PRIMERLESS FINISHING SYSTEMS

As stated above, there are two approaches to eliminate the primer from a finishing system: (1) modify the inorganic pretreatment or (2) modify the topcoat. Reference (4) discloses a coating composition and application process for a modified anodized surface treatment which precludes the use of a subsequent primer prior to topcoating. The process follows the standard anodizing procedure (8) except for the final sealing step. Anodizing is a process by which the thickness of the natural oxide surface film, normally 1 to 5 nm, is increased to 0.5 to 100 μm . This is accomplished by creating a cell in which the aluminum is anodic to another metal in an aqueous acid solution, commonly sulfuric or chromic acid. When current is passed through the cell, aluminum oxide is formed on the surface. As the process continues, oxide and hydroxide ions in the electrolyte solution diffuse and penetrate into the surface until they reach the aluminum-oxide interface. At this point they combine with aluminum ions, thus increasing the oxide layer thickness. This process is continued until equilibrium is reached which is dependent on the specific process variables. The anodized film consists of a non-porous underlying layer with a porous oxide structure on the surface. In order to increase the corrosion resistance of the film, the porous layer is closed by sealing with steam, hot water, or hot water solutions.

In contrast to the conventional process (4), the modified procedure utilizes a colloidal suspension of polyurethane resin to seal the porous oxide surface. Typically this suspension contains 7% solids in an alkaline solvent water bath. Upon contact with the aluminum surface, normally at 180°C, the solution induces film hydration and also impregnates the porous structure. The particle size of the colloidal suspension is designed to fit within the anodized surface structure. Upon completion of the sealing step, the specimen is exposed to air which allows curing and crosslinking of the polyurethane seal. The resulting film is water and solvent resistant, hard, flexible and corrosion resistant. A standard topcoat, MIL-C-83286 or equivalent, can be applied to this substrata one hour after removal from the sealing tank. Adhesion of the polyurethane topcoat is expected to be good due to the obvious chemical compatibility between pretreatment and topcoat. Specific formulations and procedures are provided in reference (4).

An alternative method for eliminating the need for a primer is to use a topcoat which is self-priming. Reference (5) describes the development and properties of one such coating. This coating can be applied directly to an aluminum substrata and provide the properties of the conventional primer and topcoat system designed for use on military aircraft. This coating can be applied to deoxidized, anodized or chromate conversion coated aluminum surfaces. It consists of a two component, aliphatic polyurethane binder with titanium dioxide, zinc molybdate, zinc phosphate, an organo-zinc salt, vesiculated polymer bead pigments. The polyurethane binder provides adhesion, flexibility, chemical and weather resistance. All of the pigments contribute to the film's opacity, however, the zinc molybdate, zinc phosphate, and organo-zinc salt are also corrosion inhibitors. This Self-Priming Topcoat exhibits good adhesion, corrosion inhibition, flexibility, chemical and weather resistance. The volatile organic compounds (VOC) content of the admixed material, which is suitable for airless spray, is 415 grams per liter of paint. If conventional air spray is desired for the application technique, this coating can be thinned with either 1,1,1 trichloroethane, which is currently exempt from emission regulations or standard urethane thinners.

EXPERIMENTAL

The objective of this effort was to illustrate the effectiveness of primerless finishing systems for aluminum. In order to accomplish this, the two primerless systems described above and the standard

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paint system on Navy and Air Force aircraft (MIL-P-23377D and MIL-C-83286) were applied to bare and clad 2024 T-3 and 7075 T-6 aluminum alloys. All of the systems were evaluated for adhesion, chemical (fluid) resistance, flexibility and corrosion protection. The following is a description of the substrates, coatings, and experimental procedures utilized.

Substrates and Coatings

Table 1 lists the twelve substrates and pretreatments which were utilized. The urethane sealed, sulfuric acid anodized (SAA) specimens were prepared by Lockheed Georgia, the dichromate sealed SAA specimens were prepared at our laboratories, and the chromate conversion coated specimens were obtained from Q Panel. The chromic acid and conversion coated specimens represent the common substrates found on military aircraft prior to painting. With the exception of the flexibility tests, all of the test procedures were conducted on all of these substrates. The flexibility tests were conducted on anodized 2024-O (annealed) aluminum specimens which were sealed with either the urethane colloidal suspension or hot water.

The three paint systems analyzed on all of the substrates in Table 1 are:

1. MIL-P-23377D, Type 1 "Primer Coatings, Epoxy Polyamide, Chemical and Solvent Resistant". Film thickness: 15.2 to 22.9 microns (0.006 to 0.009 inches).
MIL-C-83286, "Coating Urethane, Aliphatic Isocyanate, for Aerospace Application". Film thickness: 50.8 to 55.9 microns (0.020 to 0.022 inches).
2. MIL-C-83286. Film thickness: 50.8 to 55.9 microns.
3. Self-Priming Topcoat (5). Film thickness: 50.8 to 55.9 microns.

The above coatings were applied by conventional air spray and were allowed to cure for seven days prior to testing.

Experimental Procedures

Adhesion

Adhesion of the finishing systems was evaluated using two methods: wet tape adhesion (ASTM D 3359, method A) and scrape adhesion (ASTM D 2197, method A). The wet tape test was performed by immersing a specimen in distilled water for 24 hours. Upon removal, two parallel scribes, 1 inch apart, were cut through the coating and into the substrata. An "X" was subsequently scribed through the coating between the two initial scribes. A strip of 3M 250 masking tape was applied firmly to the coating surface perpendicular to the scribe lines and immediately removed with one quick motion. The specimens were examined for removal and uplifing of the coating from the substrata and the percentage of coating remaining on the surface was recorded.

The scrape test was performed on specimens with a section of the substrata surface exposed. The instrument used to perform this test was a SG-1605 Scrape Adhesion Test Apparatus manufactured by Gardner Laboratory. The test was performed by guiding a weighted stylus at a 45° angle to the specimen along the exposed substrata into the coating system. The scrape adhesion was recorded as the heaviest weight used without shearing the coating from the substrata.

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Chemical (Fluid) Resistance

The ability of the finishing systems to resist common fluids used in aircraft was evaluated by immersing each system in lubricating oil, hydraulic fluid, a hydrocarbon solvent, and water under the conditions listed in Table 2. The coatings subsequently were examined for softening, uplifting, blistering, and other defects which may have resulted from the exposure.

Flexibility

The impact flexibility of the coating systems was evaluated at 23°C (74°F) using Method 6226 (G.E. Impact) of Federal Test Method Standard 141B. The test apparatus consisted of a solid steel cylinder weighing 1.69 kg (3.7 lbs) which has spherical knobs protruding from the end. These knobs are designed such that the coating system is subjected to elongations of 0.5, 1, 2, 5, 10, 20, 40, and 60%. The impact is accomplished by allowing the steel cylinder to fall freely from a height of 1.05 meters (42 inches) through a hollow cylinder guide, striking the reverse side of the specimen. The imprints formed from the knobs were examined and the impact elongation was recorded as the highest deformation without cracking of the coating.

The coating systems were also tested for flexibility at -51°C which is common for military aircraft cruising at high altitudes. The test method is described in ASTM D 1737 and is performed by bending the specimen 180° around 0.32, 0.63, 1.27, and 2.54 cm (1/8, 1/4, 1/2, and 1 inch) diameter mandrels. After returning to room temperature, the coating were examined for cracking along the bend. The most severe bend (smallest mandrel diameter) which the coating withstood without cracking was recorded.

Corrosion Resistance

Four aluminum specimens of each finishing system were scribed in a figure "X" through the coating into the substrata. Two specimens each were exposed in 5% salt spray (ASTM B 117) for 2000 hours and two were exposed to SO₂/salt spray (ASTM G 85) for 500 hours. The panels were then inspected for corrosion in the scribe area and blistering of the coating. Subsequently, one panel was chemically treated to remove the organic coating without disturbing the substrata and the specimen was examined for corrosion.

Electrochemical Impedance Spectroscopy (EIS)

EIS measurements were made using an EG&G Princeton Applied Research Corp. (PARC) Model M368-4 AC Impedance System with Model 5208EC Lock-in Analyzer. The test cell used for this investigation consisted of a glass o-ring joint clamped onto a coated metal specimen as described in reference (9). The electrolyte used for specimen exposure was a 3.5% NaCl solution with a pH of 6. A total of nine coating and pretreatment systems on the 7075-T6 aluminum alloy substrata were selected for evaluation with EIS. These systems were based on combinations of the three surface pretreatments (SAA-urethane, SAA-dichromate, and chromate conversion coating) each with the three coating systems (epoxy-urethane, urethane, and the Self-Priming Topcoat). The specimens were exposed to the electrolyte solution for 1200 hours at room temperature and periodic impedance measurements were made over the test exposure time. The first series of tests were performed after 24 hours of exposure in order to allow the electrochemical system to reach equilibrium.

RESULTS AND DISCUSSION

A primer is normally used in a coating system to prepare the surface to be painted for the application of a topcoat. In most cases this means the primer enhances the adhesion of the topcoat. In

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addition, because the primer is adjacent to the substrate, it is the primary corrosion inhibitor for the substrate. Therefore, the suspected weakest point in a primerless system would be the substrate-topcoat interface. The finishing systems were analyzed with special emphasis placed on surface interaction phenomena at this interface, primarily adhesion and corrosion. Figure 1 is a series of scanning electron micrographs taken at 10,000X of the three different pretreatments on both bare and clad 2024 aluminum. These photographs illustrate the micro-topography of the pretreatments, which will ultimately effect the interfacial properties between the organic and inorganic coatings.

The results of the adhesion tests are provided in Table 3. All of the scrape adhesion results are significantly higher than the standard 3 kg requirement for this property, indicating adequate adhesion under ambient laboratory conditions. In contrast, numerous systems failed the wet tape adhesion, indicating a susceptibility to coating-substrate disbondment upon exposure to water. Several conclusions can be drawn from these data. Systems with a conversion coating treatment performed well and this is expected since one objective of conversion coatings is to enhance adhesion of subsequent organic coatings. Many of the finishing systems containing both urethane and dichromate sealed anodized specimens had poor wet adhesion. This is not unusual. The sealing process improves corrosion protection because it minimizes the porosity of the anodized surface. However, in doing so, it leaves the surface with a smoother topography (Figure 1), minimizing the potential for mechanical adhesion. Bonding of the organic coating is then mainly dependent upon chemical bonds which are susceptible if water penetrates the coating and reaches the interface (10). Generally, the Self-Priming Topcoat exhibited the best overall performance in the wet tape test.

The flexibility test results are presented in Table 4. Standard specification criteria for these tests on low gloss coatings are 20% elongation and a 2 inch mandrel bend. All of the coating systems performed better on the water sealed anodized substrates than on the urethane sealed SAA. Since the same organic coatings were evaluated on both substrates, this indicates a deficiency at the SAA-urethane seal/coating interface. In addition, the urethane topcoat had slightly better impact elongation than the other two coating systems on both pretreatments. Poor flexibility is expected with the system containing the epoxy primer which is more brittle than the urethane, especially at low temperatures. However, the Self-Priming Topcoat has a polymer system which should provide as much flexibility as the standard topcoat. This is illustrated in the results for the mandrel bend test performed at -51°C where the Self-Priming Topcoat is much more flexible than the other two coatings. Although the lowest mandrel used was 1/4 inch, previous results (5) indicate the SPTC can withstand a 1/8 inch bend at this temperature without cracking.

Most of the coating systems exhibited excellent resistance to lubricating oil, hydraulic fluid, hydrocarbons and water. The Self-Priming Topcoat peeled from the urethane sealed SAA pretreatment after immersion in lubricating oil. This was unexpected considering the Self-Priming Topcoat has resisted these exposures on numerous substrates and that it has a similar polyurethane binder to MIL-C-83286 which showed no signs of failure. Another deficiency was observed with the MIL-C-83286 polyurethane topcoat on the urethane sealed, anodized panels when immersed in water for 4 days at 49°C. The coating had tiny blisters over the entire surface of the panel. Since no other system with the urethane pretreatment failed this test, this indicates a slight adhesion weakness at the coating-pretreatment interface. This weak adhesion, however, could improve with aging of the finishing system.

The specimens which were exposed to 5% salt spray for 2000 hours were examined for corrosion in the scribe area and for blistering of the coating. Subsequently the coatings were carefully removed from the surface using a chemical stripper without disturbing the underlying substrate. A summary of the evaluation is provided in Table 5 and photographs of the specimens with the coatings removed are provided in Figures 2-4. The condition of the specimens illustrated in these figures is indicative of the coating system performance. The standard epoxy primer-polyurethane topcoat performed well on all

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substrates. There were no significant corrosion products in the scribe or blistering of the coating. One specimen with the standard system on chromate conversion coated 7075 clad exhibited several pits along the scribe. In addition, slight uplifting of the standard coating system at the scribe was noticed on the urethane seal anodized specimens, however this was considered insignificant. The Self-Priming Topcoat also performed well on all of the substrates. There was no uplifting or blistering of the coating on any section of the specimens. The scribe areas had slight to moderate deposits of aluminum oxide with no pitting, however examination of these specimens after removing the coating indicated these products were minimal and confined to the scribe area. A previous report (5) indicated that these deposits are formed early during salt spray exposure but no further corrosion occurs for up to one year. This suggests that these deposits assist in the corrosion inhibition process.

The MIL-C-83286 polyurethane topcoat performed well on the dichromate sealed SAA with no blistering or uplifting of the coating and slight corrosion in the scribe area of the 7075 specimens. (Corrosion on the corner of the 2024 T-3 specimen in Figure 3 was the result of an edge effect and was discounted.) The good performance of the urethane on this substrata was unexpected because, aside from the dichromate seal which is damaged in the scribe area, there are no other corrosion inhibitors in the system. The polyurethane topcoat showed some corrosion products and pitting in the scribe of all four substrates treated with the sulfuric acid anodized-urethane seal. Performance on the chromate conversion coated pretreatment was poor. All four substrates showed pitting and corrosion along the scribe and corrosion of the substrata under the coating. We consider superficial corrosion products in the scribe to be acceptable, however any pitting in the scribe, corrosion extending from the scribe, or damage to the coating is unacceptable.

The specimens exposed to SO₂/salt spray for 500 hours were also examined for damage to the coating and corrosion in and away from the scribe and these results are summarized in Table 6. Figures 5-7 are photographs of exposed specimens with the coatings removed. The SO₂/salt spray environment simulates industrial stack gases such as those found on diesel powered carriers, and it is an extremely aggressive environment. The 500 hour exposure period was selected because differences in finishing system performance were observed after this duration. The specimens coated with the standard primer and topcoat system as well as those with the urethane topcoat had severe surface corrosion and/or pitting on all twelve substrates. In addition, the topcoat blistered on the conversion coating pretreatment and on the clad specimens with the SAA-dichromate seal. The extent of the corrosion with the topcoat was expected because of the lack of a corrosion inhibiting pigment. The results with the standard system were slightly unexpected since this system is considered one of the premier protective systems for aluminum due to the strontium chromate contained within the primer. The Self-Priming Topcoat outperformed the other two coating systems on all of the substrates. Although there were some slight spots of surface corrosion and small pits, these areas were barely noticeable and considered minor, relative to the extensive corrosion observed on the other specimens. Figures 5-7 provide vivid illustrations of the performance of all of the systems after sulfur dioxide/salt spray exposure.

Electrochemical impedance spectroscopy (EIS) provides qualitative and quantitative information about the corrosion resistance properties of both the coating and the substrata in addition to providing insight on the nature of their interfacial adhesion. Reference (11) provides a detailed description of EIS and its application for analyzing organic coating/metal substrata systems. Figures 8-11 contain Bode magnitude and phase diagrams of the EIS test results obtained at various exposure intervals for several of the coating/pretreatment systems. These specific spectra represent the significant EIS trends that were identified during this investigation.

After 24 hours immersion, the Self-Priming Topcoat (SPTC) on all three substrates had an impedance of 1.2×10^9 in the low frequency range (10^{-2} Hz) which was the highest impedance of the three coatings as displayed in Figure 8. High impedance values correlate to coatings with low

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conductivity that provide good barrier protection to the substrates to which they are applied. This impedance value is far above 10^7 ohms which is widely accepted as the lower limit below which no barrier protection is provided by the coating (11). In the high frequency range, the SPTC had phase angles between -80° and -90° . These phase angles also indicate a good barrier coating, where -90° would be a perfect capacitor/barrier. In addition, the shape of the curve for the impedance of the SPTC is virtually straight over most of the frequency range with a negative slope, again indicating capacitive behavior (i.e. good barrier properties). The same results were observed for the SPTC throughout the 1200 hour test duration as illustrated in Figure 9. For all pretreatments, the low frequency SPTC impedance remained above 10^9 ohms, while the high frequency phase angles continued to exhibit capacitive behavior, remaining between -75° and -90° . There was a small shift in the low frequency phase angle curve for the SAA-urethane/SPTC system over the test duration. The change from capacitive to resistive behavior had shifted slightly to the left (lower frequency) indicating better barrier properties. This change could have resulted from several sources. One possible explanation is decreased micropore size within the coating, caused by swelling of the polymer. However, since the phenomenon occurred with only one pretreatment, this explanation was dismissed. Another plausible explanation is increased coating adhesion. This increased degree of interfacial bonding with time, also noted in reference (12), could have been enhanced or catalyzed by the presence of some electrolyte at the interface. Finally, during the 1200 hour test period, the chemical corrosion resistance properties of the inhibitors in this coating did not come into play and will not be addressed here.

The primer and topcoat (EP-UR) system on all three substrates had an impedance of 6.3×10^7 ohms after 24 hours immersion. Again this indicates barrier type properties, however not as good as the SPTC. This lower barrier protection is also apparent in the phase diagram where the phase angles for the EP-UR system were between -60° and -80° , showing less capacitive behavior. The shape of the EP-UR magnitude curve was similar to the SPTC curve, however it was evident at a lower impedance range. The improved barrier protection provided by the Self-Priming Topcoat resulted because this coating was specifically designed to have high flexibility and a smooth surface and therefore it is less porous than the standard epoxy-urethane coating system. In addition, the EP-UR impedance curve leveled off at a higher frequency than the SPTC, indicating lesser barrier properties. Although the EP-UR coating is not as good a barrier coating as the SPTC, it does provide excellent corrosion protection as indicated in the salt spray results and reference (3). The low frequency impedance magnitude of the EP-UR system remained between 10^7 and 10^8 ohms and the shape of the curve was similar over most of the exposure time. However at 1200 hours, the chromate conversion coating/EP-UR impedance curve began to show an upward turn after leveling off in the low frequency range as shown in Figure 10. Also, the phase angle curve was beginning to develop a peak in the high frequency range. These two trends indicate the presence of electrolyte at the interface resulting from some adhesion loss. Also, some type of electrochemical reactions were occurring at the interface, probably corresponding to chemical inhibition of the corrosion process by the inhibitors within the primer.

The unprimed polyurethane topcoat (UR) performed differently with the various pretreatments. After one day, the UR with the SAA/dichromate seal and the conversion coated pretreatments had low impedance values (1.3×10^7 and 2.5×10^6 ohms, respectively) and provided little or no barrier protection to the substrata. Furthermore, unlike the shape of the other two impedance curves, the UR impedance curve leveled off in the mid-frequency range and then began to curve upward at the low frequency range. This behavior corresponds to a porous coating with poor adhesion, where electrolyte is allowed to penetrate the film and accumulate at the coating-metal interface. Finally, the phase angle behavior for these pretreatments was significantly different than the other two materials (see Figure 11). At 10^5 Hz the phase angle was -80° , however as the frequency decreased, the phase angle reached a maximum of approximately -5° at about 1 Hz. This gradual change from capacitance to resistance then sharply reversed back to capacitance again in the low frequency area. This response indicates a double layer capacitance at the metal surface resulting from the presence of electrolyte at the interface caused by

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coating adhesion loss. As exposure continued, the inflections in the impedance curves for the UR with the SAA-dichromate seal and chromate conversion coating pretreatments began to shift to higher frequencies with impedance values below 10^7 showing no real barrier protection. Also, the peak maximum in the phase angle diagram for the conversion coated specimens shifted from 1 Hz at 24 hours to 10 Hz at 504 hours and finally reached 50 Hz at 1200 hours. In addition to shifting, the peak broadened from spanning five decades to six decades and finally spanning seven decades, respectively. These changes indicate that electrochemical reactions were occurring at the interface and possibly represented the onset and propagation of the corrosion process.

The UR and SAA-polyurethane seal system performed closer to the other two coatings in the impedance diagram with an initial low frequency impedance of 3×10^8 ohms and a virtually straight magnitude curve. This curve did not significantly change over the test duration. The phase angle curve for this system behaved like the SPTC and standard EP-UR systems in the low frequency range. However, in the high frequency area there was a resistance peak similar to the one described for the conversion coating-EP-UR system at 1200 hours. This peak gradually became more resistive, which relates to interface degradation.

The SPTC was by far the best barrier coating as demonstrated by EIS. The standard coating system also offered barrier protection to the substrates but not quite as good as the SPTC. The chemical protection provided by the corrosion inhibitors in the SPTC coating did not come into play during this test time. Similarly, the chemical corrosion inhibition of the EP-UR coating was not specifically demonstrated in the EIS tests, except possibly in the 1200 hour conversion coating results. The UR system provided poor barrier protection, with the exception of the polyurethane sealed SAA pretreatment, and offered no chemical protection against corrosion. Finally, as exposure time increased the results for the EP-UR and UR coatings changed for the different pretreatments, while the SPTC spectra remained virtually the same for all pretreatments over the entire 1200 hour test duration.

SUMMARY

Comparison of all the performance data for the organic coatings indicated some correlation between the test results. Adhesion data and water resistance show a general trend in adhesion performance from the Self-Priming Topcoat as the best system, to the unprimed polyurethane topcoat as the worst. Likewise, the SO_2 -salt spray test data and the EIS data correlated well with the adhesion data, again resulting in the same performance trend for the coating systems. The only exception was in the 5% NaCl salt spray test results. Here, the standard primer/topcoat (EP-UR) system properties proved to be slightly better than those of the Self-Priming Topcoat, but not to a significant degree.

In summarizing the performance of the inorganic pretreatments, the SAA-urethane resulted in poor adhesion and flexibility for nearly all of the alloy/organic coatings analyzed. However, it did assist in providing fair corrosion protection in salt spray and SO_2 -salt spray. Its electrochemical impedance characteristics were promising when coated with the standard urethane topcoat. The SAA-dichromate provided fair adhesion for the urethane coatings but poor adhesion for the epoxy-urethane system. Its performance with all of the organic coatings was good in salt spray and fair in SO_2 -salt spray. The chromate conversion coating provided excellent adhesion for all of the coatings. It also provided good corrosion protection in the salt spray when coated with either the standard system or the Self-Priming Topcoat. Performance in the SO_2 -salt spray was only good when coated with the SPTC. The EIS data indicated that the chromate conversion coating appeared to be the best pretreatment for short term durations, however, its long term durability was significantly inferior to the SAA treatments. There was some disagreement between the results for the Electrochemical Impedance Spectroscopy and the wet tape adhesion tests. These differences in performance were attributed to the decreased thermodynamic

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activity of water in the ionic solution used in the EIS testing as apposed to distilled water used in the tape test (10).

The objective of this paper was to investigate primerless finishing systems in lieu of the standard primer and topcoat system currently used on military aircraft. Two alternatives to obtain a primerless system were evaluated: (1) Modification of the surface treatment and (2) Modification of the organic coating. The sulfuric acid anodized-urethane seal did not perform as well as the standard system. However it did show promising results in the electrochemical impedance analysis. The concept of having a pretreatment which forms strong chemical bonds with an applied organic coating is viable. Incorporating corrosion inhibitors in the subsequent coating may be essential to improve the overall corrosion protection, especially if the coating system is damaged. The Self-Priming Topcoat performed well throughout the evaluation. This alternative can be used over a variety of substrates. As previous mentioned, numerous advantages can be realized with the use of primerless finishing systems. Some of these advantages depend on the specific system and its application parameters. However, three advantages which would be prevalent with all approaches are:

1. Reduced volatile organic emissions.
2. Reduced chromate emissions.
3. Reduced finishing system application time.

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TABLE 1: SUBSTRATES AND PRETREATMENTS FOR PRIMERLESS COATING SYSTEMS

<u>ALLOY</u>	<u>PRETREATMENT</u>		
	<u>SAA-URETHANE SEAL</u>	<u>SAA-DICHROMATE SEAL</u>	<u>CHROMATE CONV COAT</u>
2024 T-3, BARE	XXX	XXX	XXX
2024 T-3, CLAD	XXX	XXX	XXX
7075 T-6, BARE	XXX	XXX	XXX
7075 T-6, CLAD	XXX	XXX	XXX

TABLE 2: EXPOSURE CONDITIONS FOR CHEMICAL RESISTANCE EVALUATION

<u>FLUID</u>	<u>IMMERSION PERIOD</u> <u>(HOURS)</u>	<u>TEMPERATURE</u> <u>(°C)</u>
LUBRICATING OIL	24	65
ENGINE OIL	24	121
WATER	96	49
HYDROCARBON	24	23

TABLE 3: ADHESION TEST RESULTS

SUBSTRATE	PRETREATMENT	COATING	WET TAPE (% REMAINING)	SCRAPE (KG)
2024 BARE	SAA-URETHANE	EP-UR*	97	9
2024 CLAD	SAA-URETHANE	EP-UR	10	7
7075 BARE	SAA-URETHANE	EP-UR	25	8
7075 CLAD	SAA-URETHANE	EP-UR	100	10
2024 BARE	SAA-URETHANE	UR	0	7
2024 CLAD	SAA-URETHANE	UR	0	4
7075 BARE	SAA-URETHANE	UR	0	6
7075 CLAD	SAA-URETHANE	UR	90	9
2024 BARE	SAA-URETHANE	SPTC	100	10
2024 CLAD	SAA-URETHANE	SPTC	0	9
7075 BARE	SAA-URETHANE	SPTC	75	10
7075 CLAD	SAA-URETHANE	SPTC	100	9
2024 BARE	SAA-DICHROMATE	EP-UR	80	9
2024 CLAD	SAA-DICHROMATE	EP-UR	0	5
7075 BARE	SAA-DICHROMATE	EP-UR	75	8
7075 CLAD	SAA-DICHROMATE	EP-UR	0	7
2024 BARE	SAA-DICHROMATE	UR	100	10
2024 CLAD	SAA-DICHROMATE	UR	0	7
7075 BARE	SAA-DICHROMATE	UR	100	10
7075 CLAD	SAA-DICHROMATE	UR	100	10
2024 BARE	SAA-DICHROMATE	SPTC	100	10
2024 CLAD	SAA-DICHROMATE	SPTC	100	10
7075 BARE	SAA-DICHROMATE	SPTC	100	10
7075 CLAD	SAA-DICHROMATE	SPTC	100	9
2024 BARE	CHR CONV COAT	EP-UR	100	10
2024 CLAD	CHR CONV COAT	EP-UR	100	10
7075 BARE	CHR CONV COAT	EP-UR	100	10
7075 CLAD	CHR CONV COAT	EP-UR	100	10
2024 BARE	CHR CONV COAT	UR	100	10
2024 CLAD	CHR CONV COAT	UR	100	10
7075 BARE	CHR CONV COAT	UR	70	10
7075 CLAD	CHR CONV COAT	UR	100	10
2024 BARE	CHR CONV COAT	SPTC	100	10
2024 CLAD	CHR CONV COAT	SPTC	100	10
7075 BARE	CHR CONV COAT	SPTC	100	10
7075 CLAD	CHR CONV COAT	SPTC	100	10

*EP-UR: MIL-P-23377 PRIMER AND MIL-C-83286 TOPCOAT
 UR: MIL-C-83286 TOPCOAT
 SPTC: SELF-PRIMING TOPCOAT

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TABLE 4: FLEXIBILITY TEST RESULTS

<u>PRETREATMENT/COATING</u>	<u>IMPACT @ 23°C (% ELONGATION)</u>	<u>MANDREL BEND @ -51°C (MANDREL DIAM., INCHES)</u>
SAA-WATER/EP-UR	20	1
SAA-WATER/UR	40	1
SAA-WATER/SPTC	20	1/4
SAA-URETHANE/EP-UR	20	>1
SAA-URETHANE/UR	40	>1
SAA-URETHANE/SPTC	5	1/2

TABLE 5: SUMMARY OF SALT SPRAY EXPOSURE RESULTS

<u>SUBSTRATE</u>	<u>PREPARIMENT</u>	<u>COATING</u>	<u>COMMENTS</u>
2024 BARE	SAA-URETHANE	EP-UR*	NO CORROSION
2024 CLAD	SAA-URETHANE	EP-UR	NO CORROSION
7075 BARE	SAA-URETHANE	EP-UR	NO CORROSION
7075 CLAD	SAA-URETHANE	EP-UR	SLIGHT SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE
2024 BARE	SAA-URETHANE	UR	EXTENSIVE PITTING IN SCRIBE, CORROSION EXTENDING 1/8 INCH FROM SCRIBE
2024 CLAD	SAA-URETHANE	UR	SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE; SEVERAL PITS ALONG SCRIBE
7075 BARE	SAA-URETHANE	UR	EXTENSIVE PITTING IN SCRIBE
7075 CLAD	SAA-URETHANE	UR	SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE; SEVERAL PITS ALONG SCRIBE
2024 BARE	SAA-URETHANE	SPTC	SURFACE CORROSION PRODUCTS IN 50% OF SCRIBE
2024 CLAD	SAA-URETHANE	SPTC	SLIGHT SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE
7075 BARE	SAA-URETHANE	SPTC	SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE
7075 CLAD	SAA-URETHANE	SPTC	SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE
2024 BARE	SAA-DICHROMATE	EP-UR	NO CORROSION
2024 CLAD	SAA-DICHROMATE	EP-UR	NO CORROSION
7075 BARE	SAA-DICHROMATE	EP-UR	NO CORROSION
7075 CLAD	SAA-DICHROMATE	EP-UR	NO CORROSION
2024 BARE	SAA-DICHROMATE	UR	NO CORROSION
2024 CLAD	SAA-DICHROMATE	UR	NO CORROSION
7075 BARE	SAA-DICHROMATE	UR	SLIGHT SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE
7075 CLAD	SAA-DICHROMATE	UR	SLIGHT SURFACE CORROSION PRODUCTS IN ENTIRE SCRIBE
2024 BARE	SAA-DICHROMATE	SPTC	NO CORROSION
2024 CLAD	SAA-DICHROMATE	SPTC	SLIGHT SURFACE CORROSION PRODUCTS IN 50% OF SCRIBE
7075 BARE	SAA-DICHROMATE	SPTC	SLIGHT SURFACE CORROSION PRODUCTS IN 25% OF SCRIBE
7075 CLAD	SAA-DICHROMATE	SPTC	SLIGHT SURFACE CORROSION PRODUCTS IN 75% OF SCRIBE
2024 BARE	CHR CONV COAT	EP-UR	NO CORROSION
2024 CLAD	CHR CONV COAT	EP-UR	NO CORROSION
7075 BARE	CHR CONV COAT	EP-UR	NO CORROSION
7075 CLAD	CHR CONV COAT	EP-UR	SLIGHT SURFACE CORROSION IN ENTIRE SCRIBE; SEVERAL PITS ALONG SCRIBE
2024 BARE	CHR CONV COAT	UR	LARGE SEVERE PITS ALONG SCRIBE; SCATTERED PITTING OVER ENTIRE SURFACE
2024 CLAD	CHR CONV COAT	UR	SURFACE CORROSION PRODUCTS IN SCRIBE INCLUDING 2 SEVERE SPOTS
7075 BARE	CHR CONV COAT	UR	SURFACE CORROSION/PITTING ALONG SCRIBE; SCATTERED PITTING OVER SURFACE
7075 CLAD	CHR CONV COAT	UR	SURFACE CORROSION AND PITTING ALONG SCRIBE; A FEW PITS UNDER COATING
2024 BARE	CHR CONV COAT	SPTC	SLIGHT SURFACE CORROSION IN SCRIBE, 2 SMALL AREAS EXTENDING FROM SCRIBE
2024 CLAD	CHR CONV COAT	SPTC	SLIGHT SURFACE CORROSION IN SCRIBE, 1 SMALL AREA EXTENDING FROM SCRIBE
7075 BARE	CHR CONV COAT	SPTC	SLIGHT SURFACE CORROSION IN THE SCRIBE; 2 SMALL AREAS ALONG SCRIBE
7075 CLAD	CHR CONV COAT	SPTC	SLIGHT SURFACE CORROSION IN THE SCRIBE

MEP-UR: MIL-P-23377 PRIMER AND MIL-C-83286 TOPCOAT
 UR: MIL-C-83286 TOPCOAT
 SPTC: SELF-PRIMING TOPCOAT

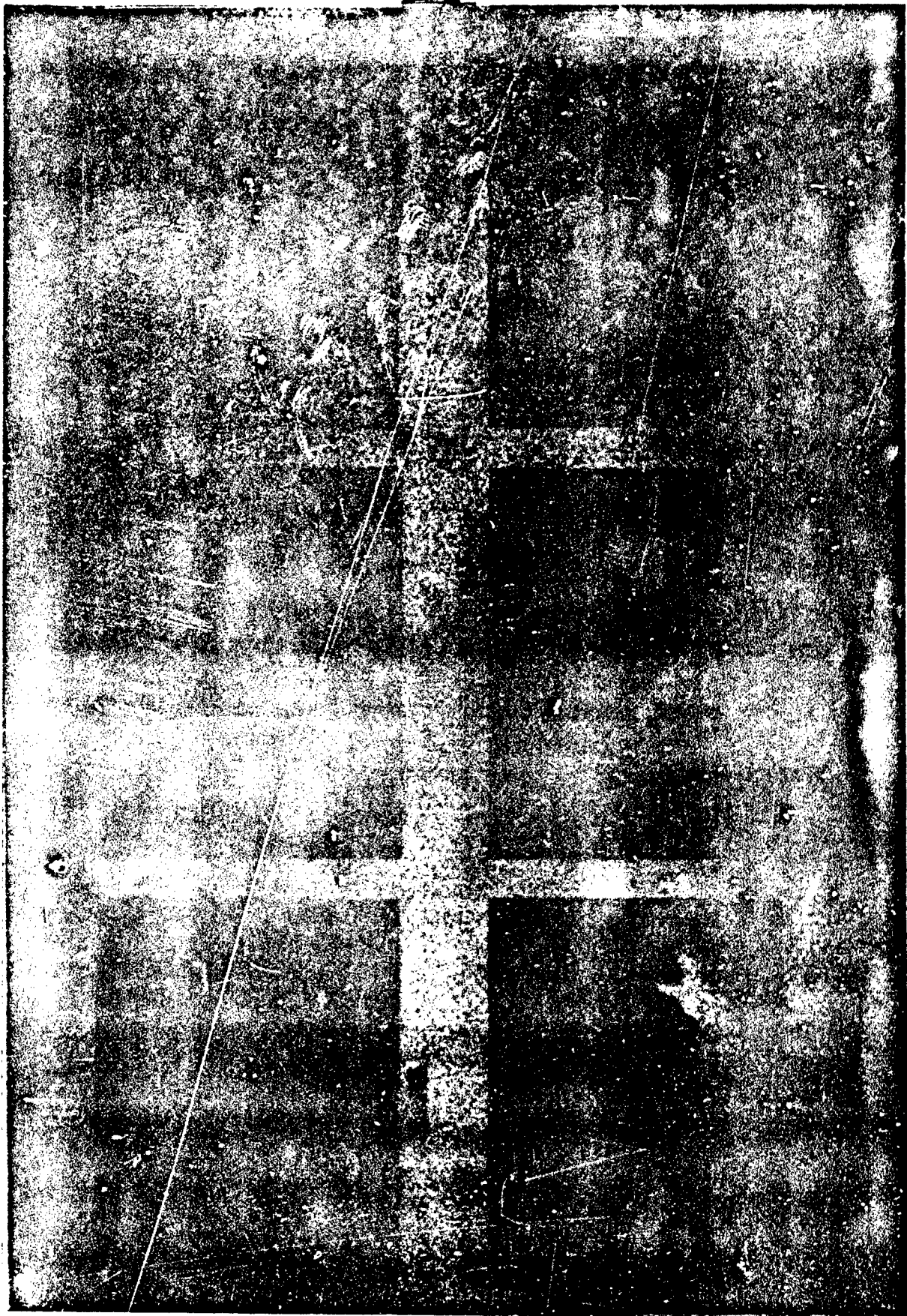
TABLE 6: SUMMARY OF SULFUR DIOXIDE-SALT SPRAY EXPOSURE RESULTS

<u>SUBSTRATE</u>	<u>PRETREATMENT</u>	<u>COATING</u>	<u>COMMENTS</u>
2024 BARE	SAA-URETHANE	EP-UR*	PITTING IN ENTIRE SCRIBE
2024 CLAD	SAA-URETHANE	EP-UR	PITTING IN ENTIRE SCRIBE; SEVERE CORROSION EXTENDING 1/2" FROM SCRIBE
7075 BARE	SAA-URETHANE	EP-UR	PITTING IN AND EXTENDING FROM THE SCRIBE
7075 CLAD	SAA-URETHANE	EP-UR	SEVERE CORROSION IN AND EXTENDING 1/4" FROM SCRIBE
2024 BARE	SAA-URETHANE	UR	PITTING IN ENTIRE SCRIBE
2024 CLAD	SAA-URETHANE	UR	PITTING IN ENTIRE SCRIBE; SEVERE CORROSION EXTENDING 1/2" FROM SCRIBE
7075 BARE	SAA-URETHANE	UR	PITTING IN AND EXTENDING FROM THE SCRIBE
7075 CLAD	SAA-URETHANE	UR	SEVERE CORROSION IN AND EXTENDING 1/4" FROM SCRIBE
2024 BARE	SAA-URETHANE	SPTC	NO CORROSION
2024 CLAD	SAA-URETHANE	SPTC	CORROSION ALONG 10% OF SCRIBE
7075 BARE	SAA-URETHANE	SPTC	NO CORROSION
7075 CLAD	SAA-URETHANE	SPTC	SEVERAL SLIGHT CORROSION SPOTS ALONG SCRIBE
2024 BARE	SAA-DICHROMATE	EP-UR	PITTING IN ENTIRE SCRIBE
2024 CLAD	SAA-DICHROMATE	EP-UR	PITTING IN AND EXTENDING 1/8" FROM ENTIRE SCRIBE
7075 BARE	SAA-DICHROMATE	EP-UR	PITTING IN AND EXTENDING FROM THE SCRIBE
7075 CLAD	SAA-DICHROMATE	EP-UR	SURFACE CORROSION AND PITTING IN AND EXTENDING 3/4" FROM SCRIBE
2024 BARE	SAA-DICHROMATE	UR	PITTING IN ENTIRE SCRIBE
2024 CLAD	SAA-DICHROMATE	UR	PITTING IN AND EXTENDING 1/8" FROM SCRIBE; PAINT BLISTERED
7075 BARE	SAA-DICHROMATE	UR	PITTING IN ENTIRE SCRIBE
7075 CLAD	SAA-DICHROMATE	UR	SURFACE CORROSION/PITTING EXTENDING 3/4" FROM SCRIBE; PAINT BLISTERED
2024 BARE	SAA-DICHROMATE	SPTC	NO CORROSION
2024 CLAD	SAA-DICHROMATE	SPTC	2 SMALL PITS ALONG SCRIBE
7075 BARE	SAA-DICHROMATE	SPTC	NO CORROSION
7075 CLAD	SAA-DICHROMATE	SPTC	SEVERAL SMALL PITS ALONG SCRIBE
2024 BARE	CHR CONV COAT	EP-UR	PITTING IN ENTIRE SCRIBE
2024 CLAD	CHR CONV COAT	EP-UR	PITTING IN AND EXTENDING SLIGHTLY FROM SCRIBE
7075 BARE	CHR CONV COAT	EP-UR	PITTING IN AND EXTENDING 1/4" FROM SCRIBE
7075 CLAD	CHR CONV COAT	EP-UR	SURFACE CORROSION AND PITTING IN AND EXTENDING 1/2" FROM SCRIBE
2024 BARE	CHR CONV COAT	UR	EXTENSIVE SURFACE CORROSION/PITTING OVER ENTIRE SURFACE; PAINT BLISTERED
2024 CLAD	CHR CONV COAT	UR	EXTENSIVE SURFACE CORROSION/PITTING OVER ENTIRE SURFACE; PAINT BLISTERED
7075 BARE	CHR CONV COAT	UR	EXTENSIVE SURFACE CORROSION/PITTING OVER ENTIRE SURFACE; PAINT BLISTERED
7075 CLAD	CHR CONV COAT	UR	EXTENSIVE SURFACE CORROSION/PITTING OVER ENTIRE SURFACE; PAINT BLISTERED
2024 BARE	CHR CONV COAT	SPTC	3 SMALL PITS ALONG SCRIBE
2024 CLAD	CHR CONV COAT	SPTC	SEVERAL SMALL PITS ALONG SCRIBE
7075 BARE	CHR CONV COAT	SPTC	5 SMALL PITS ALONG SCRIBE
7075 CLAD	CHR CONV COAT	SPTC	2 SMALL PITS ALONG SCRIBE

*EP-UR: MIL-P-23377 PRIMER AND MIL-C-83286 TOPCOAT

UR: MIL-C-83286 TOPCOAT

SPTC: SELF-PRIMING TOPCOAT



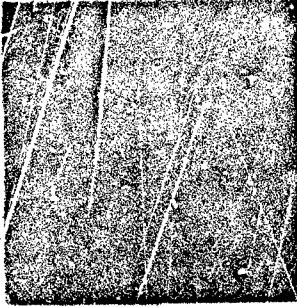
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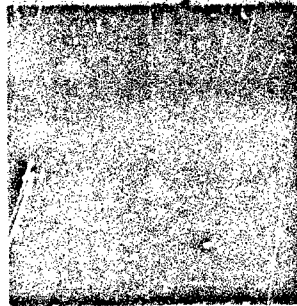
7075 T-6 CLAD



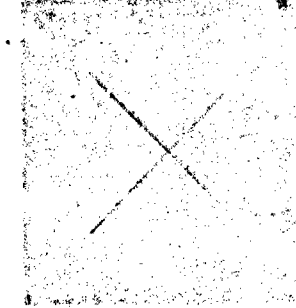
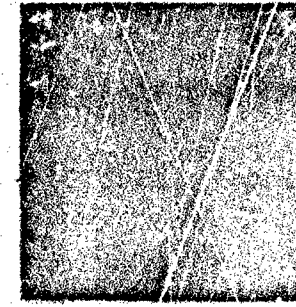
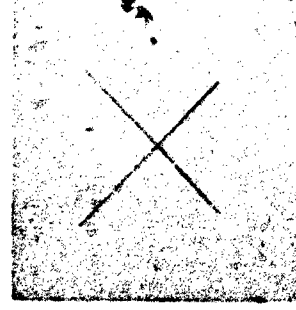
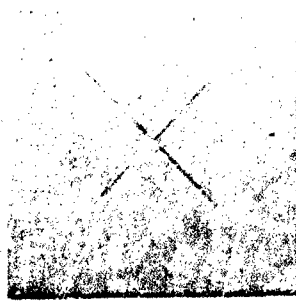
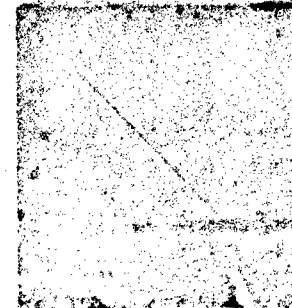
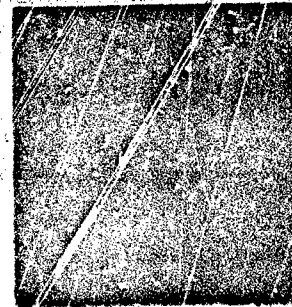
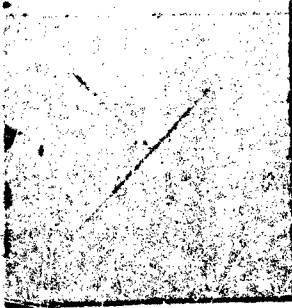
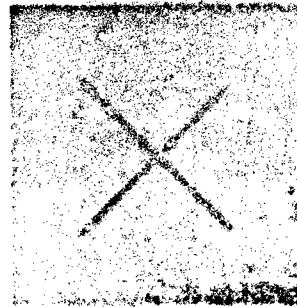
7075 T-6 BARE



2024 T-3 CLAD



2024 T-3 BARE



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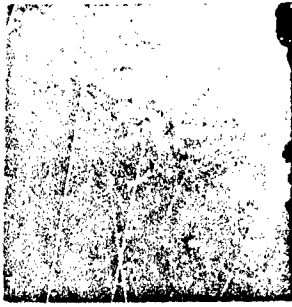
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FIGURE 2: SULFURIC ACID ANODIZED-URETHANE SEALED SPECIMENS EXPOSED TO 5% SALT SPRAY FOR 2000 HOURS.

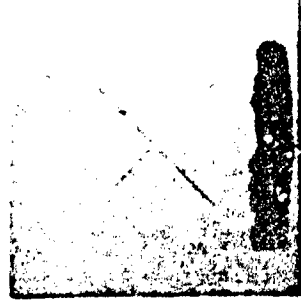
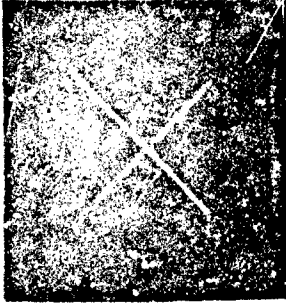
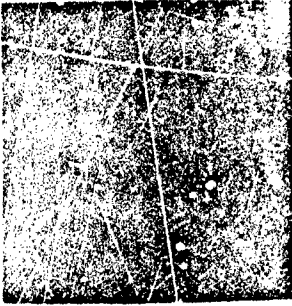
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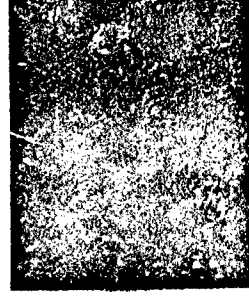
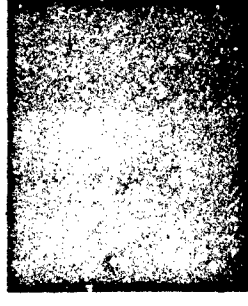
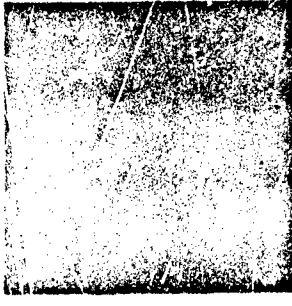
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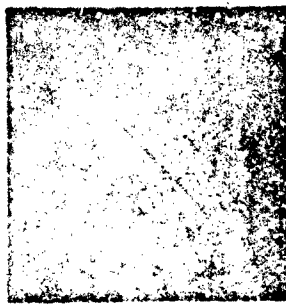
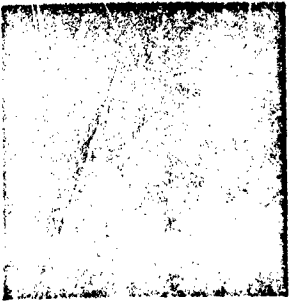
7075 T-6 BARE



2024 T-3 CLAD



2024 T-3 BARE



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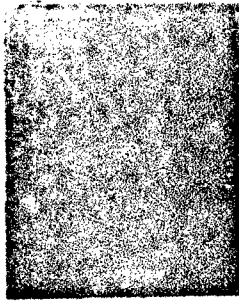
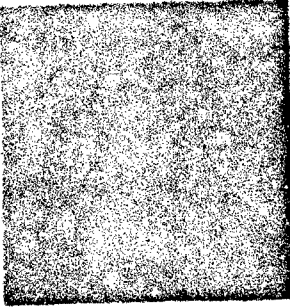
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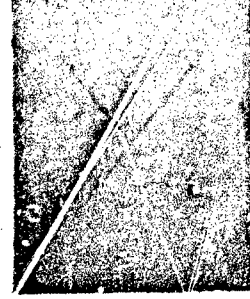
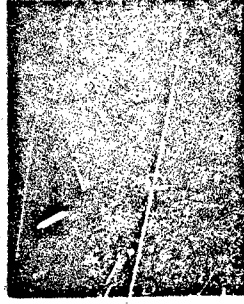
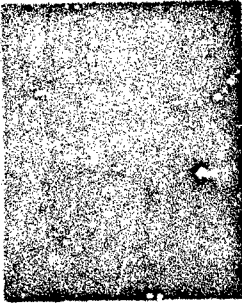
FIGURE 3: SULFURIC ACID ANODIZED-DICHROMATE SEALED SPECIMENS EXPOSED TO 5% SALT SPRAY FOR 2000 HOURS.

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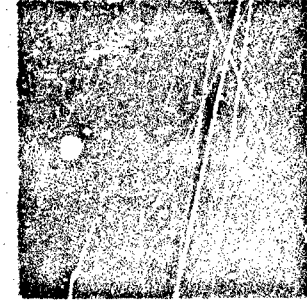
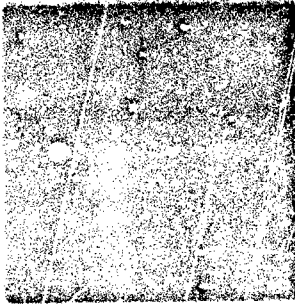
7075 T-5 CLAD



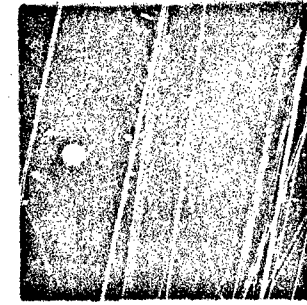
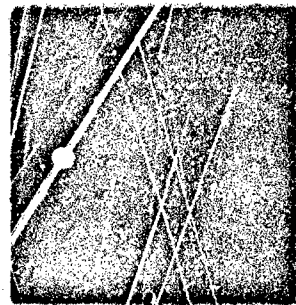
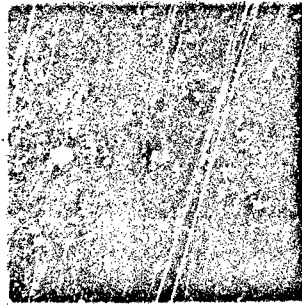
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8024 T-3 CLAD



2026 T-3 CLAD



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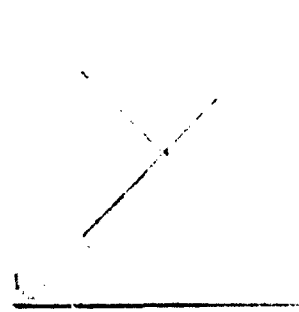
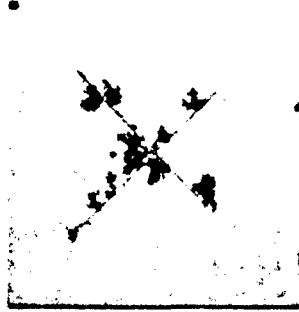
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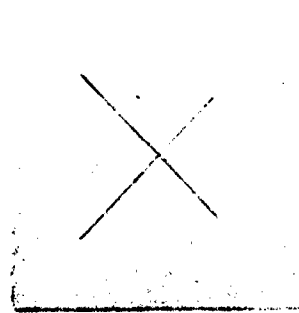
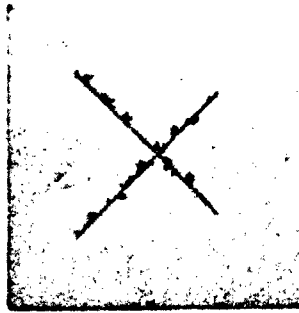
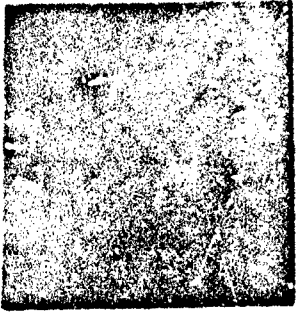
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TOPCOAT

FIGURE 4: CHROMATE CONVERSION COATED SPECIMENS EXPOSED TO 5% SALT SPRAY FOR 2000 HOURS.

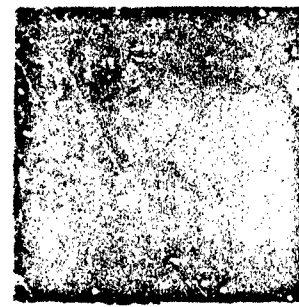
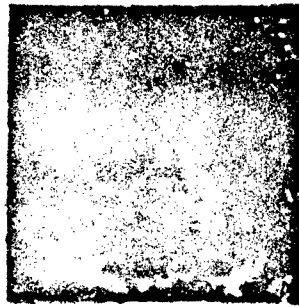
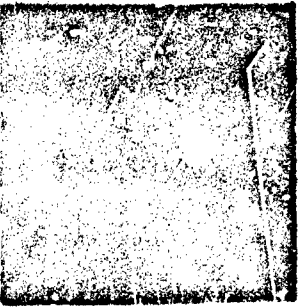
7075 T-6 CLAD



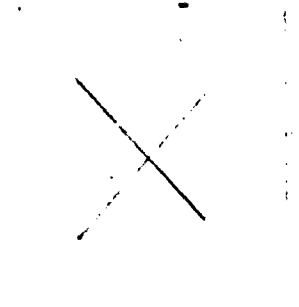
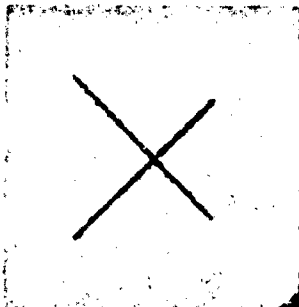
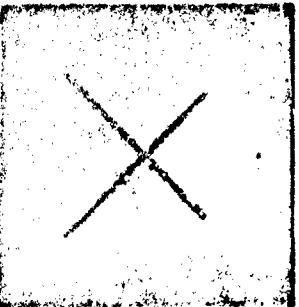
7075 T-6 BARE



2024 T-3 CLAD



2024 T-3 BARE



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TOPCOAT

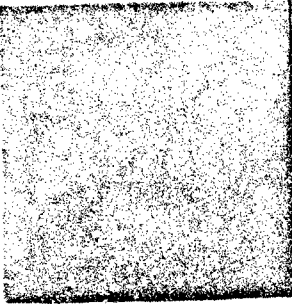
FIGURE 5: SULFURIC ACID ANODIZED-URETHANE SEALED SPECIMENS
EXPOSED TO SULFUR DIOXIDE-SALT SPRAY FOR 500 HOURS.

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7075 T-3 CLAD



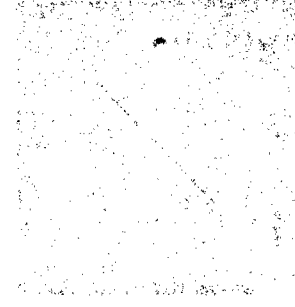
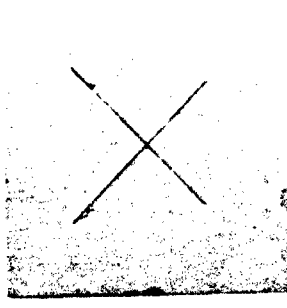
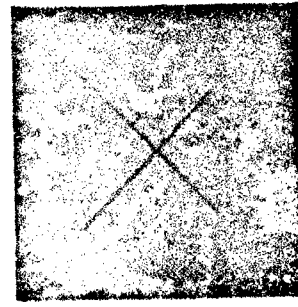
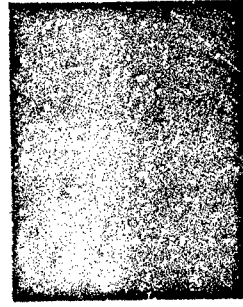
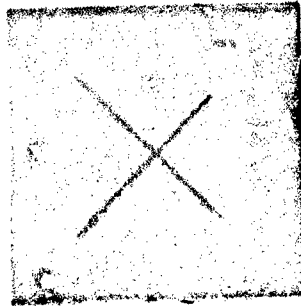
7075 T-3 CLAD



2024 T-3 CLAD



2024 T-3 BARE



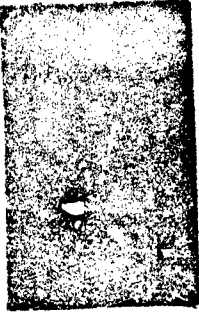
MIL-C-83286

MIL-P-23377
&
MIL-C-83286

N A D C
SELF PRIMING
TOPCOAT

FIGURE 6: SULFURIC ACID ANODIZED-DICHROMATE SEALED SPECIMENS
EXPOSED TO SULFUR DIOXIDE-SALT SPRAY FOR 500 HOURS.

Y078 T-6 CLAD



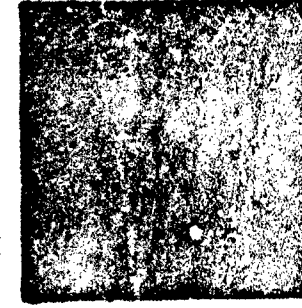
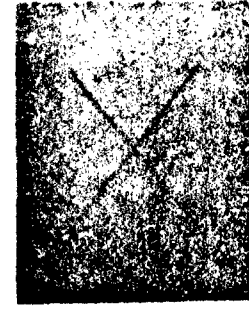
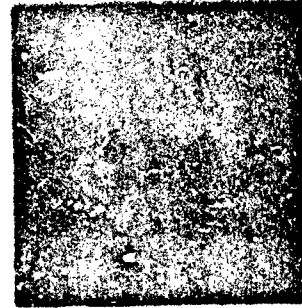
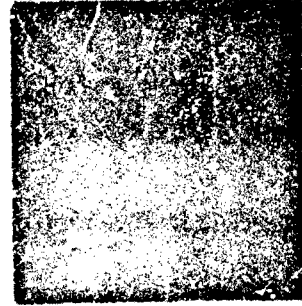
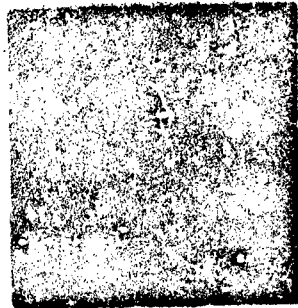
Y078 T-6 BAZZ



2024 T-3 CLAD



2024 T-3 BARE



MIL-C-83286

MIL-P-23377

&

MIL-C-83286

N A D C
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TOPCOAT

FIGURE 7: CHROMATE CONVERSION COATED SPECIMENS EXPOSED TO SULFUR DIOXIDE-SALT SPRAY FOR 500 HOURS.

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NADC-88107-60

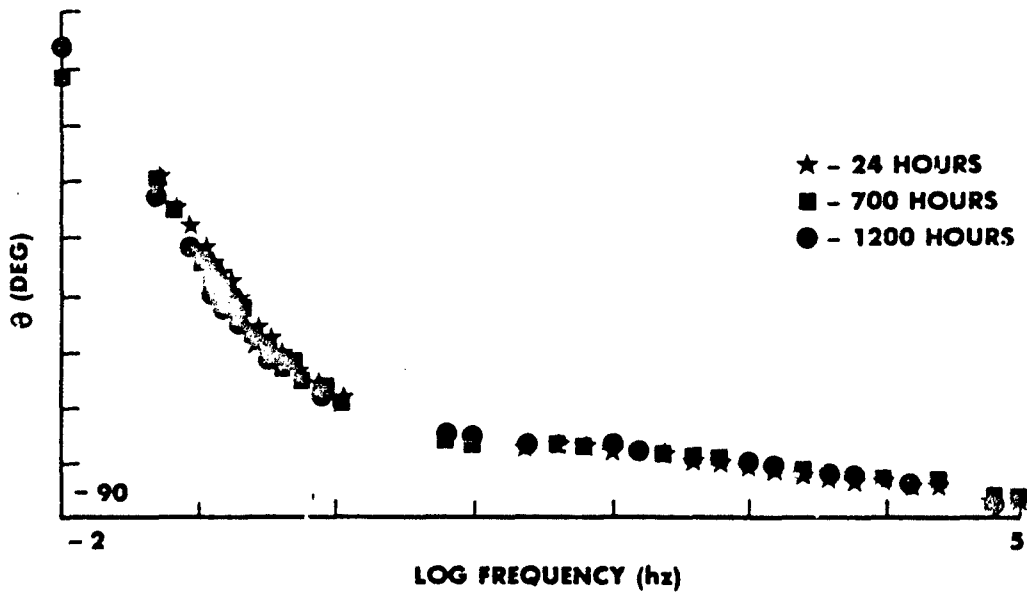
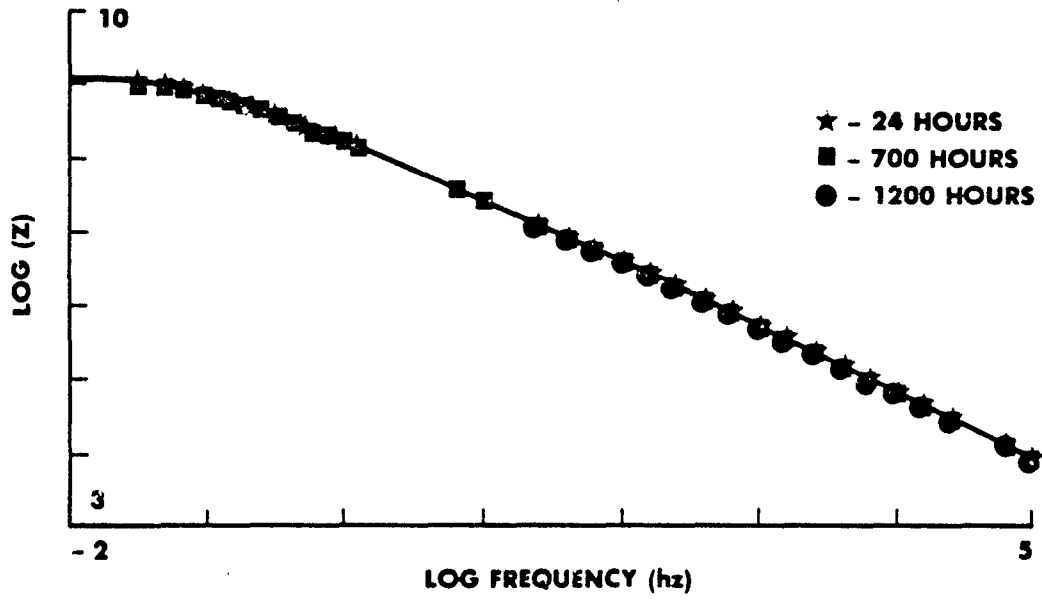


Figure 9. Bode plots for the SPTC system on the bare 7075-T6 aluminum alloy with the SAA/dichromate seal pretreatment at 24, 700 and 1200 hours.

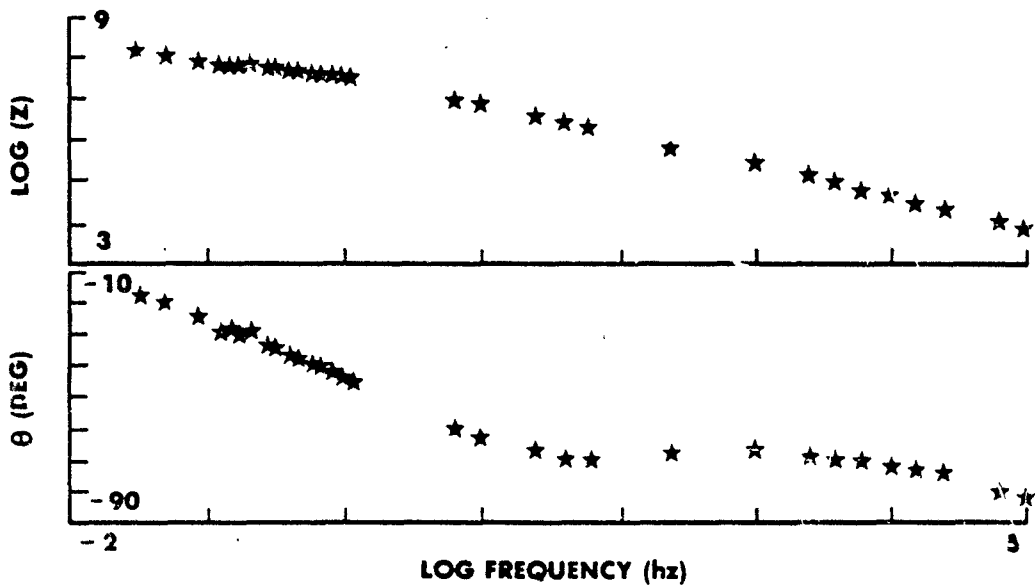


Figure 10. Bode plot of the EP-UR coating system on bare 7075-T6 aluminum with the chromate conversion coating pretreatment at 1200 hours.

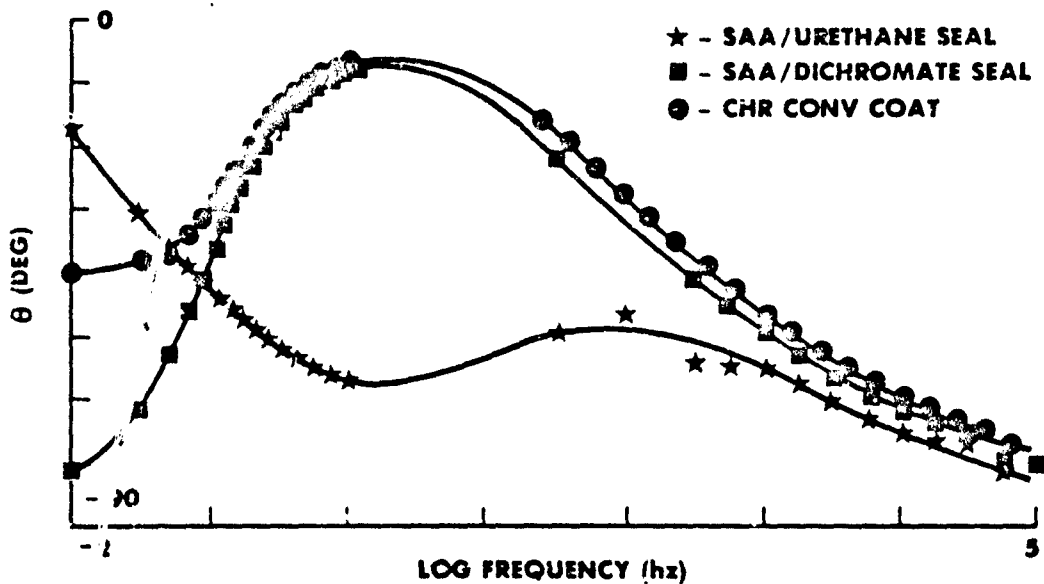
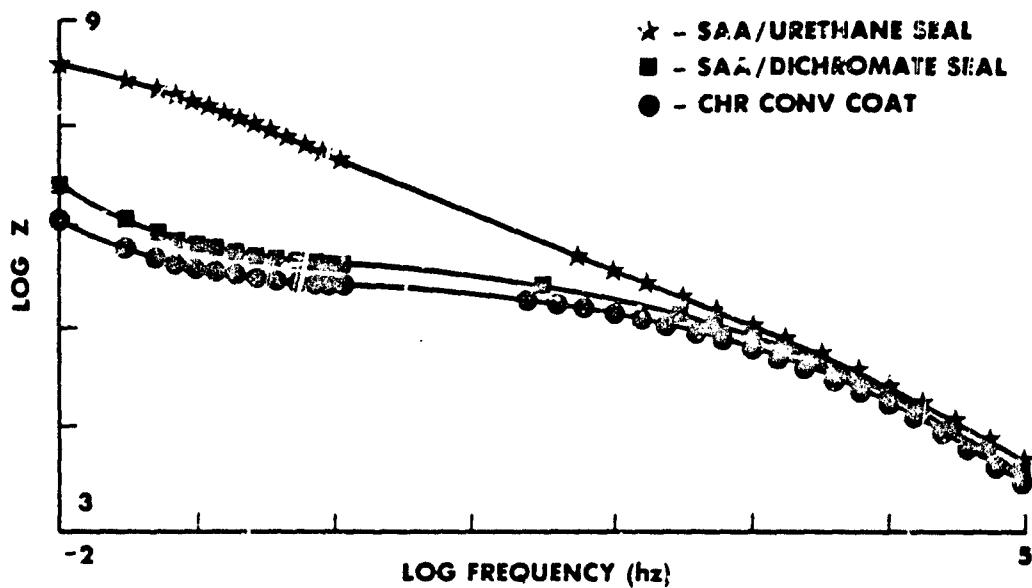


Figure 11. Bode plot of the UR coating on the three pretreatment systems after 24 hours.

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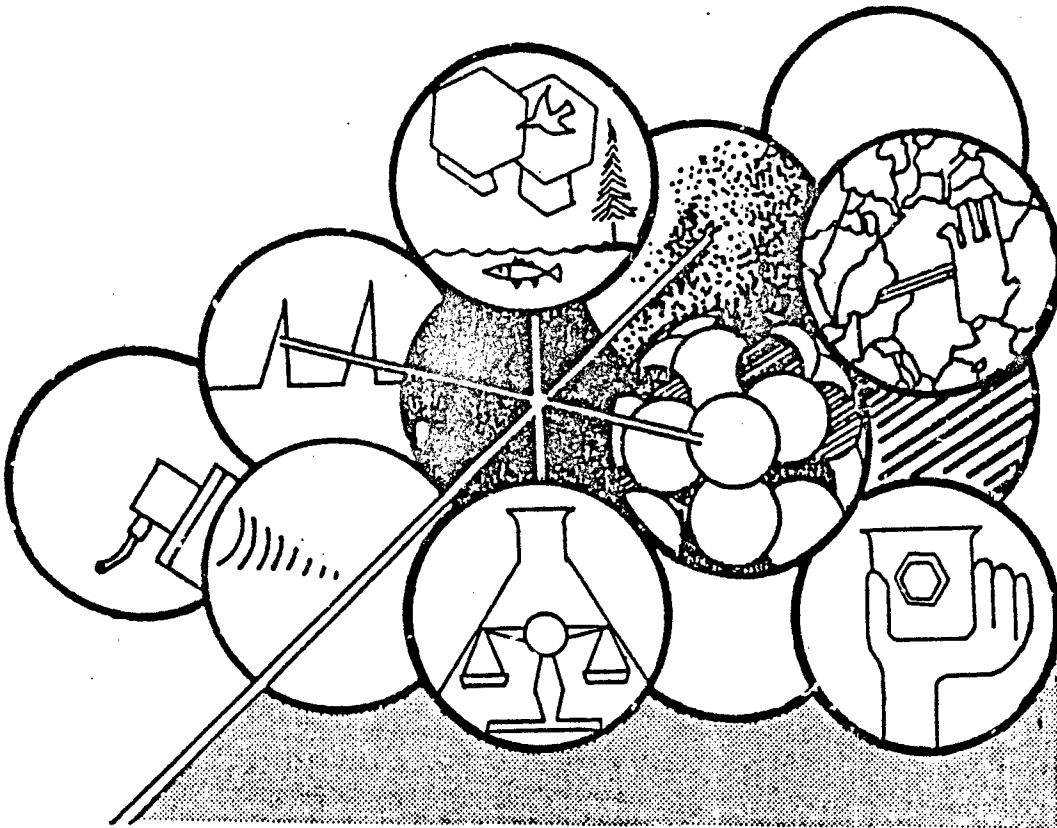
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EVALUATION OF NADC SELF-PRIMING TOPCOAT
GRUMMAN / JOHN WEIR (516) 575-2726

6/5/89

MIL-C-83286	TEST	440	NADC
3.7.1.1	COLOR	36375	-----
3.7.1.2	GLOSS (7 max.)	PASS 2.2	PASS 1.5.2.2
3.7.1.3	HIDING (95% min.)	-----	PASS 90.86, 94.28
3.7.2.1	WET TAPE ADHESION (24 hrs/DI H2O/RT)		
	Alcoholic Phosphoric Acid	-----	FAIL
	Alodine 600	-----	PASS
	161/NADC	-----	PASS
3.7.2.2	IMPACT FLEXIBILITY (RT, 20% Elongation)	PASS	PASS
3.7.3.1	SALT-SPRAY		
	1000 hrs	-----	PASS
	2000 hrs	-----	PASS
	3000 hrs	-----	PASS
3.7.3.2	HUMIDITY (500 hrs)		
3.7.3.3	HEAT RESISTANCE (300 F/4 hrs)	PASS	PASS
3.7.3.4	LOW TEMP FLEXIBILITY (-65 F, 4 hrs, 2" Mandrel)	PASS	PASS
3.7.3.5	FLUID RESISTANCE		
	a) Mil-L-23699, 24 hrs, 250 F	PASS, F	PASS, F
	b) TT-S-735, 7 days, RT	FAIL, HB	FAIL, 2B
	c) Mil-H-83282, 7 days, RT	PASS, F	PASS, F
	d) Skydrol 500B, 7 days, RT	PASS, F	FAIL, 2B
	e) DI H2O, 4 days, 100 F	PASS, F	PASS, F, HB
3.7.3.6.1	ACCELERATED WEATHERING (500 hrs Carbon Arc)	PASS	OK w/staining
3.7.3.7	RESISTANCE TO TAPING (6 hrs)	-----	PASS
	PENCIL HARDNESS	H	F, F, F, H
3.6.2	DRYING TIME		
	Set-To-Touch, 2 hrs	-----	PASS
	Dry Hard, 6 hrs	-----	PASS
3.6.3	VISCOSITY (Zahn#2), 17-23 sec	-----	-----
3.6.4	SETTLING (Mixed, 6 hrs Undisturbed)	-----	-----
3.6.5	ODOR	PASS	PASS
3.6.7	POT LIFE (6 hrs)	-----	-----
3.6.8	FINENESS OF GRIND (Flat <5)	-----	-----
3.6.9	NON-VOLATILE CONTENT	-----	-----



MATERIALS ENGINEERING LABORATORY

LABORATORY REPORT NO. 343-5-89

SUBJ: UNICOAT, self-priming topcoat

DATE: August 2, 1989



NAVAL AVIATION DEPOT
Naval Air Station
Jacksonville, Florida 32212-0016

BACKGROUND

Unicoat is a self-priming topcoat developed by NADC. The two component polyurethane high solids coating is a corrosion resistant coating for use on aluminum, graphite/epoxy composites and stainless steel substrates. Benefits of Unicoat include that it is lead and chromate free, has decreased VOC emissions, lowers the weight of the coating system and reduces application time and labor. Initial field evaluations have been conducted on F-14 and SH-3 aircraft with good results. Code 343 has examined these aircraft and has conducted tests on Unicoat with various combinations of coatings. A non-rinsing conversion coating was also evaluated along with the Unicoat system.

SUMMARY OF TEST RESULTS

Testing was performed in order to determine the adhesion of Unicoat to the conventional primer/topcoat system (MIL-P-85582/MIL-C-85285) and the adhesion of the conventional primer/topcoat system to the Unicoat material. Adhesion was evaluated after water immersion. Coatings were applied to mechanically deoxidized aluminum. Adhesion test results were excellent for both samples. This is important due to touch-up applications which may not use the same coating as was originally applied to surfaces. Lap shear results of Unicoat with conventional primer/topcoat samples averaged 900 lbs/in². This is lower than conventional primer/topcoat systems applied over a similar primer/topcoat system, which have typical values of 1200 lbs/in². There are no coating requirements for lap shear testing incorporated in standard test methods however, this method, which was developed locally many years ago, has been used very successfully for quantitative comparison of systems (sample numbers 2A through 2C).

Evaluation was performed in order to compare Unicoat to conventional primer/topcoat (MIL-P-85582/MIL-C-85285) systems. Wet and dry adhesion of the coatings to 2024-T3 aluminum substrate was selected as the basis of comparison. The samples were prepared with and without conversion coating, MIL-C-5541. Water immersion tests showed excellent results, all samples passed tape tests. Lap shear test values were comparable to conventional systems with and without conversion coatings (sample numbers 1A through 1F).

Evaluation of non-rinsing chromate conversion coating, Intex 8680, consisted of applying various paint systems over conversion coatings formed by application of the INTEX material to aluminum test panels and allowing to dry without rinsing. All samples showed blisters and poor paint adhesion after water immersion for 4 days at 120 degrees F. Lap shear results on dry panels were well below results for the other systems being tested, except for those sprayed with Unicoat. The Unicoat samples were not adversely affected by the Intex conversion coating and had an average lap shear value of 1230 lbs/in², similar to normally processed conventional coating systems (sample numbers 3A through 3C).

LAB REPORT 343-5-89
Code 343:PB
Page 2 of 4

RECOMMENDATIONS

Continue to expand field evaluation of Unicoat including follow-up on aircraft previously coated with Unicoat. Areas of concern include the short pot life, which is approximately one hour, the high viscosity at VOC compliance thinner concentration, and production scale repeatability of batches.

EXPERIMENTAL

MATERIALS:

2024-T3 Alum. panels

Conversion Coatings:

- a) Intex 8680 non-rinsing
- b) MIL-C-81706, form 1, method C, Class 1A

Primers:

- a) Koroflex
- b) MIL-P-85582, Type 1, Class 1, water borne epoxy

Topcoat:

- a) MIL-C-85285, Type I & II, high solids polyurethane
- b) Unicoat, high solids primer/topcoat polyurethane

PANEL PREPARATION

Panels were cleaned with detergent, water, and green Scotch Brite type pads, LP 0050C, Type II, Class 1, until the surface was water break free. Panels treated with Intex 8680 conversion coating were abraded while submerged in a 3 oz. per gallon concentration and allowed to stay in the solution 3 minutes. They were not water rinsed. Some panels were hung vertically and others hung horizontally to simulate on aircraft application of conversion coating. Panels treated with conversion coating MIL-C-81706 were processed in production shop 93113 using a current production batch of material. The panels were dipped/rinsed in water after chemical treatment per standard procedures. Panels were primed using conventional air spray equipment to a dry film thickness of .6 to .9 mils, then topcoated using air spray to a total dry film thickness of 2 to 2.5 mils. Unicoat panels were prepared by mixing the material in the ratio of 4:1, thinning to a viscosity of 20 seconds in a #2 Zahn cup, then spraying to a dry film thickness of 2 to 3 mils using conventional air equipment. The coating as mixed was not VOC compliant.

TESTING

Lap Shear: After coating, samples were cured 7 days at room temperature, then bonded in 1 inch width by 0.3 inch overlap dimensions. Shear values were converted to lbs/in². Samples were tested on an Instron with crosshead speed of 0.05 in/min.

Water Immersion & Tape Test: After coating, samples were cured 7 days at room temperature then scribed and immersed in deionized water at 120 degrees F for 4 days. After removal they were visually inspected for defects such as softening, wrinkling, blistering or any other coating deficiency. Samples were air dried at room temperature for 2 hours and then tape tested using MIL-T-21595 masking tape over the scribed area.

SAMPLE ID:	EVALUATION:	EVALUATION:
#, MATERIAL	SHEAR, PSI	a) WATER IMMERSION b) TAPE
1A MIL-C-81706 KOROFLEX PRIMER MIL-C-85285	MEAN=2833, STD DEV=70	a) VERY GOOD b) PASS TAPE TEST PRIMER FAILURE
1B MIL-C-81706 MIL-P-85582 MIL-C-85285	MEAN=1253, STD DEV=92	a) GOOD b) PASS TAPE TEST PRIMER FAILURE
1C MIL-C-81706 UNICOAT	MEAN=1973, STD DEV=127	a) EXCELLENT b) PASS TAPE TEST COHESIVE FAILURE IN UNICOAT
1D KOROFLEX PRIMER MIL-C-85285	MEAN=1733, STD DEV=115	a) POOR; BLISTERS b) FAIL TAPE TEST PRIMER FAILURE
1E MIL-P-85582 MIL-C-85285	MEAN=1183, STD DEV=104	a) VERY GOOD b) PASS TAPE TEST PRIMER FAILURE
1F UNICOAT	MEAN=1160, STD DEV=144	a) EXCELLENT b) PASS TAPE TEST UNICOAT FAILURE
2A UNICOAT MIL-P-85582 MIL-C-85285	MEAN=827, STD DEV=23	a) EXCELLENT b) PASS TAPE TEST
2B MIL-C-81706 UNICOAT MIL-P-85582 MIL-C-85285	MEAN=1080, STD DEV=432	a) EXCELLENT b) PASS TAPE TEST
2C MIL-C-81706 MIL-P-85582 MIL-C-85285 UNICOAT	MEAN=703, STD DEV=396	a) EXCELLENT b) PASS TAPE TEST
3A INTEX 8680 KOROFLEX PRIMER MIL-C-85285	MEAN=587, STD DEV=101	a) POOR; SEVERE BLISTERS b) FAIL TAPE TEST PRIMER FAILURE
3B INTEX 8680 MIL-P-85582 MIL-C-85285	MEAN=560, STD DEV=53	a) POOR; GRAINY b) 2 FAIL, 2 PASS TAPE TEST PRIMER FAILURE
3C INTEX 8680 UNICOAT	MEAN=1227, STD DEV=110	a) POOR; BLISTERS, GRAINY b) FAIL TAPE TEST CONVERSION COAT FAILURE

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Code 343:PB
Page 4 of 4

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Materials Engineering Division



DEFT, INC. 17351 JON KARMAN AVENUE IRVINE CALIFORNIA 92714 (714) 274 0400

SEPTEMBER 12, 1989

NAVAL AIR DEVELOPMENT CENTER
MATERIALS PROTECTION BRANCH
CODE 6062
WARMINSER, PA 18974

ATTN: CHARLIE HEGEDUS

DEAR CHARLIE:

I HAVE ENCLOSED A LAB TEST COMPARISON CHART OF YOUR SAMPLE
OF UNICOAT VERSUS OUR FORMULATION FOR A ONE COAT SYSTEM.

PER YOUR INSTRUCTIONS WE CATALYZED THE UNICOAT 4 $\frac{1}{2}$ TO 1.
OUR ONE COAT SYSTEM UTILIZES OUR OWN RESINS AND PIGMENTS.

BOTH RESULTS ARE COMPATIBLE. HOWEVER, MORE WORK MUST BE
DONE ON INITIAL VISCOSITY AND POT-LIFE. SALT SPRAY WILL
BE OUT OF THE CABINET NOVEMBER 3RD, 1989 AND FILAFORM OUT
SEPTEMBER 19, 1989.

IF YOU HAVE ANY QUESTIONS PLEASE CONTACT ME.

BEST REGARDS,

DEFT CHEMICAL COATINGS


RUDY LEVINE,
VICE-PRESIDENT

BL/BA
ENCL.



DEFT, INC. 17451 VON KARMAN AVENUE, IRVINE, CALIFORNIA 92714 / (714) 474-0400

Subject: Comparison of NADC Unicoat and Deft one coat system to the specification MIL-C-XXXX (AS)

PARAGRAPH	REQUIREMENT	NADC UNICOAT	DEFT CAMOUFLAGE
3.4.3	VOC 420 g/l max. (theoretical)	399 420	374 420
3.4.4	Compatible with 1,1,1-Trichlor	Reduces 5 to 2 (color change)	Reduces 5 to 2 (no color change)
3.6.1	Fineness 5 for Camo.	5	5
3.6.4	Viscosity 45 sec. #4FC max.	60"	44"
3.6.5	Pot Life - 1 hr. 70 sec. #4FC max. 8 hrs. no gel	gassed & gelled gelled	55" liquid
3.7.1	Drying Time STT 2 hrs. DH 8 hrs.	1 hr. 4 hrs.	1 hr. 5 hrs.
3.7.2	Surface Appearance -Uniform	Mottled	Uniform
3.7.3	Match 595 STD.	unknown color	test not tinted
3.7.4	Gloss 5 max. on Camo.	2.7 on 60° 10.7 on 85°	2.0 on 60° 2.7 on 85°
3.7.5	Hiding Power .95 min.	.96	.97
3.7.6	Water Resistance 7 days @ 150°F	pencil hardness 3B recovers to HB	2B recovers to HB
	D-3359 Adhesion	2B	2B
3.7.7	Flexibility GE impact 20% 1/4" mandrel @ 60°F	10-20 1/2 inch	10-20 1/2 inch

CONT'D

(Comparison Page 2)

PARAGRAPH	REQUIREMENT	NADC UNICOAT	DEPT CAMOUFLAGE
3.7.8	Fluid Resistance (no effect in 24 hrs.-4 hr. recovery)		
	MIL-L-20699 (250°F)	pencil HB, Adh.5B	pencil HB, Adh.5B
	MIL-H-83282 (150°F)	pencil 2B, Adh.4B	pencil HB, Adh.4B
3.7.9	Weather Resistance 500 hrs. Xenon 60°/85°	1.4/8.5	1.5/2.6
	$\Delta E/\Delta L$	1.06/1.02	0.17/0.16
	no cracks		no cracks
3.7.10	Humidity no effect 30 days	pass	pass
3.7.11	Heat Resistance ΔE max of 1	ΔE 0.89 ΔC 0.48	ΔE 0.24 ΔC 0.22
3.7.12	Solvent Resistance 25 double MEK Rubs	no effect	no effect
3.7.13	Tape Resistance-8 hrs.	2 hrs.	3 hrs.
3.7.12	Strippability 90% removal	100%	100%
3.7.13	Salt Spray 2000 hrs. 5% 500 hrs. SO	not complete not run	not complete not run
3.7.13.2	Filiform-1000 hrs. max. 0.25 inch	not complete	not complete
(no spec)	Cleanability	97%	70%
(no spec)	Recoat Adhesion to cured film	pass	pass
(no spec)	Initial pencil hardness	B	B
(no spec)	Dryed Adhesion ASTM D-3359	3B	3B
(no spec)	Adhesion to Composite Dry	4B	3B
	Wet	4B	4B
(no spec)	Adhesion to MIL-C-83286	5B	5B
(no spec)	Mix Ratio	4 1/2 to 1	4 to 1

TEST REPORT ON COMBINATION PRIMER/TOPCOAT
PERFORMED AT TEXAS INSTRUMENTS, SHERMAN

by Gene Davis

Testing was performed at Texas Instruments, Sherman TX on the combination primer/topcoat urethane coating developed by Charles Hegedus of NADC. Since testing was performed to the film requirements of MIL-C-83286 at NADC, evaluation for use over specific substrates processed at TI Sherman was performed.

Adhesion testing was performed in accordance with Federal Test Method Standard No. 141, Method 6301.1. Substrates tested were passivated 304 stainless steel, passivated 17-4 stainless steel, conversion coated 2024 aluminum, and bare 2024 aluminum. For each substrate tested, there was no loss of adhesion between coating and substrate, indicating excellent adhesion.

Corrosion resistance of broken coating film was determined by scribing coated panels with an "X", exposing the substrate. The panels were then exposed to 5% salt spray in accordance with ASTM B 117. As expected, the first substrate to fail was the bare 2024 aluminum, which failed at approximately 168 hours exposure. The remaining panels have passed over 336 hours exposure.

The utilization of the combination primer/topcoat as a final finish for military hardware looks very promising. Qualification testing has begun in order to qualify the coating on the Paveway Laser Guided Bomb programs. The duration of this qualification testing should be approximately 2 months.

One barrier to utilization of this coating system on military hardware is the lack of a Government Specification for the coating material. I understand a draft of such a specification is in work. I would request that a copy of the draft be made available, so that the incorporation of the coating on the Paveway Programs could be facilitated. Thanks to you, Charles, for developing such a coating system which provides so many benefits over the conventional military coatings. Hopefully, we can incorporate the coating on the Paveway Program by midyear.

Gene Davis
TI Sherman DSEG Process Engr. Mgr.
(214) 868-7167

B 107

Boeing Aerospace & Electronics
PO Box 3999
Seattle, WA 98124-2499

2-5321-CLH-0089-008
January 25, 1990

Naval Air Development Center (NADC)
Charles Hegedus
Code 6062
Warminster, Pennsylvania
18974-5000

BOEING

Dear Mr. Hegedus

Enclosed please find photographs of UNICOAT test panels after 1900 hours salt spray exposure in our laboratory.

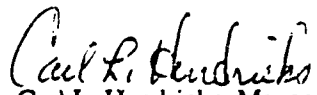
The UNICOAT material on the subject test panels was applied by the NADC. The test panels were 2024-T3 Aluminum alloy, 0.020 inch thick, prepared with Alodine 1200 chromate conversion coating prior to painting.

The UNICOAT specimens were placed in 5% salt spray (per ASTM B117) on 7/31/89 and removed on 10/16/89. Upon visual inspection, all panels showed no evidence of corrosion, loss of adhesion, blistering, or cracking of the film. This material performed exceptionally well under extended exposure to salt spray.

Please feel free to contact me if you have any further questions regarding this.

Sincerely,


David J. Swarberg
Org. 2-5321, Chemical Technology
(206) 393-3580 M/S 2E-01


Carl L. Hendricks, Manager
Org. 2-5321, Chemical Technology
(206) 393-3120 M/S 2E-01

Enclosure

PREPARED BY BOEING AEROSPACE,
SEATTLE, WA 98124-2499

EVALUATION OF NADC SELF-PRIMING TOPCOAT UB-14**OBJECTIVE**

To evaluate the performance of UB-14 as a candidate low VOC coating to be used as a replacement of MIL-C-83286.

APPROACH

This coating is not currently a qualified product to existing Boeing, military, and federal specifications. Therefore, the coating performance requirements of MIL-C-83286, an aliphatic polyurethane topcoat, were used as the qualification requirements for this material. The coating was evaluated on unprimed aluminum panels.

EXPERIMENTAL TEST PROCEDURE

Uncured coating properties were conducted prior to spraying. There was no observable settling in either component. After shaking, the components were allowed to stand for 10 minutes, then viscosity measurements were made using a #2 Zahn cup.

Bare 2024-T3 and T0 aluminum panels were prepared in the following manner.

1. Alkaline clean per BAC 5749. Rinse.
2. Deoxidize per BAC 5765; rinse in cold water.
3. Remove 5 panels for low temperature flexibility test; dry, wrap, and store in dessicator until ready to be painted.
4. Alodize all other panels using Alodine 1200 in accordance with BAC 5626; dry and wrap until needed.
5. Apply the coating in accordance with the manufacturer's instructions. The mixed paint was thinned using MEK/Toluene, (3:1) instead of 1,1,1 trichloroethane, to 20 seconds using a #2 Zahn cup.

The sprayed panels were allowed to air dry overnight and were then cured at 250 degrees F for 2 hours, therefore a full cure air time was not established. Tack free time after spraying was approximately 25 minutes. The following tests were then performed on the dry panels.

1. Wet tape adhesion after soaking at room temperature in distilled water for 7 days according to BSS 7225, type III.
2. Impact flexibility according to section 3.7.2.2 in MIL-C-83286 and Fed-Std-141.

3. Low temperature flexibility test using all of the non-alodized panels. Condition panels and a 1/8 inch diameter conical mandrel at -65 degrees C for 4 hours. Bend the panels around the mandrel. There should be no loss of coating.
4. Salt spray resistance. On four of five panels cut through coating to expose aluminum in an "X" pattern from corner to corner. Test according to ASTM B-117 in 5% salt fog for 500 hours. There should be no corrosion on the unscribed panel.
5. Humidity resistance. Scribe three panels in an "X" pattern from corner to corner. Test at 95% relative humidity at 120 degrees F for 30 days. There should be no blistering or other evidence of film failure on the unscribed panels. Evaluate scribed panels for corrosion.
6. Heat resistance. Expose four panels vertically to dry heat of 300 degrees F for four hours. Repeat the impact test and evaluate for color change. Slight yellowing or darkening does not constitute failure.
7. Immersion test. Immerse one set of panels in each of the following:
 - a. Shell SAE 10-40 motor oil at 240 degrees F for 24 hours.
 - b. Standard test fluid TT-S-735 at room temperature for 7 days.
 - c. Hydraulic fluid MIL-H-5606 at room temperature for 7 days.
 - d. Distilled water at 100 degrees F for 4 days.
 - e. Skydrol 500B at room temperature for 7 days.

After exposure, clean, rinse and dry the panels allowing one hour for recovery prior to testing. Evaluate for pencil hardness and gloss values.

8. Accelerated weathering. Expose to accelerated weathering for 500 hours according to BSS 7253 Type I. Measure 60 degree gloss before and after test and impact flexibility after weathering.

TEST RESULTS

A passing score was obtained for the following tests; wet tape adhesion, heat resistance, humidity exposure and low temperature flexibility. The unscribed control panel after salt spray showed no signs of corrosion, however, there were numerous blisters on all of the scribed panels.

There were five immersion fluids in which the coating was tested. A change of more than 2 levels of hardness is considered a failing grade which is also true for gloss readings. After immersion in motor oil there was a slight increase in gloss but no change in pencil hardness. The relative gloss after

the standard test fluid immersion was unchanged, however, the pencil hardness is considered a failure. Heated distilled water and MIL-H-5606 hydraulic fluid had no effect on either the hardness of the coating or the gloss. However, Skydrol jet fluid decreased the gloss slightly but made the coating extremely soft and is considered a failure.

Aging tests conducted for 500 hours exposure in a weatherometer showed no change in gloss. Impact flexibility tests conducted on the weathered panels showed no signs of cracking or crazing.

CONCLUSION

The coating UB-14 appears to pass the majority of the critical coating tests. There is a sensitivity to salt spray (blistering) when the painted surface has been scribed. Standard test fluid TT-S-735 and Skydrol 500B jet fluid soften the coating but do not affect the gloss. Overall, the combination primer-topcoat is an acceptable addition to MIL-C-83286.

D. M. Nemeth
Prepared by: D. M. Nemeth
2-3621 237-3064 M/S 73-09

E. C. Groshart
Approved by: E. C. Groshart
2-3621 393-3579 M/S 2E-01

C. L. Hendricks
Approved by: C. L. Hendricks
2-3621 393-3120 M/S 2E-01

DATE: February 3, 1989

PAGE 1

EVALUATION OF LOW VOC COATINGS
BAC MATERIALS AND PROCESSES ENGINEERING

FOR REPLACEMENT OF: _____

VENDOR NAME: NADC

PRODUCT NAME: Formula UB-14 Self-Priming Topcoat

COMPONENTS: _____

RESIN SYSTEM: _____

SOLVENTS IN SYSTEM: _____

SUBSTRATE USED: 2024-T3, 2024-T0 aluminum

PRIMER: none

APPLIED WITH: _____ THICKNESS: PRIMER: .01"
TOPCOAT: ✓

TIME TO: HANDLE: 25 min tack free FULL CURE: 2 hours 250°F after Rm. Temp. overcoat

PERFORMANCE

UNCURED COATING PROPERTIES:

1. VISCOSITY OF ALL COATING COMPONENTS: Component A 1:02 min
Component B 1:30 min
Mixed 1:34 min

2. INFRARED SPECTROSCOPY ANALYSIS (ATTACHED TO REPORT):

3. THERMOGRAVIMETRIC ANALYSIS (ATTACHED TO REPORT):

4. OUTGASSING (ATTACHED TO REPORT):

EVALUATION OF LOW VOC COATINGS				PAGE 2			
VENDOR NAME: <i>NADC</i>		PRODUCT NAME: <i>UB-14</i>					
PERFORMANCE (CONTINUED)							
CURED COATING PROPERTIES:							
<i>7 days in distilled H₂O, Rn. Inf</i> WET TAPE ADHESION		<i>50 hours</i> ACCELERATED WEATHERING EXPOSURE					
RESULTS	COMMENTS	GLOSS BEFORE	GLOSS AFTER	RESULTS	COMMENTS		
<i>Del</i> <i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i>	<i>WST</i> <i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i>	<i>A</i> 6	<i>6</i>	<i>Pass</i>	<i>No cracking or crazing from impact flexibility after weathering</i>		
		<i>B</i> 5	<i>5</i>	<i>Pass</i>			
		<i>C</i> 5	<i>5</i>	<i>Pass</i>			
		<i>D</i> 5	<i>5</i>	<i>Pass</i>			
		<i>E</i> 4	<i>4</i>	<i>Pass</i>			
SALT SPRAY EXPOSURE		HEAT RESISTANCE <i>4 hrs at 300°</i>					
RESULTS	<i>500 hours</i> COMMENTS	GLOSS BEFORE	GLOSS AFTER	HARDNESS BEFORE	HARDNESS AFTER	COMMENTS	
<i>1</i> <i>2</i> <i>3</i> <i>4</i> <i>5</i>	<i>Control - Pass</i> <i>Fail</i> <i>Fail</i> <i>Fail</i> <i>Fail</i>	<i>Rust on panel due to dripping from pipe in chamber</i>	<i>4</i> 6	<i>5</i>	<i>2H</i>	<i>2H</i>	<i>Pass</i>
		<i>4</i> 4	<i>6</i>	<i>2H</i>	<i>2H</i>	<i>Pass</i>	
		<i>4</i> 6	<i>5</i>	<i>H</i>	<i>2H</i>	<i>Pass</i>	
		<i>4</i> 7	<i>7</i>	<i>H</i>	<i>2H</i>	<i>Pass</i>	
		<i>4</i> 7	<i>7</i>	<i>2H</i>	<i>2H</i>	<i>Pass</i>	
HUMIDITY EXPOSURE		LOW TEMPERATURE FLEXIBILITY TEST					
RESULTS	<i>30 days</i> COMMENTS <i>95% 120°</i>	RESULTS	COMMENTS				
<i>A</i> <i>B</i> <i>C</i> <i>D</i> <i>E</i>	<i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i>	<i>A</i> <i>B</i> <i>C</i> <i>D</i> <i>E</i>	<i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i> <i>Pass</i>				

VENDOR NAME: <i>MADC</i>		EVALUATION OF LOW VOC COATINGS IMMERSION TESTING				PAGE 3	
SHELL SAE 10-40 MOTOR OIL 24 HOURS AT 240 ° F		STANDARD TEST FLUID TT-S-735 7 DAYS AT ROOM TEMPERATURE		DISTILLED WATER 4 DAYS AT 1000 F		HYDRAULIC FLUID MIL-H-5606 7 DAYS AT ROOM TEMPERATURE	
60 DEGREE GLOSS		60 DEGREE GLOSS		60 DEGREE GLOSS		60 DEGREE GLOSS	
BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
6	7	A ₄ 4	4	A ₅ 5	6	A ₆ 4	4
6	8	B ₄ 5	5	B ₅ 7	7	B ₆ 10	10
6	6	C ₄ 4	6	C ₅ 8	8	C ₆ 7	7
7	8	D ₄ 6	6	D ₅ 9	9		
7	8	E ₄ 4	4	E ₅ 5	5		
PENCIL HARDNESS		PENCIL HARDNESS		PENCIL HARDNESS		PENCIL HARDNESS	
BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
H	H	A ₄ H	2B	A ₅ H	H	A ₆ 2H	HB
H	H	B ₄ H	2B	B ₅ H	H	B ₆ 2H	H
2H	F	C ₄ F	2B	C ₅ H	F	C ₆ H	H
H	H	D ₄ F	3B	D ₅ H	H		
2H	H	E ₄ F	2B	E ₅ H	H		

A₃ B₃ C₃ D₃ E₃

A₃ B₃ C₃ D₃ E₃

(over)

	Colors Before	Colors After	Hardness Before	Hardness After
A	3	2	HB	6B
B	4	2	H	6B
C	3	2	H	6B
D	4	2	F	6B
E	3	2	F	6B



January 9, 1990

Aero Materials Division
Code 6062
Naval Air Development Center
Warminster, Pennsylvania 18974-5000

Attention: Mr. Charles Hegedus

SUBJECT: GRACO TEST REPORT HC-7502

Dear Mr. Hegedus:

Graco recently demonstrated that Unicoat, the self-priming topcoat developed by the Naval Air Development Center, can be successfully applied with plural component proportioning equipment and an air assisted airless application device. Detail is provided in the reference report, a copy is enclosed.

The Unicoat technical data sheet states that the VOC, as received, is 384 grams per liter. The addition of 625 milliliters of solvent to 5 gallons of admixed material did not exceed 420 grams per liter of VOC.

It is our opinion that Unicoat can be applied with a manual air assisted airless electrostatic gun. We recommend that an additional quantity of Unicoat be forwarded to our Chicago plant for evaluation of "wrap" properties.

Page Two
GRACO TEST REPORT HC-7502
January 9, 1990

We will conduct this electrostatic evaluation as soon as an additional sample is received. Thank you in advance for your cooperation, and we look forward to working with you on this and other future projects.

Sincerely,

CRACO, INC.



Steve Kish
Market Management

SK/rk

Enclosure

cc: Commander - Naval Air Systems Command
Air 5304B3 (Jim Thompson)
Washington, D.C. 20361-5300



PLURAL COMPONENT MATERIAL TEST REQUEST

Test No: HC-7502 Date 3-22-89

Before each test will be scheduled, the following must be submitted:

1. At least 5 gallons of each material (sent freight prepaid) to Test Lab, Attention Lab Supervisor (use Shipping Label 301-870).
2. A material manufacturer's Safety Data and Technical Data Sheet.
3. This form completely filled out.

Note: Reports to be sent to District Manager unless otherwise instructed.

END USER: NAVAL AIR DEVELOPMENT CENTER Contact: Charles Hegedus, Don Hirst
 Address: Code 6052 Warminster, PA 18973-5000 Phone: (215) 441-1452
 DISTRICT MANAGER: George Stoffelton Region: I-2130
 Address: 1406 Arrowwood Ct, Marlton, NJ 08053 Phone: (609) 596-1085
 DISTRIBUTOR: TBD Contact: _____ Phone: _____
 Address: _____

I. APPLICATION

Who to Contact: Charles Hegedus Phone: (215) 441-1452
 Spray: Conventional _____ Electrostatic: Manual: Automatic _____
 Airless: Air Assist: Air Spray:
 Mix: Wet: 4 Dry: 2 Pattern Width: Approx. 10"
 Substrate: Various metallic coupons to be supplied by NADC
 Extrusion: Flow Rate _____ Bead Size: _____ Ft/min: _____
 Transfer: Flow Rate _____
 Metering: Shot Size _____ Shots/min: _____ Tony Eng (215) 441-3269
 Material to be applied at: _____ °F
 Distance _____ Equipment Location to Point of Application _____
 Available Air Supply: CFM _____ PSI _____

II. MATERIAL INFO

Who to Contact: Jim Klotz Phone: (215) 723-0919
 Manufacturer: Coatings for Industry Sales _____
 Material Name: Uni-Coat Sales _____
 Material Number: UB14 (NADC#) A B _____
 Material Container Size (for Test): 5 Gallon Pail 5 Gall Pail _____
 Material Container Size (for Act. Application): 5 Gallon Pail 5 Gallon Pail _____
 Ratio by Volume: 4 _____
 Ratio by Weight (SP Gravity): 22 _____
 Ratio Tolerance: 5 _____
 Solvent for Thinning: Cannot be thinned _____
 Solvent for Cleanup: MEK _____
 Is Material Corrosive? Yes No _____ Ph _____ Yes No _____ Ph _____
 Is Material Abrasive? Yes No _____ Yes No _____
 Viscosity in (CP): 72 °F _____ °F _____ 72 °F _____ °F _____
 Pot Life (if premixed): _____ Sec. _____ Min. Mixed viscosity is 44 sec in Ford #4 or _____
1.5 Hrs 72 °F approx. 160 cps _____
 Solids by Volume (percent): 53 _____ 70 _____
 Toxic Material Present: Please see MSDS attached _____
 Is Material Dangerous? Yes No _____ Yes No _____

Test materials to be returned freight collect to:

Address: Code 6052, NADC Warminster, PA Attn: Charles Hegedus

III. TEST OBJECTIVE

Recommended test method: Method A, AS, AA for spraying material onto aircraft. Applicant will be used at various Naval Air facilities across country.

If test samples required, describe:

Customer to Attend Test: Yes No

HYDRA CAT TEST REPORT

Test No.: HC-7502Date: 10/10/89

Conclusions: Successfully proportioned, mixed and sprayed customer's test material. The base/paint side was reduced by adding 625 ml of a solvent blend to 4 gallons. We were able to produce spray patterns and acceptable atomization with just a slight heaviness in the patterns center. No off-ratio or mixing problems appeared during our testing.

Recommended Equipment: 4.165:1 President VRHC, 15:1 President master, #9 slave; 3/8" I.D. material hose (A); 1/4" I.D. Moisture-Lok hose (B); 215626 mix manifold, 3/8-27 mixer; 1/4 x 15 whip hose; A/A 2000 gun with H.V.F.F. cap; 182-511 to 519 tips; Pressure Pot or 1:1 Fast Flo feed pumps (A&B); agitator (A); 100 mesh Red Alert filters (A&B); 5:1 Monark solvent pump with 1/4" I.D. hose.

Tip or Nozzle

Air Spray: _____ Fluid Tip _____ Air Cap _____ Mils/Pass

Airless Spray: _____ Tip _____ PSI Minimum Fluid Atomizing Pressure _____ Mils/Pass

Air-Airless Spray: 511 Tip H.V.F.F. Air Cap 80-100 Air Pressure
500-800 PSI Min. Fluid Atomizing Pressure 1 Mils/Pass

Extrusion: _____ Nozzle Size _____ Bead Size _____ Ft/Minute

Transfer: _____ Hose Size _____ Length _____ GPM Flow Rate

Test Equipment Set-Up

_____ Fixed Ratio 4.165:1 Variable Ratio: _____ Air Motor: PresidentBase (A): Prop. Cylinder 15:1 Pres. Hose to Mixer? 3/8" Dia. 25' LengthCatalyst (B): Prop. Cylinder #9 Hose to Mixer? 1/4" Dia. 25' LengthSolv. Pump 10:1 President Hose (Size - Lg.) 1/4" x 25' Gun: A/A 2000 Manual Auto _____Mixer: _____ Power Static: 3/8-27 Mix Manifold 626 Heaters _____ Regulators __________ Immersed _____ Gravity Feed Pressure Feed_____ Feed Pumps A P. Pot B _____ Pressure Pot _____ Ram InductionOperating Pressure A 40 B 30Other Equipment: H.V.F.F. cap

Comments: Base side was reduced 625 ML of solvent blend to 4 gallons- adjusted mix ratio from 4:1 to 4.165:1. Material formulation was identical to one tested in April. High mil builds (6+ wet) produced the best initial wet finish results, but only a slight improvement over the spec mil build (4 wet) when dry.

This information was developed under laboratory conditions which may vary with Actual Field Applications.

Demonstration Attended By: _____

Test Engineer: T. EsparzaCopies Sent To: G. Gustafson, S. Kish, B. Thompson, FTU Lab



March 15, 1990

Aero Materials Division
Code 6062
Naval Air Development Center
Warminster, Pennsylvania 18974-5000

Attention: Mr. Charles Hegedus

SUBJECT: UNICOAT

Dear Mr. Hegedus:

The referenced letter detailed the application of Unicoat with plural component proportioning equipment using air assisted airless as the atomization method. That letter requested additional material for evaluation with our manual electrostatic hand guns.

We completed our evaluation of the "WRAP" characteristics of Unicoat on 2/23/90. We are pleased to advise that Unicoat demonstrated fair wrap with our air assisted airless electrostatic gun (PROAA4000).

For this test, we premixed components A and B prior to applying with a 10:1 President pump. The fluid pressure was 900 psig and the air pressure between 80 to 100 psig.

We did observe that the admixed material increased in viscosity during the evaluation. Our recommendation is that further testing be conducted with plural component proportioning equipment.

Page Two
UNICOAT
March 15, 1990

Please do not hesitate to contact me if you have any questions regarding our testing or if additional data is required.

Sincerely,

GRACO INC.

SKK
Steve Kish
Market Management

SK/rk

INFORMAL MEMO

SUBJ: UNICOAT TEST RESULTS

TO: S.L. Toepke, J.J. Reilly

DATE: 16 January 1990

CC: E. Brusius (NADC), J.J. Slavick, S.H. Devitre, M.S. Ruessing, J.M. Praiss, S. Clinch

1. A test of 17 different coatings was initiated in June 1989. NADC's Unicoat was included in this evaluation. To date all of the tests are completed except the filliform corrosion test (Completion Date-Feb. 1, 1990). Results for NADC's Unicoat are shown below in Table 1.

TEST	RESULTS	PRETREAT	PANEL TYPE
3000 hr Neutral Salt Spray	Pass (4/4)	Conversion Coat	7075-T6 Al
1500 hr Neutral Salt Spray	Pass (4/4)	Cd Plate/C.Coat	4130 Steel
750 hr SO ₂ Salt Spray	Fail (4/4)	Conversion Coat	2024-T3 Al
Cross Hatch Adhesion	Pass (2/2)	Conversion Coat	2024-T3 Al
Cross Hatch Adhesion	Pass (2/2)	Deoxidize	2024-T3 Al
Wet Tape Adhesion	Pass (2/2)	Conversion Coat	2024-T3 Al
Wet Tape Adhesion	Fail (2/2)	Conversion Coat	2024-T3 Al
Reverse Impact(60 in-lbs)	Pass (2/2)	Anodize(Typ II)	2024-T3 Al
Reverse Impact(30 in-lb)	Pass (2/2)	Anodize(Typ II)	2024-T3 Al
Mandrel Flexibility	Pass (2/2)	Conversion Coat	2024-T3 Al
Low Temperature Resistance	Pass (2/2)	Conversion Coat	2024-T3 Al

2. The results above are promising. Based on these results MCAIR would like to see the following:

(a) Painting of several areas of an F/A-18 in order to gain flight test data.

(b) More adhesion testing on titanium, CR'S, and composite substrates.

(c) Elimination of batch-to-batch consistency problems. Unicoat has been tested at MCAIR on at least two other occasions with varying results.

Rock A. Stevens

Rock A. Stevens
Material and Process
McDonnell Aircraft Co.
(314) 234-8960



DeSoto, Inc.

COATINGS AND POLYMERS DIVISION

701 SHILOH ROAD, P.O. BOX 461268, GARLAND, TEXAS 75046 TELEPHONE (214) 276-5181

January 4, 1990

TO: Ron Conti
 DEPT: Aerospace - ARC Technical Lab
 SUBJECT: CLOSEOUT DR# J9574

PURPOSE

To run critical tests on Navy Unicoat, using MIL-C-83286 and MIL-C-85285 as standards.

RESULTS

Testing has now been completed on the N.A.D.C. Unicoat. The Unicoat was tested against MIL-C-83286 (DeSoto 822X363) and MIL-C-85285 (DeSoto 822X655), over two substrates (Alodine 1200 pretreated 2024-T3 aluminum and Scotchbrite alclad 2024-T3 aluminum). In addition to the testing of fresh Unicoat material, tests were run on Unicoat material which had been subjected to accelerated aging equivalent to approximately one year at standard conditions.

As detailed in Appendix I, the Unicoat has performed as well as MIL-C-83286 and MIL-C-85285. No blistering nor loss of adhesion was seen in the water resistance test; no softening nor loss of adhesion was observed in the MIL-H-83282 test. In salt spray exposure, the Unicoat resisted corrosion better than MIL-C-83286, but not as good as MIL-C-85285. The high solids topcoat performed best in G.E. Impact testing, with the Unicoat performing slightly better than MIL-C-83286. Appendix II shows similar results for the performance of aged Unicoat.

Appendices III and IV quantify the effects of 500 hours Q.U.V. and 500 hours Twin Carbon arc exposure respectively. The Unicoat gloss was considerably lower after weathering. This can be partially attributed to the higher initial gloss which, by the way, has been lowered at Coatings for Industry by the addition of a flattening agent that is not listed in the Navy's formula. The Unicoat's color was also significantly affected by weathering.



CONCLUSION

In general, the Unicoat appears to have adequate performance properties. The main concern at this time with this formula is the short pot life/high viscosity. The following table shows typical viscosity results obtained after 30 minutes potlife.

TABLE 1: POTLIFE DATA

<u>MIX RATIO (BY WT)</u>	<u>V.O.C (g/L)</u>	<u>INITIAL VIS (SEC)</u>	<u>FINAL VIS (SEC)</u>
6.84:1.00:0.38	412	53	GEL
6.84:1.00:0.60	433	42	GEL
6.84:1.00:1.21	489	29	GEL
6.84:1.00:1.39	503	27	GEL
6.84:1.00:1.59	517	26	GEL

NOTE: Final Viscosity check at 30 minutes.
Viscosities checked using #2 G.E. Zahn Cup.

With improvements in viscosity and potlife the Navy Unicoat System would be a viable alternative to conventional primer/topcoat systems.


Ken Weaver
Chemist

KW:sm
cc: Aerospace Dist.

APPENDIX I

PERFORMANCE TEST RESULTS FOR NAVY UNICOAT

TEST DESCRIPTION	SPTC AND ALODINE 1200	SPTC & SCOTCH BRITE ALCLAD	513x390 & 822x363	513x390 & 822x655
1. Water Resistance (4 days @ 100 F)				
a. Dry Adhesion	100%	100%	100%	100%
b. Wet Adhesion	100%	100%	100%	92%
c. Vapor Phase Adhesion	100%	100%	100%	100%
2. MIL-H-83282 Resist. (24 hrs. 150 F)				
a. Adhesion (Before/After)	100%/100%	100%/100%	100%/99%	99%/99%
b. Pencil Hardness	2B/2B	2B/3B	F/2H	F/F
3. Salt Spray (500 hrs)				
a. Corrosion (1-10; 10= extreme)	3	3	4	1
b. Blisters (# per 4"x4" panel)	3	8	0	0
4. G.E. Impact				
a. Before Desiccator	60%	60%	60%	70%
b. After Desiccator	60%	60%	< 60%	80%
5. Humidity Resistance (1056 hrs, 120 F, 100% R.H)				
a. Dry Adhesion	100%	100%	100%	100%
b. After Exposure	100%	100%	100%	100%

APPENDIX II

PERFORMANCE TEST RESULTS AFTER ACCELERATED STORAGE

TEST DESCRIPTION	SPTC AND <u>ALODINE 1200</u>	SPTC & SCOTCH <u>BRITE ALCLAD</u>	513x390 & <u>822x655</u>
1. WATER RESISTANCE (4 Days @ 100 F)			
a. Dry Adhesion	100%	100%	100%
b. Wet Adhesion	100%	100%	100%
c. Vapor Phase Adhesion	100%	100%	100%
2. MIL-H-83282 Resistance (4 days @ 150 F)			
a. Adhesion (Before/After)	100%/100%	100%/100%	100%/100%
b. Pencil Hardness	HB/4B	HB/4B	2H/H
3. Salt Spray (500 hrs)			
a. Corrosion (1-10;10= extreme)	3	1	1
b. Blisters (# Per 4"x4" panel)	2	2	0
4. G.E. Impact			
a. Before Desiccator	60%	60%	70%
b. After Desiccator	70%	60%	80%

APPENDIX III

WEATHERABILITY - Q.U.V. TEST RESULTS

GLOSS

<u>PRODUCT CODE #</u>	<u>60 INITIAL</u>	<u>60 @ 500 HRS.</u>	<u>20 INITIAL</u>	<u>20 @ 500 HRS</u>
Unicoat # 1	9.6	1.0	0.2	0.2
Unicoat # 2	9.6	1.2	0.2	0.2
Unicoat # 3	9.6	1.1	0.2	0.2
822X363 # 1	1.7	1.1	0.35	0.2
822X363 # 2	1.7	1.1	0.35	0.2
822X363 # 3	1.7	1.1	0.35	0.2
822X655 # 1	1.7	0.9	0.2	0.2
822X655 # 2	1.7	0.9	0.2	0.2
822X655 # 3	1.7	1.0	0.2	0.2

COLOR

<u>PRODUCT CODE #</u>	<u>DE</u>	<u>DL</u>	<u>RG</u>	<u>YE</u>	<u>C</u>
Unicoat # 1	6.53	5.97	1.14	2.39	2.65
Unicoat # 2	8.58	8.19	1.18	2.29	2.58
Unicoat # 3	7.73	7.44	0.73	1.93	2.07
822X363 # 1	3.47	3.37	-0.80	0.14	0.81
822X363 # 2	2.14	2.02	-0.68	0.08	0.69
822X363 # 3	2.54	2.43	-0.69	0.16	0.71
822X655 # 1	0.99	-0.10	0.55	0.81	0.98
822X655 # 2	1.21	-0.52	0.60	0.91	1.09
822X655 # 3	1.05	-0.49	0.39	0.84	0.93

APPENDIX IV

UNICOAT WEATHERABILITY - TWIN CARBON ARC TEST RESULTS

GLOSS

<u>PRODUCT CODE #</u>	<u>50 INITIAL</u>	<u>60 @ 500 HRS.</u>
Unicoat # 1	9.6	5.0
Unicoat # 2	9.6	5.1
Unicoat # 3	9.6	5.5
822X363 # 1	1.7	1.6
822X363 # 2	1.7	1.5
822X363 # 3	1.7	1.4
822X655 # 1	1.7	1.1
822X655 # 2	1.7	1.0
822X655 # 3	1.7	1.0

COLOR

<u>PRODUCT CODE</u>	<u>DE</u>	<u>DL</u>	<u>Da</u>	<u>Db</u>
Unicoat # 1	1.90	1.09	-0.32	1.53
Unicoat # 2	2.01	1.11	-0.37	1.63
Unicoat # 3	1.80	0.80	-0.37	1.57
822X363 # 1	0.71	-0.58	-0.01	0.41
822X363 # 2	0.66	-0.52	-0.08	0.40
822X363 # 3	0.78	-0.67	-0.03	0.40
822X655 # 1	1.17	-1.17	-0.05	0.04
822X655 # 2	1.09	-1.08	0.00	-0.05
822X655 # 3	0.97	-0.97	0.04	0.02

8128

WEAPONS QUALITY ENGINEERING CENTER
NAVAL WEAPONS STATION
CONCORD, CALIFORNIA

REPORT ON ASTM G 85 ACIDIFIED
SALT FOG TEST OF VOC COMPLIANT COATINGS
FOR THE SPARROW MISSILE

REPORT WQEC/CO 89-11

DECEMBER 1989

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EXECUTIVE SUMMARY

As part of our materials engineering support for the Pacific Missile Test Center (PMTC) Point Mugu, tests were performed on the corrosion resistance of new high performance aerospace coatings. The purpose of these tests was to identify a coating that could serve as a replacement for the existing coating system. After 1 January 1992, the present topcoat will not be allowed for use in the San Francisco Bay Area. Included in the testing were 5 primers, 9 topcoats, and 2 self priming topcoats (unicoads).

The coatings tested have a Volatile Organic Compound (VOC) content (measured as grams of VOC per liter of paint) that will be in compliance with California's proposed air pollution control regulations for 1992. The new regulations will limit the VOC content of primers and topcoats used for aerospace and miscellaneous metal parts applications to 340 and 420 g/l respectively. Currently, the SPARROW missile uses a two coat system consisting of MIL-P-23377E epoxy polyamide primer followed by MIL-C-83286 aliphatic isocyanate polyurethane topcoat. The VOC levels for this system are 340 and 520 g/l respectively.

A replacement coating should, if possible, satisfy these additional criteria:

a. Formulated without the solvent 1,1,1 trichloroethane. The use of 1,1,1 trichloroethane is under scrutiny due to toxicity and corrosion concerns. The primer currently in use contains this solvent.

b. VOC level below 340 g/l for both the primer and the topcoat. This would allow use of the same primer and topcoat for miscellaneous metal parts painting and for aerospace painting. In addition, use of a 340 g/l topcoat will meet the anticipated VOC regulations for some time.

A search was made for high performance aerospace coatings that would comply with the proposed VOC regulations. Various primer/topcoat combinations were then applied to test panels made from SPARROW missile fuselages. Surface preparations and coating applications were carried out at Naval Aviation Depot (NAVAVNDEPOT), Alameda using standard equipment and practices.

The prepared panels were exposed to 500 hours of an acidified salt fog test environment. The test method used was American Society for Testing and Materials (ASTM) G 85. This test environment simulates the severe marine/industrial environment frequently encountered by SPARROW missiles while deployed at sea. At the end of the acidified salt fog test the panels were photographed and evaluated in accordance with ASTM D 1654.



The following major conclusions were drawn based upon the exposure to the ASTM G 85 test and ASTM D 1654 criteria to evaluate the various coated panels:

a. The coating system currently used on SPARROW missiles received the highest ASTM D 1654 rating. This coating system provided the highest degree of corrosion resistance. Unicoat, a self priming single coat polyurethane developed by Naval Air Development Center, received the second highest rating and provided a high degree of corrosion protection.

b. A commercially available 340 g/l VOC epoxy polyamide primer without 1,1,1 trichloroethane received the same ASTM D 1654 rating as the currently used MIL-P-23377E primer that contains this solvent. These two coatings provide equivalent degrees of corrosion protection. The disadvantages associated with 1,1,1 trichloroethane can be eliminated with the commercially available epoxy polyamide primer.

c. Epoxy polyamide topcoats (modified MIL-C-22750D) received ASTM D 1654 ratings that were below those obtained for the currently used MIL spec topcoat. The corrosion protection of these coatings is less than that which is provided by polyurethane topcoat currently being used.

d. Insufficient service data exists on these new high performance aerospace coatings. We conclude that the next step should be field testing.

The coatings listed below are recommended for field testing. A trial application would allow other factors, such as ultraviolet exposure and cyclic wetting/drying, to be evaluated through actual in service environmental exposure. We realize this data will take time to gather, however the deadline for obtaining a new coating is 1 January 1992. In order to obtain sufficient data for a decision, the field tests should start as soon as possible. For statistical purposes, field testing would require test groups of approximately 30 missiles for each coating system. Similar deployment patterns would also be required. Testing could be performed for 12-18 months, followed by data analysis and final recommendations, while still meeting the deadline.

a. Unicoat self priming topcoat developed by NADC.

b. A two coat system consisting of a 340 g/l VOC epoxy primer (MIL-P-23377) and a commercially available 340 g/l VOC polyurethane topcoat (Koppers A-2513/C2513).

c. A commercially available two coat system consisting of a 340 g/l VOC epoxy primer formulated without 1,1,1 trichloroethane (Koppers P-3501/C-3501) and a 340 g/l VOC polyurethane topcoat (Koppers A-2513/C-2513).

d. A two coat system consisting of MIL-P-23377 epoxy primer with MIL-C-85285 polyurethane topcoat (420 g/l VOC).

NAVAL AIR DEVELOPMENT CENTER
AEROSPACE MATERIALS DIVISION
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ENGINEERING REPORT

FROM: Protective Organic Coatings Team, Code 8062, (215)441-3269

PREPARED BY: Donald Hirst and Anthony Eng

SUBJECT: Evaluation of pretreatment/UNICOAT finishing system

DATE OF REPORT: 6 December 1989

BACKGROUND: In February 1989, the commanding officer at NAS Whiting Field prohibited the disposal of chromate containing materials in their waste treatment plant. After learning of the good performance of low gloss UNICOAT on chemically deoxidized aluminum surfaces (using corrosion removing compound Mil-C-13070) at NADEP Pensacola, ONAFRA decided to paint their T-34's with a similar non-chromated high gloss UNICOAT finishing system. In July and August 1989 at NAS Whiting Field, three T-34's (Bund 161841, 162631 & 162623) were painted with gloss white UNICOAT over a chemically deoxidized surface (Alumiprep 33 applied with a non-abrasive pad). Appendix A of this article contains the detailed preparation procedures for the T-34 and H-3 aircraft. In October 1989, NADC was informed of adhesive failures of UNICOAT on T-34 Bund 161841. In November 1989, NADC and NADEP Pensacola personnel investigated the condition of T-34 Bund 161841 stationed at NAS Corpus Christi. Ken Sanders of NADEP Pensacola also investigated the condition of the other two T-34's (Bund 162631 & 162623) at NAS Whiting Field. Due to a rigid flight test schedule, only a visual inspection could be performed on Bund 162631, which showed no adhesive failures. Bund 161823 was thoroughly inspected and the coating adhesion was evaluated based on crosshatch adhesion testing. This test indicated that the coating had poor adhesion to the substrate. However, Mr. Sanders attributed this lack of adequate adhesion to surface preparation rather than to the inherent adhesive strength of UNICOAT.

EVALUATION PROGRAM: In order to determine appropriate chrome and non-chrome treatments prior to UNICOAT application, NADC initiated a laboratory evaluation program. The following describes the evaluation program variables, test procedure, results, conclusions, and recommendations.

Variables

Pretreatments: All test panels were cleaned with Mil-C-80570 Type I (diluted 1/1 by volume with tap water) using a white non-abrasive pad (Mil-C-80957) and then allowed to air dry. All test panels consisted of 7075 bare aluminum except for the panels conversion coated by Q-panel which were 2024 T3 bare aluminum. The various pretreatments evaluated were:

- A. Chromate conversion coating Mil-C-01706 (prepared by Q-panel Co)
- B. Chromate conversion coating Mil-C-01706 (prepared by NADC)
- C. Chemical deoxidizing using a corrosion removing compound Mil-C-38334 Type I, Class 1 (diluted 1/1 by volume with tap water) and applied with a white non-abrasive pad (Mil-C-00957) for about 5 minutes. Rinsed thoroughly with tap water to a water break-free condition and allowed to

air dry. MIL-C-18214 and MIL-C-18278 (used on H-T at NAFEP Pensacola) are both phosphoric acid based and produce similar effects on aluminum.

D. Physical deoxidizing using a red abrasive pad (MIL-A-9962) while cleaning with MIL-C-45579 Type 1 for about 5 minutes. Rinsed thoroughly with tap water to a water break-free condition and allowed to air dry.

E. Chemical deoxidizing using Alumiprep 73, a US Paint corrosion removing product diluted 1/4 by volume with tap water, applied with a white abrasive pad (MIL-C-83957) for about 5 minutes. Rinsed thoroughly with tap water to a water break-free condition and allowed to air dry.

F. Wet painting with MIL-C-8014 applied to a thickness of 0.5 to 0.7 mils using conventional air-atomizing siphon cup spray equipment. Allow to air dry.

Coatings: All coatings were applied within 4 to 4.5 hrs after the pretreatment to a thickness of 1.8 to 2.2 mils using conventional air-atomizing siphon cup spray equipment. All coatings were allowed to cure for 7 days at ambient laboratory conditions (70°F). The coatings evaluated in this program were:

1. Gloss white UNICENT (retain sample from NAFEP mission; 1967)
2. Gloss white UNICENT (manufactured in NAFEP lab)
3. Flat gray UNICENT (manufactured by Coatings For Industry)

Test Procedure

Method: After allowing 48 hrs of the coatings to cure at 70°F (70°F), the specimen tests were performed by subjecting the coatings to wet/dry, wet/damp, and wet/accelerated test conditions, applying a 1/2" wide #100 mesh rasping tape over an X made with two parallel scribe lines (3/4" separation) of their lifting capacity and geometry. The following testing system (from ASTM D3303) was used to determine coating adhesion by these tests:

- 0A - No peeling or removal
- 1A - Trace peeling or removal along incisions
- 2A - Ringed removal up to 1/16" on either side of incisions
- 3A - Ringed removal along most of incision up to 1/8" on either side
- 4A - Ringed removal most of the area of the X under the tape
- 5A - Removal beyond the area of the X

Evaluation Criterion: A rating of 3A or 4A is considered acceptable.

Test Conditions:

- I. Dry, 70°F
- II. Distilled Water Immersion, 24 hr, 70°F
- III. Distilled Water Immersion, 72 hr, 100°F
- IV. Distilled Water Immersion, 120 hr, 100°F

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Test Results

TAPE TEST ADHESION RATING

Pretreatment	Condition	Gloss White UNICOAT (Whiting)	Gloss White UNICOAT (NADCO)	Flat Gray UNICOAT (OFI)
A	Dry, 75°F	5	5	5
A	H ₂ O, 24 hr, 75°F	5	5	5
A	H ₂ O, 72 hr, 120°F	5	5	5
A	H ₂ O, 120 hr, 150°F	5	5	5
A	AVERAGE RATING	5.00	5.00	4.50
B	Dry, 75°F	5	5	5
B	H ₂ O, 24 hr, 75°F	5	5	5
B	H ₂ O, 72 hr, 120°F	2	5	5
B	H ₂ O, 120 hr, 150°F	4	5	5
B	AVERAGE RATING	4.00	5.00	5.00
C	Dry, 75°F	5	5	5
C	H ₂ O, 24 hr, 75°F	5	5	5
C	H ₂ O, 72 hr, 120°F	5	5	5
C	H ₂ O, 120 hr, 150°F	5	5	4
C	AVERAGE RATING	5.00	5.00	4.75
D	Dry, 75°F	5	2	5
D	H ₂ O, 24 hr, 75°F	0	0	0
D	H ₂ O, 72 hr, 120°F	0	0	0
D	H ₂ O, 120 hr, 150°F	0	0	0
D	AVERAGE RATING	1.25	0.50	1.25
E	Dry, 75°F	5	5	5
E	H ₂ O, 24 hr, 75°F	1	0	0
E	H ₂ O, 72 hr, 120°F	4	5	0
E	H ₂ O, 120 hr, 150°F	5	5	0
E	AVERAGE RATING	3.75	3.75	1.25
F	Dry, 75°F	5	5	5
F	H ₂ O, 24 hr, 75°F	2	4	4
F	H ₂ O, 72 hr, 120°F	3	4	4
F	H ₂ O, 120 hr, 150°F	5	5	5
F	AVERAGE RATING	3.75	4.50	4.50

Pretreatments:

- A - Chromate Conversion Coating (D-Panel)
- B - Chromate Conversion Coating (NADCO)
- C - Chemical Etch/oxide (Mil-C-28374)
- D - Physical Etch/oxide (Mil-A-4962)
- E - Chemical Etch/oxide (Alumiprep 33)
- F - Wash Primer (Mil-C-8514)

Conclusions

The conclusions made from these test results with regard to adhesion are:

1. The batch of gloss white UNICOAT used to paint the three T-34's at NAS Whiting Field was good.
2. Aluminum surfaces pretreated with a chromate conversion coating conforming to Mil-C-8170b or a chemical deoxidizer conforming to Mil-C-38334 using a non-abrasive pad conforming to Mil-C-83957 performed well when coated with gloss or flat UNICOAT.
3. Chemical deoxidizing using US Paints' Alumiprep 37 as the sole pretreatment process did not prove to be adequate for gloss or flat UNICOAT.
4. Physical deoxidizing using a red abrasive pad (Mil-R-9962) while cleaning with Mil-C-85570 Type I as the sole pretreatment process did not prove to be adequate for gloss or flat UNICOAT. Note: NADEF Jacksonville successfully applied flat gray UNICOAT over a physically deoxidized surface (port side only) of a F-3 in August 1989. See Appendix A for the detailed surface preparation procedure for this aircraft.
7. Wash priming using Mil-C-6514 (contains chromates) in conjunction with UNICOAT, although promising in terms of adhesion, does not appear to be a viable alternative to either Mil-C-8170b or Mil-C-38334 with UNICOAT.

Recommendations

The following recommendations are made with respect to the application of UNICOAT (flat and gloss):

1. A chemical deoxidizer (or corrosion removing compound) conforming to Mil-C-38334 can be used as the single pretreatment to activate the aluminum surface prior to the application of UNICOAT. This pretreatment can be used where environmental regulations restrict the use of chromates. A chromate conversion coating conforming to Mil-C-8170b can be used as the pretreatment for UNICOAT.
2. Painting should be performed within 4 hrs of pretreatment step.
3. All other substrate preparation and paint application procedures shall conform to NAVAIR 01-1A-509.
4. See Appendix B for the recommended surface pretreatment, materials handling, and application procedures for the UNICOAT finishing system.

Donald Hiner
Anthony T. E.

APPENDIX A - Surface Preparation Procedures Used For The UNICOAT Finishing System At Several Navy Activities

T-34 Buno 161841 (7/89 NAS Whiting Field - Chemical Deoxidizing)

- strip paint from aircraft
- alkali detergent wash
- chemical deoxidizing (US Paints' Alumiprep 33) applied with non-abrasive pad Mil-C-83957 for 3 minutes
- water rinse (to break-free condition) and allow to air dry
- next day mask and tape
- MEK wipe
- tack cloth
- apply gloss white UNICOAT (30 hr after deoxidizing) (manuf. by Coatings For Industry)

T-34 Buno 162631 (8/89 NAS Whiting Field - Chemical Deoxidizing)

- strip paint from aircraft
- alkali detergent wash
- next day chemical deoxidizing (US Paints' Alumiprep 33) applied with non-abrasive pad Mil-C-83957 for 3 minutes
- water rinse (to break-free condition) and dry with air hose
- mask and tape
- solvent (US Paints' Alumiprep T0008) wipe
- tack cloth
- apply gloss white UNICOAT (4 hr after deoxidizing) (manuf. by CFI)

T-34 Buno 162623 (8/89 NAS Whiting Field - Chemical Deoxidizing)

- strip paint from aircraft
- alkali detergent wash
- next day chemical deoxidizing (US Paints' Alumiprep 33) applied with non-abrasive pad Mil-C-83957 for 3 minutes
- water rinse (to break-free condition) and dry with air hose
- mask and tape
- solvent (US Paints' Alumiprep T0008) wipe
- tack cloth
- apply gloss white UNICOAT (4 hr after deoxidizing) (manuf. by CFI)

H-3 Buno 148049 (6/88 NADEP Pensacola - Chemical Deoxidizing)

- strip paint from aircraft
- wash with Mil-C-85570 Type I
- water rinse (to break-free condition)
- chemical deoxidize with corrosion removing compound Mil-C-10578 applied with a non-abrasive pad conforming to Mil-C-83957 for 5 to 7 minutes
- water rinse (to break-free condition)
- mask and tape
- tack cloth
- paint with flat gray UNICOAT (manuf. by CFI)

B 136

P-3 Buro 148889 (8/89 NAFEP Jacksonville - Physical Deepcleaning)

- paint stripped from aircraft
- scrub with Mil-T-6096A and Mil-C-87936 Type I using 3M Co #7447 abrasive pads
- water rinse
- steam clean
- wash with Mil-C-87936 Type I using 3M #7447 abrasive pads
- conversion coat (Mil-C-81746) on starboard side only
- wash with Mil-C-87936 Type I using 3M #7447 abrasive pads (port side) and 3M non-abrasive pads (starboard side)
- mask and tape
- paint with flat gray UNICOAT (manuf. by CFI)

APPENDIX B - The Recommended Surface Preparation, Materials Handling, and Application Procedures For The UNICOAT Finishing System.

Aircraft Preparation

- strip paint from aircraft
- wash with Mil-C-85579 Type I (diluted 1/1 by volume with water)
- water rinse (to break-free condition)
- chemical deoxidize with corrosion removing compound Mil-C-30334 Type I Class 1 (diluted 1/1 by volume with water) applied with a non-abrasive pad conforming to Mil-C-87957 for 12 but not more than 20 minutes
- apply chromate conversion coating conforming to Mil-C-81700, this step can be omitted if chromate-free finishing system is desired
- water rinse (to break-free condition) and allow to air dry
- mask and tape
- tack cloth
- prepare and apply UNICOAT
- UNICOAT application should be performed within 4 hr of the last chemical surface treatment process (deoxidizing or chromate conversion)

UNICOAT Storage

- promptly store UNICOAT in a refrigerated area (but not less than 35°F) whenever possible; this will significantly increase shelf-life and maintain the current pot life property

Mixing Individual Components

- mix part A (pigmented) by mechanical or manual techniques in 5 - 10 minute intervals until uniform or homogeneous
- check for caking or settling at the bottom
- Caution: do not excessively shake, mix, or stir such that significant air bubbles are produced; excessive dispersing will generate heat which will decrease pot life
- part B (resin only) does not need to be mixed

Mixing Catalyzed Paint

- mechanically or manually stir the appropriate amount (per paint manufacturer's instructions) of part B into part A for 1 - 3 minutes or until thoroughly dispersed.

Thinning

- to obtain the self-priming topcoat compliant VOC of 420 g/l for all types/colors of UNICOAT, thin the admixed paint with MIL-T-81772 Type I at the prescribed volume or weight (per manufacturer's instructions)
- or
- to obtain non-VOC compliant flat or low gloss UNICOAT, thin the admixed paint to a Zahn #2 spray viscosity of 20 - 25 seconds depending on the spray application atomization technique (conventional, airless, air-assisted airless, or HVLP) and delivery system (siphon feed or pressurized feed)
- or
- to obtain non-VOC compliant high gloss UNICOAT, thin the admixed paint to a Zahn #2 spray viscosity of 25 - 30 seconds

Application

- apply two full cross-coats for flat UNICOAT and three full cross-coats for gloss UNICOAT to a dry film thickness of 2.0 - 3.0 mils
- check the viscosity of the feed material after 30 minutes and at 15 minute intervals thereafter for paint thickening
- if the Zahn#2 viscosity exceeds 60 seconds, purge the system and dispose of the material

NOTE: This draft dated _____, prepared by the Systems Engineering and Standardization Department, Naval Air Engineering Center, has not been approved and is subject to modification. DO NOT USE FOR PROCUREMENT PURPOSES. (Project No. 8010-038)

TT-C-2756
PROPOSED

PROPOSED FEDERAL SPECIFICATION

COATING: SELF-PRIMING TOPCOAT, LOW VOLATILE ORGANIC COMPOUND (VOC)

This Federal specification draft, dated _____ prepared by the Systems Engineering and Standardization Department, code 93, Naval Air Engineering Center, Lakehurst, NJ 08733-500 has not been approved for promulgation and is subject to modification.

DO NOT USE FOR PROCUREMENT PURPOSES

1. SCOPE

1.1 Scope. This specification covers the requirements for a self-priming topcoat which can be used in lieu of standard primer/topcoat systems for protection of metallic and polymeric substrates.

1.2 Colors. The coating shall be furnished in any color and gloss specified by the procuring activity. The part number designation is the FED-STD-595 color number. The following colors are required most frequently:

<u>Colors:</u>	<u>FED-STD-595 Color</u>	<u>Name</u>
Gloss colors:	11136	Red
	13538	Orange-yellow
	14187	Green
	15180	Blue
	16440	Light gray
	17038	Black
	17925	Untinted white
Semi-gloss colors:	25200	Blue
	26231	Gray
Camouflage (low gloss) colors:	34095	Field green
	34037	Green
	35237	Blue-gray
	36320	Dark gray
	36375	Medium gray
	36440	Light gray
	36495	Aircraft gray
	37038	Black

AMSC N/A FSC 8010
DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

1.3 Kit size. The coating covered by this specification shall be purchased by volume (as a kit if the coating is a two component material. If the coating is supplied as two components, the components shall be labeled as component A and component B, respectively, furnished in the volume mixing ratio required by the manufacturer. The coatings shall be supplied and identified as follows:

<u>Kit Size</u>	<u>Part Designation Number</u>
1 pint (0.47 L)	1
1 quart (0.94 L)	2
2 quart (1.89 L)	3
2 gallon (7.57 L)	4
10 gallon (37.85 L)	5

2. APPLICABLE DOCUMENTS

2.1 Government publications.

2.1.1 Specifications and standards. The issues of the following documents, in effect on the date of invitation for bids or solicitation for offers, form a part of this specification to the extent specified herein.

Federal Specifications:

QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet
PPP-P-1892	Paint: Varnish, Lacquer, and Related Materials, Packaging, Packing and Marking of

Federal Standards:

FED-STD-141	Paint, Varnish, Lacquer and Related Materials, Methods of Inspection, Sampling and Testing
FED-STD-313	Material Safety Data Sheets; Preparation and Submission of
FED-STD-595	Colors

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions, as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

(Single copies of this specification and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.)

(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Military Specifications:

MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-T-81772	Thinner, Aircraft Coating
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft

Military Standard:

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
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(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.1.2 Other Government documents and publications. The following other Government documents and publications, in effect on the date of invitation for bids or solicitation for offers, form a part of this specification to the extent specified herein.

Bureau of Medicine and Surgery:

BUMEDINST 6260.16A	Polyurethane Paints and Other Substances Containing Isocyanates; Measures of Control of Health Hazards Related to
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(Application for copies should be addressed to: Superintendent of Documents, Government Printing Office, Washington, DC 20402. Orders should cite the latest edition and supplements thereto.)

Code of Federal Regulations (CFR):

29 CFR 1910.1200	Material Safety Data Sheet; Preparation and Submission Of
49 CFR 171-178	Department of Transportation (DOT) Regulations for the Transportation of Explosives and Other Dangerous Articles by Land and Water

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bid or solicitation for offers shall apply.

American National Standards Institute (ANSI) Standard.

ANSI Z129.1 American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

American Society for Testing and Materials (ASTM) Standards:

ASTM D 185	Coarse Particles in Pigments, Pastes and Paints
ASTM D 523	Specular Gloss
ASTM D 1200	Viscosity of Paints, Varnishes and Lacquers by Ford Viscosity Cup
ASTM D 1210	Fineness of Dispersion of Pigment-Vehicle Systems
ASTM D 1364	Water in Volatile Solvents (Fischer Reagent Titration Method)
ASTM D 1640	Drying, Curing or Film Formation of Organic Coatings at Room Temperature
ASTM D 1737	Elongation of Attached Organic Coatings with Cylindrical Mandrel Appartus
ASTM D 2197	Adhesion of Organic Coatings
ASTM D 2244	Color Differences of Opaque Materials
ASTM D 2247	Coated Metal Specimens at 100% Relative Humidity
ASTM D 3335	Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3432	Free Toluene Diisocyanate in Urethane Prepolymers and Coating Solutions by Gas Chromatography
ASTM D 3960	Volatile Organic Content (VOC) of Paints and Related Coatings
ASTM G 26	Light-and-Water-Exposure Apparatus (Xenon-Arc Type) for Exposure of Nonmetallic Materials, Recommended Practice for Operating

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.)

3. REQUIREMENTS

3.1 Qualifications. The coatings furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.6). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Materials. The specified materials shall be of sufficient quality to produce coatings conforming to specification requirements.

3.3 Toxicity. The manufacturer shall certify that the materials shall have no adverse effect on the health of personnel when used for its intended purpose and under the precautions of 5.2.1 and BLUMEDINST 6260.16A. Material Safety Data Sheets shall be prepared and submitted in accordance with FED-STD-313 and shall meet the requirements of 29 CFR 1910.1200. When FED-STD-313 is a variance with the CFR, 29 CFR 1910.1200 shall take precedence, modify and supplement FED-STD-313. One copy shall accompany the samples being submitted to the qualifying activity for testing (see 4.3.2). Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency (see 4.1.1 and 6.3). The total free isocyanate in the admixed coating shall not exceed 1.0 percent by weight (see 4.6). The formulation of this coating shall preclude the use of lead (see 4.6) and chromium.

3.4 Composition. The composition of the coating shall be such that the final coating meets all of the requirements of this specification. The prepared coating (prior to thinning) shall consist of the minimum volume stipulated under the kit size. (See paragraph 1.3)

3.4.1 Binder. The polymeric binder of the coating shall be compatible with the other components within the coating (i.e. pigments, solvents, and additives). It shall be compatible with common metallic and polymeric substrates to which it may be applied (i.e. aluminum, steel, titanium, magnesium, epoxy) and form a coating which meets the requirements specified herein. If a multi-component coating is supplied, the material shall be supplied as a kit in the volumes specified (See 1.3). The manufacturer shall clearly specify the mixing instructions and mixing ratio to obtain the desired admixed material.

3.4.2 Pigments. The pigments shall have proven outdoor durability. Only lead and chromium free pigments shall be used (see 4.6).

3.4.3 Volatile content. The solvents used in manufacturing and thinning prior to application shall conform to the following requirements by volume when tested as specified in 4.6. The maximum volatile organic compounds (VOC) content shall be 420 grams per liter of paint. Solvents should be of the highest quality necessary for the coating to meet the requirements of this specification. The resistivity of the solvents shall be for electrostatic spray application.

3.4.4 Thinner. The coating (admixed material if a multi-component coating is supplied) shall be compatible with any thinner meeting MIL-T-81772, Type 1. The coating shall be formulated and supplied such that upon reducing with solvents to obtain proper application viscosity, the admixed coating does not exceed the maximum VOC content specified (see 3.4.3) in geographical locations where air pollution regulations exist. Halogenated solvents shall not be used in the formulation of this product.

3.5 Component properties.

3.5.1 Condition in container. Each component of the coating shall be capable of being easily mixed by hand with a paddle to a smooth, homogeneous, pourable condition, free from gelation when tested as specified in 4.6.1. The material shall be free from grit, seeds, lumps, abnormal thickening, or livering and shall not show excessive pigment floatation or settling which cannot be easily reincorporated to a smooth, homogeneous state. The container(s) shall not show evidence of excessive pressure or be deformed by gassing.

3.5.2 Storage stability. The previously unopened packaged product shall meet all the requirements specified herein for a period of one year when stored as in 4.6.2.

3.5.3 Accelerated stability. A full, unopened can, when exposed as specified in 4.6.3, shall not show excessive pressure buildup or distortion of the can. The material shall exhibit no trace of gelation or particulate matter, either suspended in solution or settled on the inner surface of the container.

3.6 Liquid properties.

3.6.1 Fineness of grind. The fineness of grind on the Hegman scale shall be a minimum of 7 for gloss colors and 5 for camouflage colors when tested 1 hour after mixing (see 4.6).

3.6.2 Coarse particles. Coarse retained on a No. 325 sieve shall be no more than 0.5 percent by weight of the application-ready material (see 4.6).

3.6.3 Odor. The odor of the coating, (before and after application) shall not be obnoxious. An air-dried film shall retain no residual odor 48 hours after application.

3.6.4 Viscosity. The viscosity of the admixed coating, after thinning to the maximum VOC content (420 grams per liter of paint), shall not exceed 45 seconds through a No. 4 Ford cup (see 4.6).

3.6.5 Pot life. The viscosity of the admixed and thinned coatings from 3.6.4 shall not exceed 70 seconds through a No. 4 Ford cup, after 1 hour in a closed container. The admixed coating shall not gel within 8 hours after mixing (see 4.6).

3.7 Film properties.

3.7.1 Drying time. The coating film, after spray application, shall be set-to-touch within 2 hours and dry-hard within 8 hours (see 4.6).

3.7.2 Surface appearance. The paint film shall dry to a uniform smooth surface free from runs, sags, bubbles, streaks, hazing, seeding, dusting, orange peel, floating, mottling, or other film defects.

3.7.3 Color. The color of the coating after drying 24 hours shall be a good visual match with the specified color chip in FED-STD-595 and the delta E between the coating and the chip shall be a maximum of 1.0 (see 4.6).

3.7.4 Gloss. The 60 specular gloss of the coating shall be as follows (see 4.6):

	<u>Minimum</u>	<u>Maximum</u>
Gloss colors	90	--
Semi-gloss (colors)	15	45
Camouflage (low gloss) colors	—	5

The 65 specular gloss of camouflage (low gloss) colors shall not exceed 9.

3.7.5 Hiding power. The contrast ratio of a 2.0 mil thick coating on a black and white chart shall be a minimum of 0.95 (see 4.6).

3.7.6 Adhesion and water resistance. After immersion in water at 150 F for 7 days, the coating shall show no signs of blistering, uplifting, softening, or other coating defects. In addition, the coating shall exhibit a 5A rating in the tape test and a minimum scrape adhesion on the substance of 5 kg when tested within 5 minutes after removed from water immersion (see 4.6).

3.7.7 Flexibility. Gloss coatings shall exhibit a minimum G.E. impact elongation of 40%; camouflage coatings shall exhibit a minimum impact elongation of 20% when tested at room temperature. At a temperature of -60 F, both gloss and camouflage coatings shall exhibit no cracking when bent, coated side out, over a 0.25 inch mandrel when tested as described in 4.6.6.

3.7.8 Fluid resistance. The coating shall withstand immersion for 24 hours in the following fluids and temperatures: MIL-L-23699 lubricating oil at $121 + 3$ C ($250 + 5$ F) and MIL-H-83282 hydraulic fluid $66 + 3$ C ($150 + 5$ F). Four hours after removal, the film shall not exhibit any blistering, softening, dark staining, or other film defects (see 4.6.7). Slight staining is acceptable.

3.7.9 Weather resistance. The coating shall be exposed separately for 500 hours in a 6000 watt Xenon-arc weatherometer and one year in Key West, Florida. After exposure, the specular gloss at 60 angle of incidence shall be a minimum of 80 for gloss colors, a minimum of 15 for semi-gloss colors, and a maximum of 5 for camouflage colors. The colors shall remain unchanged, with a Delta E value of 1.0 or less (see 4.6.8).

3.7.10 Humidity resistance. The coating shall be exposed for 30 days in a humidity cabinet at 100 percent relative humidity and 120 F as specified in 4.6. After removal, the coating shall exhibit no loss of adhesion, blistering, softening or other film defects.

3.7.11 Heat resistance. After 4 hours at 250 F, the color of the coating shall remain unchanged with a Delta E value of 1.0 or less (see 4.6.9).

3.7.12 Solvent resistance (cure). The coating shall withstand repeated rubbing by a cloth rag soaked in methyl ethyl ketone solvent (see 4.6.10).

3.7.13 Tape resistance. There shall be no evidence of permanent marring caused by masking tape applied to the coating after eight hours air-dry (see 4.6.11).

3.7.14 Strippability. At least 90 percent of the coating shall be stripped in 60 minutes with the use of MIL-R-91294, Type 1, Class 1 paint remover (see 4.6.12).

3.7.15 Corrosion resistance.

3.7.15.1 Salt spray test. When the coating film is tested as specified in 4.6.13.1, it shall exhibit no blistering or uplifting of the coating system, or pitting, extensive corrosion in the scribe, or corrosion extending from the scribe. A slight amount of general surface corrosion is permitted within the scribe.

3.7.15.2 Fillform test. The coating, when tested as in 4.6.13.2, shall exhibit no filliform corrosion extending more than 0.25 inch from the scribe lines. A majority of the filaments shall be less than 0.125 inch in length.

3.8 Working properties.

3.8.1 Mixing. All components of the coating shall mix readily with a hand-held paddle, to a homogeneous product.

3.8.2 Application. When the coating is mixed and ready for application, the material shall be homogeneous and, when spray applied, shall yield a smooth, uniform film. Caution must be taken when reducing the coating not to exceed the maximum VOC content specified where air pollution regulations exist.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet the requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material. The contractor shall furnish to the procuring activity the toxicological data and formulations required to evaluate the safety of the material for the proposed use through the submission of the Material Safety Data Sheet detailed in FED-STD-313.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall consist of all the tests specified in table I.

4.3.1 Qualification samples. The test samples shall consist of at least one quart of each component of the coating material in FED-STD-595 colors 17925 and 36375. The material shall be furnished in containers of the type to be used in filling contract orders. Samples shall be identified as follows and forwarded to the laboratory designated in the letter of authorization (see 6.6.)

TABLE I. QUALIFICATION INSPECTION

Requirement Inspection	Requirement Paragraph	Test Method Paragraph
Toxicity	3.3	4.6
Volatile content	3.4.3	4.6
Condition in container	3.5.1	4.6.1
Storage stability	3.5.2	4.6.2
Accelerated stability	3.5.3	4.6.3
Fineness of grind	3.6.1	4.6
Coarse particles	3.6.2	4.6
Odor	3.6.3	4.6.4
Viscosity	3.6.4	4.6
Pot life	3.6.5	4.6
Drying time	3.7.1	4.6
Surface appearance	3.7.2	4.6.5
Color	3.7.3	4.6.5
Gloss	3.7.4	4.6
Hiding power	3.7.5	4.6
Adhesion	3.7.6	4.6
Flexibility	3.7.7	4.6.6
Fluid resistance	3.7.8	4.6.7
Weather resistance	3.7.9	4.6.8
Humidity resistance	3.7.10	4.6
Heat resistance	3.7.11	4.6.9
Solvent resistance	3.7.12	4.6.10
Tape resistance	3.7.13	4.6.11
Stripability	3.7.14	4.6.12
Corrosion resistance	3.7.15	4.6.13

Qualification test samples.

Specification TT-C-2756; Color
 Coating, Self-Priming Topcoat, Low Volatile Organic Compounds (VOC)
 Manufacturer's name and product number.
 Submitted by (name and date) for qualification testing in accordance with
 authorization (reference authorizing letter).

4.3.2 Test report. In addition to the qualification test samples, the manufacturer shall furnish a test report showing that the material satisfactorily conforms to the requirements of this specification. Material Safety Data Sheets shall be prepared and submitted in accordance with FED-STD-313 and 29 CFR 1910.1200.

4.3.3 Retention of qualification. In order to retain qualification of products approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that his product(s) comply with the requirements of this specification. Unless otherwise specified by the qualifying activity, the time of periodic verification by certification shall be in two-year intervals from the date of original qualification and shall be initiated by the qualifying activity.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of all the tests specified in Table II.

TABLE II. QUALITY CONFORMANCE INSPECTION

Inspection	Retirement Paragraph	Test Method Paragraph
Condition in container	3.5.1	4.6.1
Accelerated stability	3.5.3	4.6.3
Fineness of grind	3.6.1	4.6
Coarse particles	3.6.2	4.6
Odor	3.6.3	4.6.4
Viscosity	3.6.4	4.6
Pot life	3.6.5	4.6
Drying time	3.7.1	4.6
Surface appearance	3.7.2	4.6.5
Color	3.7.3	4.6.5
Gloss	3.7.4	4.6
Hiding power	3.7.5	4.6
Adhesion	3.7.6	4.6
Flexibility	3.7.7	4.6.6
Fluid resistance	3.7.8	4.6.7
Heat resistance	3.7.11	4.6.9
Solvent resistance	3.7.12	4.6.10
Tape resistance	3.7.13	4.6.11

4.4.1 Lot formation. A lot shall consist of all polyurethane coating of the same type and color, manufactured at one time from one batch, forming part of one contract, and submitted for acceptance. A batch shall consist of all coating material manufactured during one continuous operation and forming part of one contract or order for delivery.

4.4.2 Retention sample. At least one quart of each component of the coating material shall be selected at random from each batch by an authorized government representative and forwarded to the laboratory designated by the procuring activity.

4.4.2.1 Batch data. With each sample, the manufacturer shall furnish a certified test report showing that the material satisfactorily meets the quality conformance requirements (4.4). In addition, the manufacturers shall certify that there has been no formulation or process change from that which resulted in the production of the qualification inspection sample.

4.4.3 Inspections.

4.4.3.1 Tests. The inspections shall consist of all the tests specified in Table II. There shall be no failures. Samples for tests shall consist of one complete unopened kit selected at random from each batch. Containers shall only be opened when being tested.

4.4.3.2 Visual examination of filled containers. Samples selected at random for examination in accordance with 4.4.3.3 shall be examined for proper filling and weight.

4.4.3.3 Examination of packaging and marking. An examination shall be made to determine that packaging, packing and marking comply with the requirements of Section 5 of this specification. Defects shall be scored in accordance with the list below. The sample unit for this examination shall be one shipping container fully prepared for delivery except that it shall not be palletized and need not be sealed. Shipping containers fully prepared for delivery that have not been palletized shall be examined for defects of closure. The lot size shall be the number of shipping containers in the end item inspection lot. The samples for this examination shall be selected at random in accordance with MIL-STD-105, inspection level S-2, and acceptable quality level (AQL) 4.0 defects per hundred units.

<u>Examination of:</u>	<u>Defect</u>
Packaging	Container not as specified, closures not accomplished by specified or required methods or materials. Leakage or seepage of contents. Non-conforming component, component missing, damaged or otherwise defective. Bulged or distorted container.
Markings	Data, including directions for use, omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements.

4.4.3.4 Examination for palletization. An examination shall be made to determine that palletization complies with the requirements of Section 5 of this specification. Defects shall be scored in accordance with the list below. The sample unit shall be one palletized unit load fully prepared for delivery. The lot size shall be the number of palletized unit loads in the end item inspection lot. The samples for this examination shall be selected at random in accordance with MIL-STD-105, inspection level S-1 and acceptable quality level (AQL) 6.5 defects per hundred units.

<u>Examination of:</u>	<u>Defect</u>
Finished dimension	Length, width, or height exceeds specified maximum requirements.
Palletization	Not as specified. Pallet pattern not as specified. Interlocking of loads not as specified. Load not bonded with required straps as specified.
Weight	Exceeds maximum load limits.
Marking	Omitted, incorrect, illegible, of improper size, location, sequence or method of application.

4.4.4 Rejection and retest. Failure in any quality conformance test shall result in rejection of that batch and shall constitute sufficient justification for removal from the qualified products list. Rejected material shall not be resubmitted for acceptance without written approval from the Naval Air Development Center, Code 6062, Warminster, PA 18974. The application for resubmission shall contain full particulars concerning previous rejections and measures taken to correct these deficiencies. Samples for retest shall be randomly selected as in 4.4.2 and forwarded to the testing activity.

4.5 Test panels. Panels shall be prepared under laboratory testing conditions. Panels used for test purposes other than flexibility shall be aluminum alloy conforming to QQ-A-250/4 (T3 temper) and shall be 0.020 by 3 by 6 inches in size. Test panels for flexibility (paragraph 4.6.6) shall conform to QQ-A-250/4 (O temper) and anodized in accordance with MIL-A-8625, Type I.

4.5.1 Panel preparation. With the exception of the flexibility (4.6.7) weather resistance (4.6.8) and filliform corrosion (4.6.13.2) tests, the panels shall be treated with materials conforming to Form I, Method C (Immersion), Class 1A of MIL-C-81706 to produce coatings conforming to MIL-C-5541.

4.5.2 Application of coating for testing of film properties. The coating shall be spray applied to a dry-film thickness of 1.7 to 2.3 mils. This shall be accomplished by mixing the material according to the manufacturers instructions. Caution shall be taken not to exceed the maximum VOC content. The coating shall be applied by spraying a mist coat of the paint and allowing 15 minutes for drying at ambient conditions. A second coat shall be applied to obtain a final dry-film thickness of 1.7 to 2.3 mils. The applied coating shall be allowed at least seven days at ambient laboratory conditions before testing.

4.6 Test methods. The tests of this specification shall be conducted in accordance with Table III and the subparagraph of 4.6, and the panels used prepared as specified in 4.5 and subparagraphs of 4.6 as specified. The laboratory testing conditions shall be in accordance with the applicable test method described herein.

4.6.1 Condition in container. Allow each component to stand without agitation for at least 14 days in a closed container. Mix by hand with a paddle and examine the condition.

4.6.2 Storage stability. The daily temperature of the ambient air at the storage locations shall fall within the range of 1.7 -46 C (35 - 115 F).

4.6.3 Accelerated stability. A full unopened can of each Component shall be stored in an oven at 57 ± 3 C (135 ± 5 F) for 24 hours and cooled to room temperature before being examined. The unopened can should be placed in a larger vented container in the oven to confine any splash that may occur, in the event the lid of the unopened can is blown off by gassing.

NOTE: Open cans cautiously, as they may be under pressure. Do not open deformed cans.

4.6.4 Odor. Test the admixed coating and an air-dried film for odor.

TABLE III. TEST METHODS

Requirements Paragraph	Test	FED-STD-141 Test Method No.	ASTM Method No.
3.3	Free isocyanate content		D 3432
3.3, 3.4.2	Lead content		D 3335
3.3, 3.4.2	Chromium Content		D 3718
3.4	Volatile organic compounds (VOC) content		D 3960
3.6.1	Fineness of grind		D 1210
3.6.2	Coarse particles		D 185
3.6.4, 3.6.5	Viscosity, Pot life		D 1200
3.7.1	Drying time		D 1640
3.7.3	Color		D 2244
3.7.4	Gloss		D 523
3.7.5	Hiding power		D 2805
3.7.6	Adhesion, Tape test		D 3359 <u>1/</u>
3.7.6	Adhesion, Scrape test		D 2197 <u>1/</u>
3.7.10	Humidity resistance		D 2247
3.7.11	Heat resistance	6051	
	<u>1/</u> Method A		

4.6.5 Examination of the paint film. Examine the surface for the defects listed in 3.7.2. The color shall match the specified color chip in FED-STD-595. The DELTA E of the coating color compared to the FED-STD-595 color chip shall be a maximum of 1.0 when tested according to ASTM D 2244.

A.6.6 Flexibility. Test panels shall be aluminum alloy conforming to QQ-A-250/4 (0 temper) and anodized in accordance with MIL-A-8625, Type I. Panels shall be 0.020 by 3 by 6 inches in size and prepared as specified in 4.5 without a primer. The panels shall be allowed at least seven days air-dry before testing (see 3.7.8).

4.6.6.1 Ambient flexibility. Two coated panels, prepared as in 4.6.6 shall be tested with a GE Impact-Flexibility Tester at room temperature. Place the coated panel, film downward, on the rubber pad at the bottom of the impactor guide. Drop the impactor on the panel, so that the impression of the entire rim of the impactor is made in the panel. Reverse the impactor ends; and drop it on the panel adjacent to the first area of impact. Use ten power magnification to detect fine surface cracking. Report the percent elongation corresponding to the largest spherical impression at which no cracking occurs.

4.6.6.2 Low temperature flexibility. Two coated panels, prepared as in 4.6.7, shall be tested in accordance with ASTM D 1737 at a temperature of -51 ± 3 C (-60 ± 5 F) using a 1/4" mandrel for gloss and semi-gloss colors and a two-inch mandrel for camouflage colors.

4.6.7 Fluid resistance. Test panels, prepared as directed in 4.5, shall be separately immersed for 24 hours in MIL-L-23699 lubricating oil at a temperature of 121 ± 3 C (250 ± 5 F) and MIL-H-83282 hydraulic fluid at a temperature of 66 ± 3 C (150 ± 5 F). Four hours after removal, the various films shall be examined for conformity to the requirements of 3.8.1.

4.6.8 Weather resistance. Test panels, prepared as directed in 4.5, shall be exposed for 500 hours in a 6000 watt Xenon-arc weatherometer (Atlas Electric Devices Company or equivalent) that is cycling between 102 minutes of light only and 18 minutes of light and waterspray. The following conditions shall apply when tested according to ASTM G 26, Type BH.

Black body temperature in cabinet:	60 ± 3 C (140 ± 5 F)
Relative humidity in cabinet:	$50 \pm 5\%$
Intensity of xenon-arc:	0.3 to 0.4 watts/square meter at 340 nm wavelength

In addition, a separate set of test panels shall be exposed outdoors facing south at a 45 angle (upward) for one year in Key West, FL. After exposure, the specular gloss of the specimens shall be determined in accordance with ASTM D 523. The color difference shall be measured using the Delta E value in accordance with ASTM D 2244.

4.6.9 Heat resistance. After exposure in a 250 F oven for four hours, the color difference shall be measured using the Delta E value in accordance with ASTM D 2244.

4.6.10 Solvent resistance (cure). Test panels shall prepared as directed in 4.5. A cotton, terrycloth rag shall be soaked in methyl ethyl ketone solvent and rubbed back and forth 25 times (50 passes) over the coating with firm finger pressure. Rubbing through to bare metal indicated failure due to improper cure.

4.6.11 Tape resistance. Test panels, prepared as specified in 4.5, shall be air-dried for eight hours. A one-inch wide strip of masking tape (3M Company #250 or equivalent) shall be applied to each panel, adhesive side down, and pressed down with one pass of a 4 1/2 pound (2.04 kilogram) roller to adhere the tape to the panel. The tape shall remain in contact with the panel for one hour. Then remove the tape carefully and examine the test film for conformance with 3.7.13.

4.6.12 Strippability. Test panels, prepared as directed in 4.5 and weathered for 500 hours as directed in 4.6.8, shall be placed on a rack at a 60 angle with the horizontal. Enough MIL-R-81294, Type I, Class I paint remover shall be poured along the upper edge of each panel to completely cover the coating surface. After 60 minutes exposure time, the loosened film shall be brushed off and the panels shall be rinsed while brushing under a stream of cool water. The amount of coating stripped in this manner is determined by the percentage of substrate surface area exposed.

4.6.13 Corrosion resistance.

4.6.13.1 Salt spray. Four coated panels shall be prepared as in 4.5. Two intersecting lines shall be scribed diagonally across the surface of each panel, so that the bare substrate is exposed. Two panels shall then be placed in a 5% salt spray cabinet as described in ASTM B 117 for 2000 hours and two panels shall be placed in a sulfur dioxide - salt spray cabinet as described in ASTM G 85 for 500 hours. The specimens shall be examined for conformance to 3.7.15.1.

4.6.13.2 Filiform. Two aluminum test panels (3 by 6 by 0.02 inches) meeting QQ-A-250/5 (T3 temper) with a pretreatment meeting MIL-C-5541, Class 1A conversion coating, shall be prepared. After allowing the coating to cure for 7 days at ambient conditions, two intersecting lines shall be scribed diagonally across the surface of each panel so that the bare substrate is exposed. The panels shall then be placed vertically in a desiccator containing 12 N hydrochloric acid for one hour. This is equivalent to concentrated hydrochloric acid (A.C.S. reagent grade). The panels shall be placed within 5 minutes in a humidity cabinet maintained at 40 ± 1.7 C (104 ± 3 F) and 80 ± 5 percent relative humidity for 1000 hours. The panels shall then be examined for filiform corrosion as described in ASTM 2803 and 3.7.15.2.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging and packing. For direct purchases by or direct shipments to the Government, the preservation, packaging, packing, and marking for shipment shall be in accordance with PPP-P-1892 and as specified in 5.2. Multi-frictional sealed cans shall be used. The level of preservation and packaging shall be as specified (see 6.2). When specified, palletization is required for handling by mechanical equipment (see 6.2h). The coating shall be supplied in a kit. For multicomponent coatings, each component shall be packaged separately and marked as specified in 5.2. The containers shall be thoroughly dry and filled in a dry atmosphere.

5.2 Marking and labeling. In addition to the marking specified in PPP-P-1892, individual cans and containers shall bear printed labels showing the following nomenclature and information as applicable:

Component Identification (for Multi-Component Coatings)
Specification TT-C-2756
Color (name and number)
Manufacturer's name and product number
Date of manufacture by month and year
Batch number
VOC content in grams/liter

Maximum solvent addition allowed (without exceeding the VOC limit)
Net contents
Mixing Instructions for Application

All unit and intermediate packs of toxic and hazardous chemicals and materials shall also be labeled in accordance with the applicable laws, statutes, regulations or ordinances, including Federal, state and municipal requirements. In addition, unit and intermediate containers, including unit containers that serve as shipping containers such as pails and drums, shall be marked with the applicable precautionary information detailed in American National Standard ANSI Z129.1.

5.2.1 Precautionary markings.

5.2.1.1 Container. In addition to labeling as specified in the Department of Transportation Regulations 49CFR 171-178, the following labeling shall appear on each component container in every kit and on each exterior shipping container:

CAUTION

THIS COATING MATERIAL IS TOXIC AND FLAMMABLE AND SHALL NOT BE USED IN CONFINED AREAS WHERE THERE ARE OPEN FLAMES, ARCING EQUIPMENT, HOT SURFACES, OR WHERE SMOKING IS PERMITTED.

USE ONLY WITH ADEQUATE VENTILATION.

AVOID BREATHING OF VAPOR

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER. FOR EYES, GET MEDICAL ATTENTION.

Precautions: (To be included on a sheet with each kit).

1. The surface to be coated shall be absolutely clean (free of contamination).
2. All spray equipment shall be adequately grounded. Clean equipment thoroughly after each use with methyl ethyl ketone or MIL-T-81772, Type I thinner.
3. Open component B carefully. Do not open bulged container. Discard the component if can is bulged or material is not clear.
4. Mix only the number of kits that can be used within four hours. Use only the specified thinner. Keep containers closed when not in use.
5. Coating from one vendor shall never be mixed with that of another, even if the color is the same. In addition, components from different kits are not inter-changeable.

6. Production type operations shall be performed only in specifically designated areas with local exhaust ventilation and such other environmental control measures as may be recommended on the basis of an on-site industrial hygiene survey.
7. Touch-up type operations shall be performed only in areas with good general ventilation, such as the hanger deck of a carrier or in a hanger ashore with the doors open. Unprotected personnel in adjacent areas shall not be exposed to mist, spray, or vapor. Application shall be restricted to brush, roller coat, or self-pressurized aerosol spray kit. No individual shall apply more than one quart of polyurethane paint by self-pressurized spray in any 24-hour period.

6. NOTES

6.1 Intended use. This low VOC, self-priming topcoat is intended for exterior use on aircraft, weapon systems and other applications. No additives other than the appropriate thinner to obtain the proper spray viscosity shall be added. The coating has been formulated to meet air pollution regulations requiring a maximum volatile organic compounds (VOC) content.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Type desired.
- c. Kit desired, including the quantity and size of containers (see 1.3).
- d. Color number and name (see 1.2).
- e. Level of packaging and packing (see Section 5).
- f. Special marking (see 5.2).
- g. Toxicological data requirements (see 3.3 and 4.3.2).
- h. FAR clauses 23.303 and 52.223-3.
- i. Specify if palletization is required.

6.3 Toxicity. Some free isocyanate is released during mixing and application of 2 component polyurethanes. The free isocyanates released can produce a significant irritation of the skin, eyes and respiratory tract. They may also produce an allergic sensitization of personnel exposed, particularly if there is an inhalation of vapor and mist produced during spray application. Once sensitized, further exposure cannot be tolerated, hence the restriction on issue and use of this material. Additional information pertaining to protective equipment and other necessary precautions can be obtained from BUMEDINST 6260.16A.

6.4 Moisture. Polyurethane components should be kept dry. The presence of moisture degrades the quality of the coating. Packaging of the materials should be done in a dry atmosphere. Solvents and resins should be examined for evidence of contamination before they are incorporated, even though they are of "urethane grade." Urethane grade solvents or thinners may become contaminated with water in tank cars or storage tanks. The purchase of urethane grade solvents or thinners is no guarantee that excessive moisture is not present. It is therefore recommended that all users check for moisture contamination. The following suggested method may be used to determine the presence of water: Add one drop of aluminum secondary butoxide to 100 ml of the solvent in a stoppered flask and shake. An appreciable amount of turbidity indicates the presence of water.

6.5 Composition of Isocyanate Components. It is suggested that no methyl ethyl ketone be used in the Isocyanate Component, as it may degrade the isocyanate portion of the resin.

6.6 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List, whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Development Center, Attn: Code 6062, Warminster, PA 18974; and information pertaining to qualification of products may be obtained from that activity. In the event that the coating furnished under contract fails to perform satisfactorily, approval of such a product will be subject to immediate withdrawal from the Qualified Products List.

6.7 Subject term (key word) listing.

Aliphatic polyurethane
 Coating
 Exterior use
 Flammable
 Hazardous material
 High-solids
 Isocyanate
 Material Safety Data Sheets
 Qualification
 Qualified Products List (QPL)
 Toxic
 VOC compliant

6.8 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313 is at variance with the CFR, 29 CFR 1910.1200 shall take precedence, modify and supplement FED-STD-313. The pertinent government mailing addresses for submission of data are listed in Appendix B of FED-STD-313.

6.9 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

B 1 5 7

TT-C-2756

CIVIL COORD. AGENCY

Preparing Activity

NAVY-AS

Project 8010-0381

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F-14 FIELD EVALUATION

PCV MSG B TIME RADAY ROUTINE
 26606 2013 254/86
 0011012013014015016017018010210310410421043104410921704182183184101121
 ACTION: _____
 INFO: _____ X _____

RTTUZYUW RUEOFSAS116 2541937-UUUU--RUEOFSA.
 ZNR UUUUU

R 111937Z SEP 86 ZYB
 FM NAVAIRDEVCEM WARMINSTER PA
 TO COMNAVAIRLANT NORFOLK VA
 INFO NAVAIREWORKFAC NORFOLK VA
 BT

UNCLAS//MID360//
 SUBJ: FIELD TEST OF EXPERIMENTAL COATINGS
 A NIRTASK R6154200

1. IAW REF A, WE HAVE DEVELOPED TWO CORROSION PREVENTIVE COATINGS FOR NAVY AIRCRAFT. ONE IS A FLEXIBLE PRIMER INTENDED TO MINIMIZE CRACKING OF THE AIRCRAFT PAINT SYSTEM AND THUS REDUCE POTENTIAL CORROSION PROBLEMS AND REQUIRED MAINTENANCE. THE IMPORTANCE OF THIS MATERIAL IS THAT IT WILL PROVIDE AN ALTERNATIVE SOURCE FOR A FLEXIBLE PRIMER. THIS PRIMER IS APPLIED IN THE SAME MANNER AS MIL-P-23377D EPOXY PRIMER.
 2. THE SECOND DEVELOPED COATING IS A CORROSION PREVENTIVE TOPCOAT WHICH IS APPLIED DIRECTLY TO THE SUBSTRATE. IT IS A ONE-COAT, COATING SYSTEM WHICH DOES NOT REQUIRE THE USE OF A PRIMER. IT WILL PROTECT AGAINST CORROSION WHILE PROVIDING THE DESIRED CAMOUFLAGE COLOR. THIS COATING WAS DEVELOPED TO REDUCE PAINT APPLICATION TIME BY 50 PERCENT AND AIRCRAFT WEIGHT BY APPROXIMATELY 50 POUNDS.
 3. WE ASK THAT TWO F-14 AIRCRAFT BEING REWORKED AT NAVAIREWORKFAC NORFOLK BE PROVIDED TO APPLY AND FIELD TEST THESE TWO MATERIALS. NO SPECIAL HANDLING, APPLICATION, OR TOUCH-UP PROCEDURES ARE REQUIRED FOR THESE COATINGS. FOR FURTHER INFORMATION, CONTACT CHARLES R. WEGEDUS AT AUTOVON 441-1452.
 BT
 05116

	<input type="checkbox"/> Action	<input type="checkbox"/> Req	<input type="checkbox"/> Info
401			AC01A
402			AC03
403			DF
404			
405			MF
406			
407			PF

NNNN

12 SEP 1986

RCV MSG 0 TIME RADAY ROUTINE

27336 2239 258/86

0011012013014015016017018010210310410421043104410921704182183184101121

ACTION: INFO:

RTTUZYUW RUCOSGGB448 2582236-UUUU--RUEOFSA.

ZNR UUUUU

@ 121656Z SEP 86

FM COMNAVAIRLANT NORFOLK VA

TO RUEOFSA/NAVAIRDEVCCEN WARMINSTER PA

RUEBRDZ/NAVAVHLOGCEN PATUXENT RIVER MD

INFO RUCOSAA/NAVAIREWORKFAC NORFOLK VA

BT

UNCLAS //N10360//

SUBJ: FIELD TEST OF EXPERIMENTAL COATINGS

1. NAVAIRDEVCCEN WARMINSTER PA 111937Z SEP 86 PASEP

1. NAVAIRDEVCCEN: CONCUR IN SUBJ EVALUATION, COMNAVAIRLANT WILL ASSIGN AIRCRAFT WHEN REQUIRED.

2. NAVAVHLOGCEN: REQ TAKE REF A FORAC

3. COMNAVAIRLANT POC G. T. BRADNE, AV 564-7340.

BT

88448

<input checked="" type="checkbox"/>	Action	<input type="checkbox"/>	Log	<input checked="" type="checkbox"/>	Info
01					001A
02					0008
03					00
04					00
05					00
06					00
07					00
08					00
09					00
10					00

NNNN

16 SEP 86

PROTECTIVE COATINGS TEAM

TRIP REPORT

22 FEB 1988

From 16-18 Feb 1988, Don Hirst and Charles Hegedus visited NADEP Norfolk to supervise and observe the painting of an F-14 with the Self-Priming Topcoat developed at NADC. NADEP personnel were instructed to prepare this aircraft in the same manner as if it were to receive the standard epoxy primer/polyurethane topcoat system. The aircraft was closely examined upon arrival at the cleaning shop. The exterior surface had been entirely stripped of the previous paint system. While in the cleaning shop, the aircraft was examined for corrosion by shop personnel, and any corrosion areas were blasted or sanded. The aircraft was then cleaned with a standard aircraft cleaner to obtain a water break-free surface. A chemical conversion coating was applied and rinsed to obtain the desired pretreatment. At this point, the aircraft surface was re-examined and found to be in excellent condition. It would appear that all F-14s processed through the NADEP are in this condition as we did not interfere with the process at all. This was determined to be important because the self-priming topcoat was designed to be applied without any special treatment to the surface. At this time, the aircraft was delivered to the paint shop.

Once in the paint shop, parts of the aircraft were masked for application of spray sealant, MIL-S-8802, as is common practice on the F-14. The engine nacelles and the underside of the aircraft were wiped with a solution called TEC 901 which was developed at NADEP Norfolk as a final cleaning wipe prior to coating application. Normally, F-14s processed at Norfolk are spray sealed (5-7 mils) on their horizontal stabilizers and engine nacelle because of the severe vibrations experienced by these components. It was felt that this would also be applicable for the self-priming topcoat. Previous evaluations at NADC confirmed that adhesion of the self-priming topcoat to sealant was good.

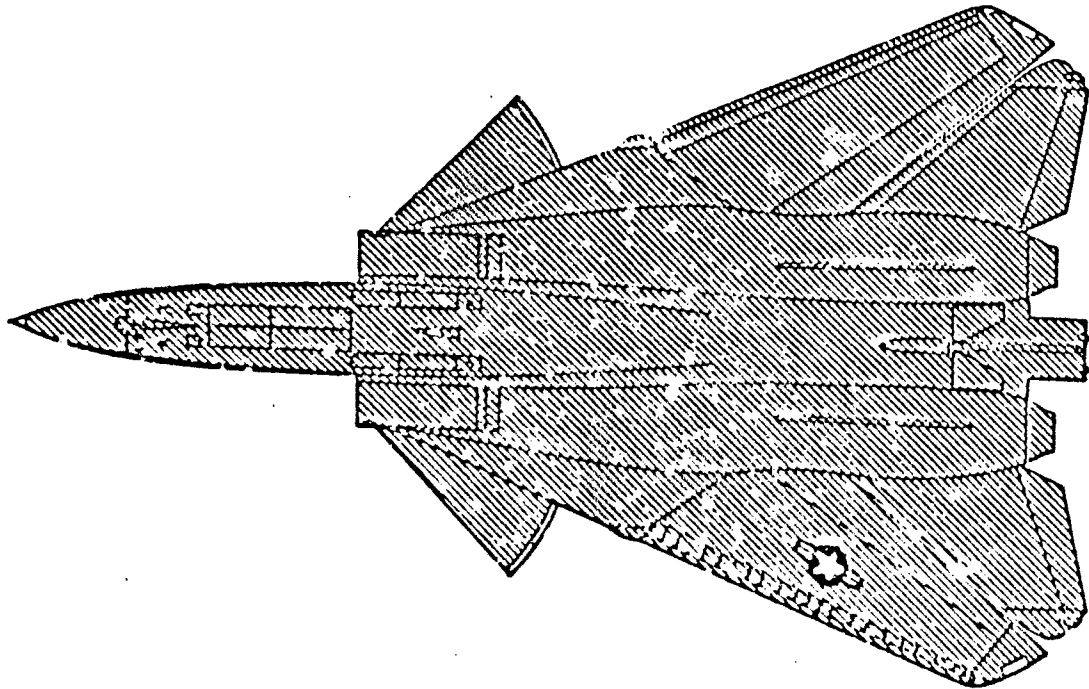
Approximately 1.5 hours after the spray sealant was applied to the aircraft, nine gallons of the 36375 color self-priming topcoat were mixed by NADEP personnel. This is the normal amount of polyurethane topcoat prepared for the F-14. See the attached schematic of the multi-theater camouflage scheme for the F-14. This volume was made by mixing six gallons of part A, 1.5 gallons of part B, and approximately 1.5 gallons of standard polyurethane paint thinner, MIL-T-81772. The Zahn 2 viscosity was 18 seconds which is normal for a polyurethane topcoat. Four painters began to spray the 36375 material. Of the four, one painter claimed to have problems, stating the material was too thin and was running on the surface. Although the surface was examined and no sags were found on her area, she was instructed to apply a mist coat and then reapply a full wet coat to obtain the desired 1.8-2.2 mil thickness. It was later revealed that this painter was fairly new to the paint shop and was far less experienced. Nonetheless, it was determined that thinning the self-priming topcoat to 19-21 seconds through a Zahn 2 cup would provide a better consistency for this coating and make it easier to apply. This poses no problem for the paint shop personnel.

The next color to be applied to the aircraft was 36320. Six gallons of this material were mixed to a viscosity of 20 seconds. This batch of paint was applied by two other experienced painters. Upon completion, they claimed to appreciate the ease of application and the covering power (opacity) of the coating. The last color to be applied was 35237. Six gallons of this material were also mixed. The two experienced painters also applied this batch and had favorable comments. The entire painting process took three hours from the time the first batch of self-priming topcoat was mixed. The only concern during that time was the short pot life of the coating, approximately two hours. This was known beforehand since this batch of paint had slightly too much catalyst. Future batches will be modified to obtain a six hour pot life. Upon drying, the coating appeared to cover well, have good hiding power (opacity) and exhibit suitable color and gloss properties. The paint shop supervisor stated that he liked the coating and felt that it would definitely save manpower and time in the paint processing of aircraft.

We were informed that the aircraft would be moved to South Mat at Norfolk which is where flight testing is performed before the aircraft is delivered to a squadron. In order for NADC and NADEP personnel to track the aircraft, the BUNOS. No. was recorded: 160901. The enclosed evaluation sheet and cover letter were devised to accompany the aircraft as it is deployed, allowing for continuous evaluation of the coating. We plan to track the aircraft closely through AIRLANT and to travel and evaluate the aircraft after six to nine months when it is available.

CR Heydus

MIL-STD-2161(AS)






-  35237
-  36320
-  36375

FIGURE E-7. F-14 TACTICAL PAINT SCHEME PATTERN

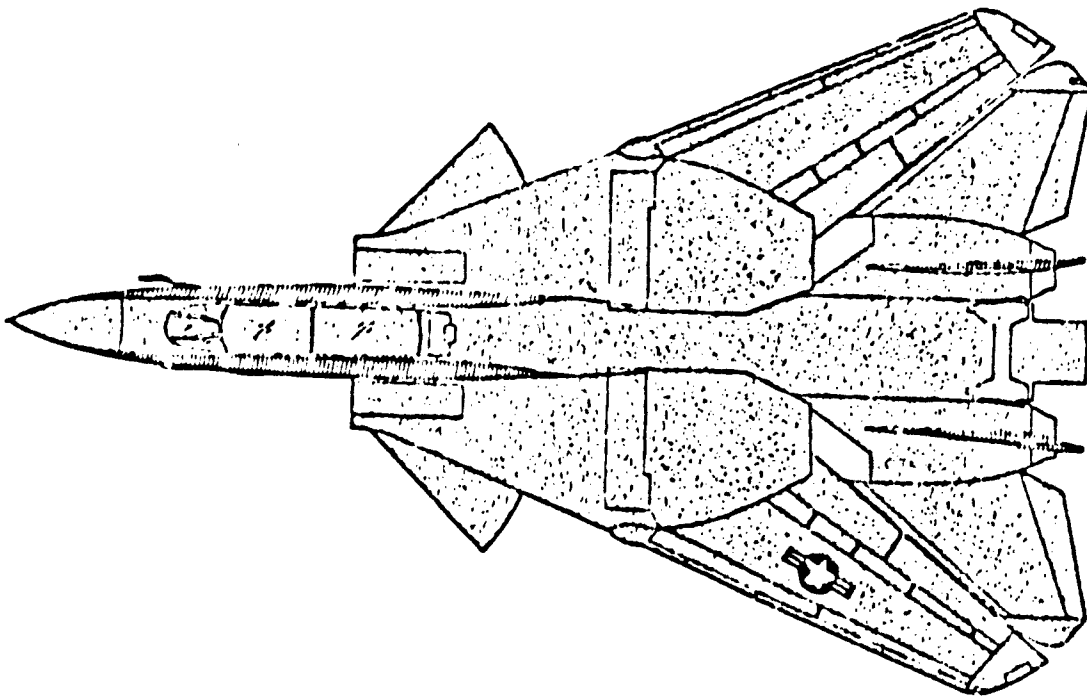
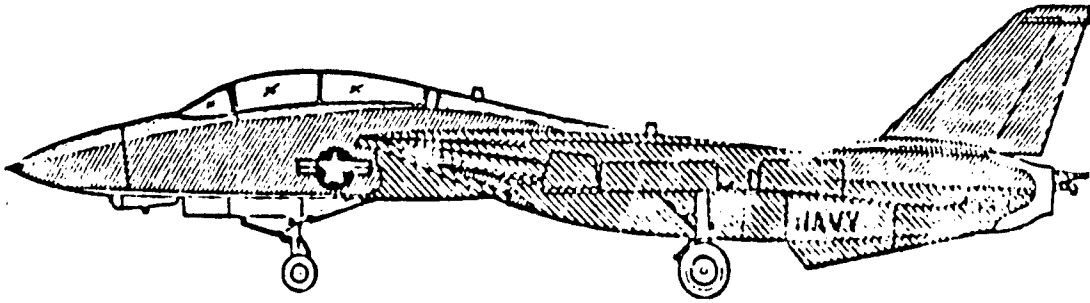


FIGURE E-7. F-14 TACTICAL PAINT SCHEME PATTERN (CONTD)

Log Book Entry

F-14 Bureau *

Seq.

Production Planning and Control Department Release *

The NAVAIRDEVCON Warminster Pa. and the NAVAVNDEPOT Norfolk, Materials Engineering Laboratory is evaluating a new self-priming topcoat for aircraft application as an alternative to Mil-P-23377D and Mil-C-83286 currently used on the F-14. The material is especially formulated and provides the same protection as the presently used system while being a one coat rather than a two coat system thus reducing one of the two coat systems being sprayed on the aircraft. This new system is compatible with existing paint systems currently used in the field. Touch-up as per NAVAIR 01-1A-509 using Mil-P-23377D and Mil-C-83286 material.

Attached are report form for evaluating performance on the subject aircraft. Please submit reports to NAVAIRDEVCON Warminster Pa. and copy to NAVAVNDEPOT Norfolk. (Code 36300) at three month intervals.

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian _____ Aircraft EUN _____ Date _____

Acft Flt Hrs: _____

Type Service () Ship Based () Shore Based ()

General Appearance Satisfactory Unsatisfactory
() ()

If Unsatisfactory, Why?

Area on Aircraft needing repair:

Type of repair required (Light, Touch-up, Corrosion removal, etc)

Ease of Repair: Satisfactory Unsatisfactory
() ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat:
Satisfactory Unsatisfactory
() ()

If Unsatisfactory, Why?

Overall Effectiveness: Excellent Good
() ()
Fair Poor
() ()

Additional Comments:

Prepared by: _____

Send to:

NAVAIRDEVGEN
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-88
Norfolk, VA 23511

NAVAL AIR DEVELOPMENT CENTER
AIR VEHICLE AND CREW SYSTEMS TECHNOLOGY DEPARTMENT
WARMINSTER, PA 18974-5000

1 Nov 1988

TRIP REPORT

TO: U.S.S. JOHN F. KENNEDY, MEDITERANEAN SEA

DATES: 29-30 OCT 1988

PURPOSE: EVALUATION OF NADC SELF-PRIMING TOPCOAT ON F-14

REPORT BY: Charles Hegedus, Naval Air Development Center, Code 6062

BACKGROUND

On 17 Feb 1988, an F-14 (Bu. No. 160901) was painted at NADEP Norfolk with the NADC Self-Priming Topcoat (SPTC). This single coating was developed to replace the standard two coat system (epoxy primer and polyurethane topcoat) used on Navy aircraft. Reference (1) discusses the development of this coating and reference (2) is a report on the application of the coating to the F-14. The advantages of this material are:

1. Reduced application time and aircraft processing time
2. Reduced manpower required for application
3. Reduced material costs
4. Reduced volatile organic content (VOC) emissions to the environment
5. Elimination of chromates (carcenogens) from the paint system

The conclusions of reference (2) were that the coating application process went well and the coating system looked good while eliminating the application of a primer coat. NADEP Norfolk paint shop, quality control, and materials engineering personnel were impressed with the application performance of the coating.

The aircraft location and performance of the coating system has been closely monitored in order to rigorously evaluate the performance of the Self-Priming Topcoat. Both NADEP and squadron personnel have stated that this coating seems to be performing well and is more cleanable than the standard camouflage topcoat. In June 1988, C. Hegedus and D. Hirst of NADC visited NAS Oceana (VF-32) to inspect the aircraft prior to deployment on the U.S.S. John F. Kennedy. Although it had been painted for only 4 months, we felt that consistent tracking of this aircraft, the first painted with the Self-Priming Topcoat, was essential to evaluate and understand its performance. At that time the coating system appeared in very good condition and comments from squadron maintenance personnel were favorable. In early August 1988, the F-14 was deployed on the aircraft carrier for a cruise to the Mediteranian Sea.

COATING EVALUATION

On 29 Oct 1988, Dave Jamieson (NAVAIRSYSCOM, AIR 4112E), Mel Rose (NAS Oceana, NASUE Det.) and Charles Hegedus (NAVAIRDEVGEN, Code 6062) inspected the Self-Priming Topcoat on the F-14 (160901) on board the U.S.S. John F.

Kennedy. In general the coating system looked very good. Of special interest was performance in areas around fasteners, on titanium and on the horizontal stabilizer. The stabilizer had been spray sealed prior to painting. There was little, if any, cracking of the paint system around fasteners. This is a common failure location for paints on aircraft due to the stresses and fatigue which occur due to the gap between the fastener head and the skin of the aircraft. The coating was intact on titanium components and the coating adhesion appeared good. Adhesion to titanium is often a problem, especially under wet or high humidity conditions. The coating was also adhering well to the horizontal stabilizers and the engine nacelles which had been spray sealed prior to application of the Self-Priming Topcoat. On the underbelly of the F-14, which is constantly wet with hydraulic fluid, the coating was intact and there were no signs of peeling, blistering, or any coating defects. The turtle back area was also in good condition. However, on the upper side of the aircraft, the coating had blotches of a rust color stain. The blotches appeared to be similar to water stains, 0.25 to 0.5 inches in diameter and distributed over the entire upper surfaces. Squadron personnel stated that this stain had occurred overnight and they were not sure how it had happened or what the stain was. It appears as if something was accidentally sprayed over the aircraft and, upon drying, caused the stain. It is certain this is not related to the coating and a sample of the stain was taken for analysis at NADC. Finally, one area which is subject to peeling and is a common location for paint failure is the external skin just above the main landing gear and the SPTC was intact with no signs of any defects. Only one area, approximately 2 square inches under the port wing, was observed where paint had peeled, revealing bare metal. This is considered minor and is common on nearly all aircraft.

Squadron maintenance chiefs stated that they were very happy with the performance of the paint system. They compared it to another aircraft (Bu. No. 159603) in VF-32 which had been painted at NADEP Norfolk with the standard system just prior to the Self-Priming Topcoat F-14. They stated that in overall performance, appearance, and corrosion protection, the Self-Priming Topcoat performed as good or better than the standard system. One warrant officer claimed that the SPTC was more cleanable than the standard system. Another chief stated that when the aircraft was delivered from NADEP, there were some small, minor areas where paint had peeled. He stated that this was common for almost all aircraft and that this peeling usually continued until the aircraft was reworked again. (It is suspected that this peeling is due to poor surface preparation on sporadic areas of the aircraft prior to painting.) However, the chief also stated that unlike the standard paint system, any peeling of the SPTC stopped after the squadron received the aircraft.

As a final evaluation of the Self-Priming Topcoat, VF-32 Corrosion History Files and JM data on the two aircraft (standard paint and SPTC) were analyzed. All paint touch-up was performed using MIL-P-23377D, Type II and MIL-C-22750 (epoxy primer and epoxy topcoat - standard for painting on board carrier). The touch-up system was compatible with and adhered to the SPTC. However, one of the chiefs stated that the color blend was better with the SPTC. Comparing the SAF (preventive maintenance) JM data for the months of August and September (while deployed on the carrier), the F-14 with the standard paint system had a total of 300 corrosion actions, 71 of which were for bare metal exposed due to chipped paint. The F-14 with the SPTC had a total of 201 actions with only 3 reports of bare metal due to chipped paint.

In conclusion, inspections by NAVAIR, NAESU, and NADC personnel, along with comments from squadron maintenance personnel, and analysis of corrosion data illustrated that after 8 months (3 of which were ship deployed) the NADC Self-Priming Topcoat performed as good as, or possibly better than, the standard paint system on F-14 160901.

The following personnel provided tremendous support during our visit to the carrier: CDR Derieck, CDR Connelly, LCDR Jones, LCDR Elliot, AVCM Matthews, and especially AM1 Winters and AM1 Paltanwich.

REFERENCES:

1. Charles R. Hegedus, DEVELOPMENT OF A PRIMER/TOPCOAT AND FLEXIBLE PRIMER FOR ALUMINUM, Naval Air Development Center Reprort Number 87016-60, Warminster, PA, 20 March 1987.
2. Charles R. Hegedus and Donald J. Hirst, Naval Air Development Center Trip Report, Warminster, PA, 22 Feb 1988.

CR Hegedus

22 November 1988

From: Melvin K. Rose, Naval Aviation Engineering Service Unit
 Detachment Oceana, Badge No. 260-68391
 To: Commanding Officer, Naval Aviation Engineering Service Unit
 Via: Officer in Charge, Naval Aviation Engineering Service Unit
 Detachment Oceana

Subj: SUBMISSION OF TRIP REPORT

1. Activity Visited: USS KENNEDY (CV-67), VF-32.
2. Dates of Visit: 27 October through 1 November 1988.
3. Purpose of Trip: To evaluate the self-priming top coat (developed at Naval Air Development Center) on VF-32 F-14 160910 and standard paint system (STP) applied to F-14 159603.

4. Summary of Accomplishments:

a. F-14 aircraft 160901 and 159603 were painted at the same time and placed in service with Fighter Squadron VF-32, April 12, 1988. Aircraft 160901 was painted with an experimental self-priming top coat (SPTC). Aircraft 159603 was painted with the standard paint system epoxy polyamide primer, MIL-P-23377 and top coat Aliphatic Polyurethane, MIL-C083286 (SP5). A trend is being developed with a comparison between these paint systems in an attempt to evaluate the effectiveness of the SPTC.

b. The following items will be evaluated over the first year of operation.

- (1) Chipping and cracking of paint around fasteners and highly flexible sections of the aircraft
- (2) Corrosion discrepancies
- (3) Cleanability
 - (a) Ease of cleaning
 - (b) Fading and streaking from aircraft cleaning compound
- (4) Man-hours spent on corrosion prevention
- (5) Touch up of the paint system including:
 - (a) Blendability
 - (b) Adhesion of epoxy polyamide top coat, MIL-C-22750

c. Aircraft 160901 and 159603 were inspected by Mr. C. Hagedus, NADC, Mr. O. Jamieson, NAVAIR, and Mr. M. Rose, NAESU. On aircraft 160901, the paint around fasteners and flexible sections of fuselage, tail sections, speed brakes, and underside of wings was excellent with very little paint cracking or peeling. A comment from Mr. Winters, VF-32 corrosion supervisor, ... some peeling right after SDLM, but is not a problem now. Peeling is somewhat typical, but it usually doesn't get better as it did with this aircraft...

22 November 1988

Subj: SUBMISSION OF TRIP REPORT

d. Aircraft 159603 had a significant amount of chipping and cracking of the SPS in the same sections evaluated. The corrosion history folders and the 3M data summary for August and September on the subject aircraft is as follows:

Corrosion preventative actions squadron-wide:

159609 - 380 total maintenance actions, 71 of those were bare metal or chipped paint.

160901 - 201 total maintenance actions, 3 were bare metal or chipped paint.

Flight hours for August and September 1988

160901	159603
Total hours - 82.7	Total hours - 24.2

e. Corrosion discrepancies: No major corrosion discrepancies were discovered during this first evaluation period.

f. Cleanability: The aircraft were cleaned on the following dates with aircraft cleaning compound, MIL-C-43616, Class I, from Octagon Process, Inc., Edgewater, NJ, or MIL-C-43616, Class 1A, spray cleaner.

A/C 160901	A/C 159603
4-18	4-18 hand cleaned
5-08 hand cleaned	5-08 hand cleaned
5-24	5-28
6-08	7-14
6-22	9-07
7-14	8-13
7-19	9-01
8-07 hand cleaned	9-06
8-13	9-10 hand cleaned
8-26	9-25
9-01	10-05
9-14	10-10
9-20	10-23
9-25	
10-03	
10-11	
10-23	

A summarization of the comments solicited from Mr. J. Paltanawick, Line Supervisor VF-32, indicate that the SPTC is easier to clean and is less susceptible to fading or streaking from the aircraft cleaning compound although aircraft 160901 was cleaned more frequently than 159603. The SPTC system appears to be holding up better than the SPS.

g. Both aircraft were touched up during this period. The touch up paint was epoxy polyamide top coat, MIL-C-22750. The epoxy blended well with both systems with no adhesion problems.

22 November 1989

Subj: SUBMISSION OF TRIP REPORT

5. Items Requiring Further Action: The aircraft will again be evaluated in February 1989 after the deployment.

6. Recommendations: Recommendations will be forthcoming after the one year evaluation.



MELVIN K. ROSE

Copy to:
NADC (Mr. C. Hegadus)
NAVAIR (Mr. D. Jamieson)
COMFITWING ONE
NAESU Det Norfolk

4123
Doc 6067401231
16 Dec 1988

From: Commander, Naval Air Development Center

Subj: F-14 FIELD TEST OF HUNICAT (SELF-PRIMING TARGOAT)

Refs: (a) NAVAIRDEVCOM Report Number NADC-97015-49 of 27 May 87
(b) COMNAVAIRLANT Rep 121007 605 86

Incl: (1) NAVAIRDEVCOM Trip Report of 1 May 88
(2) NAVAIR Trip Report, undtd
(3) NADC PIT, Orlando, Virginia Beach, VA Trip Report of 27 May 87

1. Reference (a) discusses the development and laboratory evaluation of a single coating (HUNICAT) which was designed to replace the current two coat system (primer and topcoat) on Navy aircraft. Reference (b) provided approval to paint an F-14 at the Naval Aviation Depot, Norfolk, VA for a field evaluation of HUNICAT. Inclosures (1), (2), and (3) are trip reports which discuss the performance of this coating six months after application to the F-14 at the Naval Aviation Depot, Norfolk, VA.

2. The overall conclusion is that HUNICAT is performing as well or better than the standard paint system. Expected benefits from this coating are:

- a. Reduced paint application time, manpower, and materials.
- b. Reduced emissions of hazardous materials.
- c. Reduced corrosion maintenance on aircraft.

3. For further information, contact Mr. G. Hegedus at WFOUHQ 651-1452.

J. J. F. LINDGREN
By direction

Distribution:

COMNAVAIR (A12-4112, 51163, 5116F, 5164, 5214, 511-241, 245)

COMNAVAIRLANT (Code 5200)

NAVAVNDDEPOT (Code 140), Alameda, CA

NAVAVNDDEPOT (Code 140), Cherry Point, NC

NAVAVNDDEPOT (Code 140), Jacksonville, FL

NAVAVNDDEPOT (Code 140), Norfolk, VA

NAVAVNDDEPOT (Code 140), North Island, San Diego, CA

NAVAVNDDEPOT (Code 140), Pensacola, FL

Grumman Aerospace Corporation, Mail Stop A06-12, Bethpage, NY 11714-2012

Copy to: COMDF GENP 60DF 606DF 6052DF C.HEGEDUS;mw;12/16/88;3993

4133
Ser 60327 003457

26 Apr 1989

From: Commander, Naval Air Development Center

Subj: F-14 FIELD TEST OF UNICOAT (SELF-PRIMING TOPOAT)

Ref: (a) NAVAIRDEVCOM Report Number NADC-87016-89 of 20 Mar 87
(b) COMNAVAIRLANT Norfolk VA 121652 5 Apr 86

Encl: (1) NAVAIRDEVCOM Trip Report of 23 Feb 89
(2) NAVAVNSOPOT, Cherry Point, NC Trip report of 15 Mar 89
(3) NAVAVNSOPOT, Jacksonville, FL Trip report of 27 Mar 89
(4) McDonnell Aircraft Co., St. Louis, MO Trip report of 23 Feb 89
(5) Grumman Aerospace Corp., Bethpage, NY Trip Report of 3 Mar 89

1. Reference (a) discusses the development and laboratory evaluation of a single coating (UNICOAT) which was designed to replace the current two coat system (primer and topeat) on Navy aircraft. Reference (b) provided approval to paint an F-14 at the Naval Aviation Depot, Norfolk, VA for a field evaluation of UNICOAT. Enclosures (1) through (5) are trip reports which discuss the performance of this coating one year after application to the F-14 at the Naval Aviation Depot, Norfolk, VA.

2. The overall conclusion is that UNICOAT is performing as well or better than the standard paint system. The paint cracking, reported in enclosure (a), was investigated further by Mr. Mel Rose (Naval Aviation Engineering Service Unit Detachment, Naval Air Station, Oceana, Virginia Beach, VA). Nearly all F-14's have cracked paint on the fiberglass skin panel just aft of the canopy. This cracking is due to excessive flexing and fatigue of this panel. Overall there is less paint cracking and chipping with UNICOAT than the standard paint system. Expected benefits from this coating are:

- a. Reduced paint application time, manpower, and materials.
- b. Reduced emissions of hazardous materials.
- c. Reduced corrosion maintenance on aircraft.

3. For further information, contact Mr. G. Maguire at NADC/OC 441-1452, or (215) 441-1452.

J. J. DE LUCCIA
By direction

Distribution on Page 2

Subj: F-16 FIELD TEST OF WEIGOUT (SELF-PAINTING TOPCOAT)

Distribution:

COMNAVAIR (AIR-6112, 5116B, 5115F, 5154, 5304, 2MA-241, 265)

COMNAVIAIRLANT (Code 528B)

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NAVAVNDEPOT (Code 340), Jacksonville, FL

NAVAVNDEPOT (Code 340), Norfolk, VA

NAVAVNDEPOT (Code 340), North Island, San Diego, CA

NAVAVNDEPOT (Code 340), Pensacola, FL

Cruzan Aerospace Corporation, Mail Stop 504-12, Bethpage, NY 11714-3540

McDonnell Aircraft Company (Code 034200), Box 516, Building 2,

St. Louis, MO 63169-2516

Copy to:

COMDP

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60DP

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6062DP

C. HEGEDUS; mw; 4/21/89; 3993

REPORT OF TRIP TO: USS J. F. KENNEDY
DATE OF TRIP: 27 OCTOBER - 1 NOVEMBER 1988
MADE BY: Dave Jamieson, NAVAIR CODE AIR-41121E
PURPOSE OF TRIP: To evaluate the NADC developed SELF-PRIMING TOPCOAT on a deployed F-14 aircraft.

1. The Naval Air Development Center (NADC) developed a self-priming topcoat (SPTC) that eliminates the need for a primer coating prior to the application of the colored top coat on Naval Aircraft. The SPTC has been applied to 3 H-3s and 1 F-14 aircraft to evaluate its performance and corrosion inhibiting capabilities in a fleet environment

2. NADC requested Mr. M. Rose, NAESU corrosion, NAESU detachment Oceana and this writer to assist Mr. C. Hegedus (NADC Code 6062) in an inspection of F-14 Buno 160901 (F-14-1) which was aboard the USS John F. Kennedy in the Mediterranean. On 27 October 1988 we departed for the USS Kennedy to evaluate the performance of the SPTC.

3. On 29 October 1988 the inspection team briefed CDR Connelly, the CO of VF-32, (F-14-1 reporting custodian) and LCDR JONES, the CAG maintenance officer, on the SPTC and the goals of inspection team. The team then met with LCDR Elliot, VF-32 Maintenance and Materials Control Officer, and AVCM Matthews, VF-32 Maintenance Chief, who supported the team during the inspection. AMS1 Winters, the VF-32 corrosion control work center supervisor, met the team at the aircraft and provided information on the maintenance history of F-14-1. He told the team that the only problem he had with the SPTC was a slight peeling condition noted on its arrival from the depot. AMS1 Winters indicated that paint peeling on returning depot aircraft is very common, and said that once the peeling on F-14-1 was repaired no further problems were noted. He stated that other aircraft with the standard coating systems which peels tend to continue to peel even after repair.

4. The inspection of F-14-1 took place 29-30 October 1988. The SPTC on F-14-1 was in excellent condition and exhibited no signs of peeling, cracking, blistering or corrosion. The SPTC on areas of high foot traffic (eg; Upper surfaces on the fuselage, wings, horizontal stabilizers or nacelles) was dirty but not worn or abraded. A thorough inspection for cracking of the SPTC along fastener rows was also accomplished. No cracking was noted. This is a significant finding since the most common cause of corrosion on naval aircraft is due to fatigue/stress cracking of the coating system along fastener rows. This condition allows moisture to intrude below the coating system and create a dissimilar metals corrosion cell between the fasteners and the aluminum skin. An orange stain covered the upper surfaces of F-14-1. AMS1 Winters stated that the stain had appeared since the cruise began and he did not know the source. This stain could not be removed by any of the approved cleaning methods. The team took samples of the stain to possibly identify the source/cause and removal method.

5. To evaluate the SPTC performance against the standard coating system VF-32s F-14, BuNo 159603 (F-14-2) which completed depot 1 day prior to F-14-1 was inspected. The standard coating system was in good condition. The aircraft appeared dirtier. There was a significantly higher number of paint touch up areas and chipped paint. The coating system on this aircraft was not good as the SPTC on F-14-1.

6. We then interviewed Petty Officer Paltanawick, the VF-32 line division supervisor, to inquire about the cleanability of the SPTC. Petty Officer Paltanawick stated that of the two types of topcoats the SPTC was easier to clean and that it was more resistant to deterioration caused by the use of harsh cleaning compounds. MIL-C-43616 was the cleaner used by VF-32 which can contain up to 60% Aromatic Solvents. He also stated that the SPTC maintained its color better than the standard Polyurethane Topcoat after multiple lathings.

7. The team then reviewed VF-32s MDR-11s (The 3M Corrosion Control Summary) for August and September on F-14-1/2. The documented corrosion discrepancies for both aircraft were nominal and similar. However, preventive corrosion maintenance actions which includes the touch up of bare metal and chipped paint were quite different. F-14-1 had 201 items processed under support action code 04 for August/September. Of those only 3 were caused by loss of paint. F-14-2 had 398 items processed for the same period. Of those 71 were for loss of paint. This is a significant difference for aircraft having the same depot cycle, squadron, and operational environment. Flight hours for August/September for F-14-1 was 82.7 and for F-14-2 was 24.2. A higher rate of coating damage is usually seen for aircraft accruing higher flight times due to the amount of handling and maintenance associated with flight operations. However, in this case the opposite was true which makes a strong statement for the durability of the SPTC.

8. A final discussion was held with both Petty Officer Winters and Paltanawick to review any additional information they would like to add. Petty Officer Winters stated that he had experienced no problems applying the standard touch up primer and topcoat over the SPTC and that the adhesion was good. He also stated that color match was good between the SPTC and touch up topcoat being used. Both petty officers agreed that the SPTC was at least as good, if not better than, the standard Polyurethane topcoat and much better than the Epoxy Topcoat (MIL-C-22750) being used for touch up.

9. Based on this inspection the SPTC appears to be as good as the existing Polyurethane topcoats being applied to Naval Aircraft today. This inspection provides only a snapshot of one data point. Additional inspections of this F-14 and the H-3 aircraft with SPTC applied must be conducted to establish a better data base. However, if the SPTC continues to perform as well as it has to date, I will recommend that this material become the standard coating system for Naval aircraft. If the SPTC proves to be an effective coating system, it will provide a substantial cost reduction in manhours and materials required to support aircraft coating system maintenance. There will also be a reduction in supply inventory needed aboard ships and air stations allowing additional space for other required items.

NAVAL AIR DEVELOPMENT CENTER
AEROSPACE MATERIALS DIVISION
WARMINSTER, PA 18974-5000

TRIP REPORT

TO: NAS Oceana

DATE: 23 Feb 1989

PURPOSE: Evaluation of NADC Unicoat on F-14 after 1 year of service.

REPORT BY: A. Eng, C. Hegedus, and D. Hirst, NAAC, Code 6067

BACKGROUND

On 17 Feb 1988, an F-14 (BuNo 160901) was painted at NADDF Norfolk with the NADC-developed Unicoat (previously called Self-Priming Topcoat). One week prior to that date another F-14 (BuNo 159603) was painted at NADDF Norfolk with the standard Navy aircraft coating system (M11-P-23377/M11-C-83236). These aircraft were placed in service with Fighter Squadron VF-32 on 12 April 1988 and in early August 1988 they were deployed on the USS John F. Kennedy for a tour of duty in the Mediterranean Sea. On 29-30 October 1988, an evaluation team consisting of C. Hegedus (NADC), D. Jamieson (NAVAIR-41121F), and M. Rose (NAESU Det. Oceana) inspected both aircraft on board the carrier in the Mediterranean Sea. Visual inspection showed Unicoat to be superior to the standard paint system. 3M data verified their findings since BuNo 160901 registered 201 total maintenance actions (bare metal or chipped paint accounted for 3 actions) versus 380 maintenance actions (bare metal or chipped paint accounted for 71 actions) for BuNo 159603. Also, Unicoat was reported by squadron maintenance personnel as being easier to clean and less susceptible to fading and streaking. This team concluded that Unicoat on BuNo 160901 performed comparably to (if not better than) the standard system on BuNo 159603.

ONE YEAR INSPECTION

On 23 Feb 1989, Charles Hegedus, Donald Hirst, and Anthony Eng visited NAS Oceana with other Navy and industry coatings experts (see Enclosure 1) in order to evaluate and discuss the performance of UNICOAT on an F-14 (BuNo 160901) after a 1 year service test duration. From a visual inspection, BuNo 160901 (with UNICOAT) appeared to have less paint chipping/cracking than the F-14 with the standard coating system (BuNo 159603) particularly around fasteners on the underbelly. UNICOAT appeared to be cleaner but slightly glossier than the standard coating system. The 3M data for the period up to the last inspection in October was presented by M. Rose (see Enclosure 2). The 3M data indicates relatively equivalent performance between the two coating systems, 34 maintenance actions for the aircraft painted with UNICOAT versus 42 for the aircraft with the standard paint system. Confirming previous reports, maintenance personnel stated that UNICOAT was easier to clean, more resistant to burnishing and running when treated with the standard aircraft cleaner used on board ship (M11-C-42616), and blended better with touch-up paint (M11-C-22750) compared to the standard coating system. They also stated that using UNICOAT to touch-

up in the field (organizational and intermediate levels) would reduce their painting time and man-hours by 50%.

In an open forum discussion, various participants expressed their comments, concerns, and suggestions with regards to UNICOAT. These items included IR reflectance, strippability, microcracking/weathering, adhesion, environmental aspects, application methods, draft specification, and future application plans. The following points summarize the discussion.

1) The total IR reflectance of UNICOAT is comparable with the standard coating system (low IR primer - MIL-P-23377 Type II and MIL-C-83286). However, bi-directional IR reflectance analysis, which will be a more extensive analysis, is expected to be completed in March.

2) UNICOAT has been effectively stripped by chemical means, Mil-R-81294, and by plastic media blasting. On laboratory specimens, Unicoat strips easier than the standard coating system since it precludes the use of an epoxy primer which is difficult to chemically remove, and because UNICOAT is thinner than the standard coating system.

3) Microcracking of the standard topcoat after weathering is common due to UV degradation and the high stresses placed on the coating system due to airframe flexing and vibration. Certain studies have suggested that polymeric beads (contained in UNICOAT) have not been effective in eliminating microcracking to date. However, the preclusion of the relatively brittle epoxy primer, and the fact that UNICOAT is applied at a lower total film thickness, suggests that UNICOAT should be a more flexible coating than the standard coating system. Laboratory tests and the on-going field evaluations further indicate this may be the case.

4) Dry and wet tape adhesion of UNICOAT on scotchbrite/deoxidized (no chromate conversion pretreatment) aluminum was reported to be excellent. This correlates with service test results of UNICOAT on a scotchbrite/deoxidized H-3 painted at NADEP Pensacola in April 1988. The elimination of this pretreatment process, reduces maintenance man-hours and greatly reduces disposal problems by eliminating all chromates from the finishing system.

5) The volatile organic compounds (VOC) content of UNICOAT in camouflage colors is currently at 415 g/l, with a Zahn #2 viscosity of 34 seconds. This material can be spray applied with conventional air equipment with air pressure of 60 psi, producing a uniform film. This VOC currently complies with regulations implemented in California for aerospace topcoats (420 g/l) but not for primers (350 g/l). However, classification of UNICOAT is still ambiguous since definitions of topcoats and primers are different in the various regulatory districts. A new and separate classification may be appropriate to accommodate UNICOAT since it greatly reduces the total volume of VOC of the overall painting operation when compared to the standard coating system. NADC plans to approach the EPA and the appropriate California districts to obtain an official ruling and clarification on UNICOAT. The pigment system is lead and chromate free. The resin system is chemically similar to the resin system in the standard topcoat (Mil-C-83286) and thus can be handled with relative ease with the proper respirator and clothing.

6) Although UNICOAT has been applied using conventional and air-assisted airless spray, Graco (a paint application equipment manufacturer) is currently investigating the use of other types of application equipment to determine the optimum process for UNICOAT application. They will provide a complete report on their investigation, which will include appropriate recommendations.

7) A draft specification for UNICOAT has been prepared by NADC and will be distributed for review, comments, and suggestions.

8) The F-14 class desk plans to paint F-14A+ models in order to generate additional field data on this material. NADEP Jax expressed interest in painting several A-7's and F-18's. NADEP Norfolk and MCAS Cherry Pt also wish to paint several aircraft in the future. MCAIR would like to paint some F-18's or AV-8's after an extensive laboratory evaluation.

In conclusion, UNICOAT on Buno 160901 performed comparably to (if not better than) the standard coating system on Buno 169603 after 1 year of service. In light of the fact that UNICOAT has numerous advantages over the standard coating system (i.e. reduced application time and moreover, reduced aircraft processing time, reduced material costs, reduced VOC emissions, and elimination of chromates) and that it has performed well on four fleet aircraft, a more extensive field testing program is warranted and recommended.

C. R. Hezeler

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CORROSION DOCUMENTATION

	<u>AC 159609</u>	<u>AC 160901</u>
OCT 88		
A/C Wash Hours	74.9	43.5
SAF Hours	163.3	151.4
MAF Hours	<u>19.7</u>	<u>10.7</u>
Totals	257.9	205.6

NOV 88		
A/C Wash Hours	89.3	43.7
SAF Hours	483.5	491.7
MAF Hours	<u>204.4</u>	<u>210.3</u>
Totals	777.2	745.7

DEC 88		
A/C Wash Hours	66.3	64.6
SAF Hours	376.2	298.9
MAF Hours	<u>183.7</u>	<u>98.5</u>
Totals	625.2	462.0

Three Month Total

Wash Hours	230.5	151.8
SAF Hours	1023.0	942.0
MAF Hours	<u>407.8</u>	<u>319.5</u>
Totals	1661.3	1413.3

A/C Wash Hours by Month

A/C 189603

Oct 88

Wash hrs.

4 74.9

Nov 88

4 89.3

Dec 88

3 66.3

A/C 180901

Oct 88

Wash hrs.

2 43.5

Nov 88

2 43.7

Dec 88

3 64.6

A/C Washes

Julian Date Hrs.

8282 21.6

8278 15.3

8285 14.3

8297 13.8

8306 21.9

8312 16.1

8316 16.2

8327 14.2

8340 9.9

8355 23.8

8365 23.6

9014 18.6

9027 12.7

Julian Date Hrs.

8284 19.6

8297 18.9

8313 21.6

8335 18.8

8340 18.6

8350 15.6

8354 21.9

9001 22.6

9014 16.7

40 Day corrosion inspections.

A/C 159606

Nov 6, 88

Bare metal 9 items

Chipped paint 3 items

Galvanic corrosion 2 items

Surface corrosion 3 items

Rust 3 items

Dec 21 88

Bare metal 3 items

Chipped paint 5 items

Galvanic corrosion 2 items

Surface corrosion 0 items

Rust 1 item

Jan 25 89

Bare metal 1 item

Chipped paint 6 items

Galvanic corrosion 4 items

Surface corrosion 0 items

Rust 1 item

Totals

Bare metal	13
Chipped paint	14
Galvanic cor.	8
Surface cor	3
Rust	4

42

A/C 160901

Nov 11, 88

Bare metal 4 items

Chipped paint 7 items

Galvanic corrosion 0 items

Surface corrosion 1 item

Rust 2 items

Dec 18 88

Bare metal 7 items

Chipped paint 0 items

Galvanic corrosion 1 item

Surface corrosion 3 items

Rust 0 items

Jan 27 89

Bare metal 3 items

Chipped paint 3 items

Galvanic corrosion 2 items

Surface corrosion 1 item

Rust 0 items

Bare metal	14
Chipped paint	10
Galvanic cor.	3
Surface cor	5
Rust	2

34



DEPARTMENT OF THE NAVY

NAVAL AVIATION DEPOT
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA 28533-5030

IN REPLY REFER TO:
7200
35420-JW
15 Mar 89

PRODUCT SUPPORT DIRECTORATE TRIP REPORT NO. 043-89

From: J. A. Whitfield, Nonmetals Branch (35420)
To: Commanding Officer
Via: (1) Director, Product Support Directorate (05)

Subj: EVALUATION OF NAVAL AIR DEVELOPMENT CENTER SELF-PRIMING TOPCOAT
(UNICOAT) ON F-14 (NAVAVNDEPOTINST 7200.1)

1. On 23 February 1989, the undersigned traveled to Naval Air Station Oceana, Virginia Beach, Virginia, to evaluate a self-priming polyurethane topcoat (Unicoat) developed by the Naval Air Development Center (NAVAIRDEVCEN) which eliminates the need for primer when coating Naval aircraft. This coating was applied to an F-14 aircraft (BUNO 160901) on 17 February 1988 which was later deployed to the Mediterranean Sea aboard the U.S.S. John F. Kennedy. Another F-14 aircraft (BUNO 159603), deployed there also, was coated with the standard epoxy primer/polyurethane topcoat system just prior to the F-14 with the Unicoat. Both aircraft were available for inspection at Naval Air Station (NAS) Oceana (VF-32) on 23 February 1989, one year after being coated.

2. Evaluation: Both aircraft were painted the same color, flat gray, FED-STD-494, Color No. 35237. The coating on both aircraft appeared in very good condition; no large scale peeling, flaking, or chipping. Particular attention was given to areas such as rivet lines, leading edges, seams, and underside surfaces where coating failure is most prevalent. Color, fading, staining, and streaking was also compared on the two aircraft; no significant differences were observed. Following onsite evaluation, the inspection team was briefed by Mr. C. Hegedus (NAVAIRDEVCEN Code 6062), who was instrumental in the development of the Unicoat material. Mr. Hegedus spoke of the advantages of the Unicoat material as compared to the standard coating system, including (1) reduced application time, (2) reduced overall material cost, (3) reduced volatile organic content (VOC), and (4) elimination of chromates from the coating material. Mr. M. Rose (NAS Oceana, NAESU Det.) presented VF-32 corrosion history files of the two aircraft which included corrosion discrepancies and preventative corrosion maintenance actions. According to Mr. Rose, based on the data presented, the Unicoat performed as good if not better than the conventional coating system. VF-32 personnel present at the briefing stated that the aircraft with Unicoat was easier to clean and appeared to be more resistant to streaking by cleaning compounds than the standard paint system. They also stated that there were no problems with adhesion or color match of MIL-C-22750 Epoxy Topcoat when used for touch-up. Personnel from NAVAVNDEPOT Norfolk, where the two aircraft were painted, were on hand to provide comments on the application of the Unicoat. Among the comments on application was that the Unicoat appeared "wetter" than the conventional coating material when sprayed, giving the appearance of potential runs and sags, but runs and sags occurred no more frequently. The Unicoat material has a shorter pot life (1.5 hours) compared with the standard polyurethane coating. Mr. Hegedus added that because of the short pot life, the two-component Unicoat material had to be mixed immediately prior to application. Dry film thickness of the Unicoat was typically two mils.

PRODUCT SUPPORT DIRECTORATE TRIP REPORT NO. 043-89

3. Conclusions: Based on the evaluation and observations made, the Unicoat material appears to perform as well as and possibly better than the standard epoxy primer/polyurethane topcoat system. The only negative aspect was the short pot life, and it remains to be seen if there would be any problems because of this at this Depot. The Unicoat material warrants further evaluation, therefore, this Depot will acquire the necessary material to perform such evaluations.

J. A. Whitfield 9/5/89

J. A. WHITFIELD

343iPB
27 Mar 89

MEMORANDUM

From: Patricia Betzig, NADEP/JAX Code 343
To: Charlie Hegedus, NADC Code 6062
Via: Polymeric Materials Branch, Code 343 MBZ.

Subj: TRIP REPORT - CONCERNS OF UNICOAT SELF PRIMING TOPCOAT AND REVIEW OF F-14 AIRCRAFT.

Encl: (1) List of attendees, Unicoat Eval/NAS Oceana

1. On 2/23/89 a meeting was held at NAS Oceana to evaluate and discuss the self-priming topcoat developed at NADC. A list of attendees is attached. The meeting was run by Charlie Hegedus, NADC Code 6062.
2. Two F-14's were on site for review and comparison. One had been painted with Unicoat (B/N 160901), the other in the conventional primer/topcoat system (B/N 159609). The coatings had been in service for one year aboard the same carrier. Carrier crew were available during the meeting to answer questions. Corrosion control had been documented. In summary the two aircraft coatings had the same amount of touch-ups and were considered equal in performance by the crew.
3. Attendees at the meeting reviewed the two aircraft and were in agreement that the Unicoat system looked good and should continue to be evaluated. Future evaluation might focus on the following areas of concern:
 - A) Corrosion is not a major problem with the F-14, field corrosion protection needs to be evaluated further.
 - B) Microcracking might be expected to appear after a year. Another review of this aircraft in 6 months may reveal this problem.
 - C) Lack of confidence in adhesion of current topcoat to Unicoat as in touch-up repairs and Unicoat to current topcoat. These are being evaluated by NADEP/JAX Code 343 currently.
 - D) Small component use appears to be a good avenue to gain more experience with the Unicoat system.

Patricia Betzig
PATRICIA BETZIG
Materials Engineer

CONCERN FOR OUR CUSTOMERS ELIMINATED CONCERN FOR COMPETITORS.

SUBJECT/PURPOSE		<input type="checkbox"/> CONTRACTUAL	<input type="checkbox"/> NEW BUSINESS	<input type="checkbox"/> _____ SPECIFY	PAGE OF
Inspection of Non-Chromated Paint on an F-14 Aircraft					DATE OF TELECON /TR/ CONF. 2/23/89
					TR NO.
					CHARGE NO.
PLACE OF CONFERENCE/LOCATION/FACILITY					
Oceana NADEP - Norfolk, VA					
MDC PERSONNEL			OTHER PERSONNEL/CONTACTS		
Jim Faller John Robertson Sheldon Toepke			See attached list for individual names 15 Navy 2 Grumman		
DISCUSSION/COMMENTS (INFO.OBTAINED. CONCLUSIONS)					
<p>1. The Naval Air Development Center (NADC) has developed a non-chromated, self priming topcoat. In addition to its low toxicity feature, three years of laboratory testing have demonstrated other positive features. Because the topcoat is corrosion inhibited, it does not require a primer. This would improve quality, save cycle time and man hours both in production and maintenance in service. Required paint film thickness is only 2 Mills as compared to 3 Mills of standard epoxy primer/polyurethane topcoat system.</p> <p>2. Two F-14 aircraft were stripped and repainted in FEB 1986. One aircraft (155609) had standard paint system reapplied and the other (160901) received the self priming topcoat. Both aircraft were deployed on USS John F. Kennedy for a six month cruise in the Mediterranean Sea. Detailed records show that the non-chromated paint had fewer corrosion reports and required slightly less maintenance than standard paint finish. A relatively short inspection (less than one hour) was made of the two aircraft because they were in flight status. The following are observations from this inspection:</p> <ul style="list-style-type: none"> o unicoat paint much smoother than standard paint o unicoat paint appeared to be semigloss rather than flat o much touch-up and rework was done to fasten patterns and door/skin edges on both aircraft. o Bottoms of both A/C and hanger floor was very wet with aircraft fluids o macro cracks in paint film on nose radome and fiberglass skin on top of wing o micro cracks could be seen with 30x glass in new paint on both fiberglass skin and on an adjacent aluminum skin. <p>3. After the inspection a discussion was held and some general conclusions were developed. The unicoat system can be applied with standard paint</p>					
PREPARED BY				DATE	
S. L. Toepke <i>S. L. Toepke</i>				3/8/89	

CC: R. O. Ahrens, S. Bettadapur (NAVAIR), J. F. Faller, M. P. Gleason, C. Hegedus (NADC), R. Massey (NAVPRO, St. Louis), J. J. Reilly, J. M. Robertson, M. S. Ruessing, L. R. Sanders, J. J. Slavick, P. M. Stifel, B. E. Upton

equipment but due to short pot life (50 minutes), plural component equipment may be needed in continuous manufacturing process. The unicoat paint was equal to or slightly better than standard paint system on this aircraft. Because of good performance, the flight test program should be expanded to more aircraft. It was also definitely stated that more experience is needed before wholesale change to this paint is considered. Need low VOC version of unicoat in order to be seriously considered for use at NADEP's for production use. Each representative was asked to state their action plans, both verbally and in a copy of their trip report to be sent to C. Hegedus at NADC. (NADEP Cherry Point considering painting an AV-8, NADEP JAX considering number of A-7's and overcoating several F/A-18's, class desk considering more F-14's).

4. Somewhat unrelated comments made in general discussion were:

- o MIL-C-43616 detergent required for use on aircraft carriers will burn paint (bleach out color) if used in concentrated form or left on surface too long. On shore they use MIL-C-85570.
- o All NADEP's stated that great regulatory pressure is being applied to eliminate use of chromium compounds. Several Florida bases already can not use chromate conversion coatings.
- o NADEP JAX is going to switch from air assisted airless electrostatic guns to HVLP (air turbine) equipment because they can get higher transfer efficiency on non-metallic surfaces and with water-borne primers.

Action Required

1. MCAIR will finish laboratory test and if positive results are obtained, then plan flight evaluation.
2. MCAIR to watch weathering characteristics of unicoat paint due to observation of micro cracks in several areas.

1433G

UNICOAT EVAL/NAS OCEANA

<u>NAME</u>	<u>ORGANIZATION</u>	<u>PHONE</u>
George Leed	GTS	804-422-1690
Janet Priebe	Grumman	516-575-1117
G. K. Phillips	HAD	804-444-4209
W. Mehaffey	NADEP	804-444-8811
D. P. Carter	NADEP	804-444-4209
H. D. Bright	NAESU	804-433-5161
M. K. Rose	NAESL	804-433-5161
Tony Eng	NADC	215-441-3269
Don Hirst	NADC	215-441-1473
Michael Linn	PSD Jax	904-772-4519
Patricia Betzig	PSD Jax	904-772-4519
G. T. Browne	COMNAVAIRLANT Code 528	804-444-7940
S. L. Toepke	MCAIR	314-233-2610
Jim Faller	MCAIR	314-777-8336
John Robertson	MCAIR	314-777-7655
Jim Klotz	Coatings for Industry	215-723-0919
LCDR Sean Hanrahan	F-14 Class Desk NAVAIR (5116B)	202-746-1172
James Whitfield	NADEP Cherry Point	919-466-7161
Dave Jamieson	NAVAIR 41121	202-692-1518
AMSC Skip Brashears	COMFITWING One	804-433-5570

CORROSION DOCUMENTATION
 STD 206 New Paint
AC 159609 AC 160901

OCT 88

<i>Preventive Time</i>	A/C Wash Hours	74.9	43.5
<i>corrosion support action</i> →	SAF Hours	163.3	151.4
	MAF Hours	19.7	10.7
	Totals	<u>257.9</u>	<u>205.6</u>

actual corrosion network

NOV 88

A/C Wash Hours	89.3	43.7
SAF Hours	483.5	491.7
MAF Hours	204.4	210.3
Totals	<u>777.2</u>	<u>745.7</u>

DEC 88

A/C Wash Hours	66.3	64.6
SAF Hours	376.2	298.9
MAF Hours	183.7	98.5
Totals	<u>625.2</u>	<u>462.0</u>

Three Month Total

Wash Hours	230.5	151.8
SAF Hours	1023.0	942.0
MAF Hours	407.6	319.5
Totals	<u>1661.3</u>	<u>1413.3</u>

42 Day corrosion inspections.

A/C 159606

Nov 6, 88

Bare metal 9 items
 Chipped paint 3 items
 Galvanic corrosion 2 items
 Surface corrosion 3 items
 Rust 3 items

Dec 21 88

Bare metal 3 items
 Chipped paint 5 items
 Galvanic corrosion 2 items
 Surface corrosion 0 items
 Rust 1 item

Jan 25 89

Bare metal 1 item
 Chipped paint 6 items
 Galvanic corrosion 4 items
 Surface corrosion 0 items
 Rust 1 item

Totals

Bare metal 13
 Chipped paint 14
 Galvanic cor. 8
 Surface cor. 3
 Rust 4

42

A/C 160901

Nov 11, 88

Bare metal 4 items
 Chipped paint 7 items
 Galvanic corrosion 0 items
 Surface corrosion 1 item
 Rust 2 items

Dec 18 88

Bare metal 7 items
 Chipped paint 0 items
 Galvanic corrosion 1 item
 Surface corrosion 3 items
 Rust 0 items

Jan 27 89

Bare metal 3 items
 Chipped paint 3 items
 Galvanic corrosion 2 items
 Surface corrosion 1 item
 Rust 0 items

Bare metal 14
 Chipped paint 10
 Galvanic cor. 3
 Surface cor. 5
 Rust 2

34

CONFERENCE/TRIP INFORMAL REPORT

BRIEF DISCUSSION (Cont'd)

UNICOAT appears to have very good potential for replacing the existing paint system. Among the advantages:

- o Reduced labor in all final finish operations.
- o Reduced VOC (Volatile Organic Compounds)
Content: Maximum 420 grams/litre
- o Improved corrosion protection, maintainability

Unfortunately there will be no weight savings by eliminating the primer coat. UNICOAT though thinner than the two part system (approx. 2 mils on test A/C existing approx. 3 mils) is more dense so does not reduce weight.

UNICOAT shows promise and there are only advantages apparent. Grumman should monitor its progress and incorporate upon completion of continued successful field tests.

AGREEMENTS

None

ACTION

None

cc: J. Dante
 N. Soley *N. Soley*
 R. Dahl (w/encl.)
 N. Hadigeorge
 R. Bidonda
 A. Della Monica
 G. Hilton (w/encl.)
 W. Horney (w/encl.)
 J. Weir (w/encl.)
 S. DeMay (w/encl.)
 R. Jackson

NAVAL AIR DEVELOPMENT CENTER
Aerospace Materials Division
Warminster, PA 18974-5000

ENGINEERING REPORT

FROM: Organic Coatings Team, Code 6062

PREPARED BY: Anthony T. Eng and Donald J. Hurst

PURPOSE: Discuss problems encountered with batch of UNICOAT applied
at NADEP Norfolk

DATE OF REPORT: 10 August 1989

On 14 June 1989, 155 gal of tactical paint scheme UNICOAT (batch# 893242) was sent to NADEP Norfolk by Coatings For Industry (currently the only manufacturer producing UNICOAT). This paint was supplied for use on F-14A+ (FB) aircraft. FB-21 (Buno 161601) was painted on 27 June 1989 and FB-22 (Buno 161403) was painted on July 1989. During these applications, the pot life (duration after mixing paint after which application becomes impossible) was determined to be 90 min and 70 min, respectively and no problems were encountered during these applications. NADEP personnel knew that the pot life would be relatively short and adjusted their procedures accordingly. The finish of UNICOAT on these F-14's was observed to be excellent (i.e. better than the standard paint system).

On 26 July 1989, FB-23 (Buno 161608) was painted with UNICOAT (batch# 893242). The pot life was 30 minutes for this application of UNICOAT. The finish of UNICOAT on this F-14 also was excellent. NADEP Norfolk personnel (D. Cadman) informed NADC (C. Hegeus) of the short pot life. Mr. Cadman stated that it was becoming increasingly difficult to paint the aircraft with such a short pot-life.

Most aircraft coatings have a pot-life of greater than 4 hours in order to minimize logistical and schedule problems during paint application. UNICOAT has an inherently short pot life due to the chemistry of the coating. This short pot life characteristic is enhanced when the coating is excessively milled during production, exposed to heat, and with passage of time. These effects are believed to be irreversible. This particular batch of UNICOAT was inadvertently milled more than normally expected to obtain the proper gloss. In addition, after the coating was delivered to NADEP Norfolk, a large portion of the batch was stored in a non-air conditioned building where temperatures up to 120°F could be reached during hot summer days. The UNICOAT applied to FB-23 had been stored in the non-refrigerated building for approximately 3 weeks, thus drastically reducing the pot life. To date, attempts to increase the pot life have been unsuccessful. However, laboratory studies are continuing.

On 2 August 1989, we were informed by NADEP Norfolk that a sample of UNICOAT, taken from KB-23 near the tactical paint scheme blend line (over a sealant) appeared to have a cellular structure. They were concerned that the coating would not perform adequately.

However, on 26 July 1989, NADD sprayed out a sample of UNICOAT (batch# 893242) in order to determine the effect of decreased pot life on the physical paint properties. This paint had been part of the original shipment sent to NADEP Norfolk. After allowing these paint specimens to completely cure (7 days, 75°F), a series of critical paint tests were performed to determine if the coating performance on the KB aircraft will be adequate.

Dry and wet tape adhesion, 5 ft impact flexibility, hydraulic fluid resistance (1 day, 250°F), and accelerated water resistance (5 days, 160°F) test results exceeded specification requirements. Also, UNICOAT (batch# 893242) was sprayed out in the lab at various dwell times, 0, 15, and 30 min after mixing, in order to duplicate the application scenario at NADEP Norfolk. The cured films, for all three dwell times, were examined both visually and using an optical microscope (10X). All appeared normal and no cellular or porous structure was observed. Based on the above test results, we are confident that this batch of UNICOAT will perform well on KB-21, 22, & 23.

KB-23 departed from NAS Norfolk to NAS Miramar on 7 Aug 1989 as scheduled.

MATERIALS ENGINEERING DIVISION
NAVAIR ENGINEERING SUPPORT OFFICE
NAVAL AVIATION DEPOT
NORFOLK, VIRGINIA 23511-5899

MELR NR. H-1631

DATE: 18 August 1989

SUBJECT: Unicoat, application of

REFERENCE: (a) Telephone conversation between Code 93502 (E. Bracy) and Code 36300 (W. Maharfey) on 26 July 1989.

ENCLOSURE: (1) Photographic support of paint analysis

The present paint system used on Navy aircraft is Epoxy primer and Polyurethane. In 1986 NADC developed a primerless topcoat substitute called Unicoat. After satisfactory lab test (NADC report #87016-60) an aircraft was chosen for in-service testing. In 1988 NADEP painted an F-14 as part of this evaluation. To date, testing of Unicoat is on schedule.

In Feb 1989 a decision was made to extend the evaluation of Unicoat to twelve additional aircraft. A supply of the Unicoat material was acquired. However, a formula modification had been made on the Unicoat for which no notification, documentation or test data were provided prior to the application of coating on the first of the twelve aircraft.

Production reported difficulty, ref (a), in the application of the modified Unicoat in July. Laboratory evaluation of Unicoat Batch #893242B revealed the following:

- 1) Unicoat batch #893242B was found to have a useable pot life of about 30 minutes.
- 2) After 60 minutes the coating was fully cured to a rubber like texture.
- 3) Further examination of the cured material revealed an open cell structure of the material.
- 4) A sample from the painted aircraft KB 23 also revealed an open cell structure of the coating.
- 5) A similar sampling of the original formulation did not reveal an open cell structure.

Conclusion:

Since coatings that display an open cell structure will not provide satisfactory protection for a substrate and since a 30 minute pot life is not a satisfactory working time for the application process, the material Batch #893242B is considered unsatisfactory. However if the original formulation of Unicoat

can be supplied, normal painting of the remaining aircraft can proceed satisfactorily.

Recommendation:

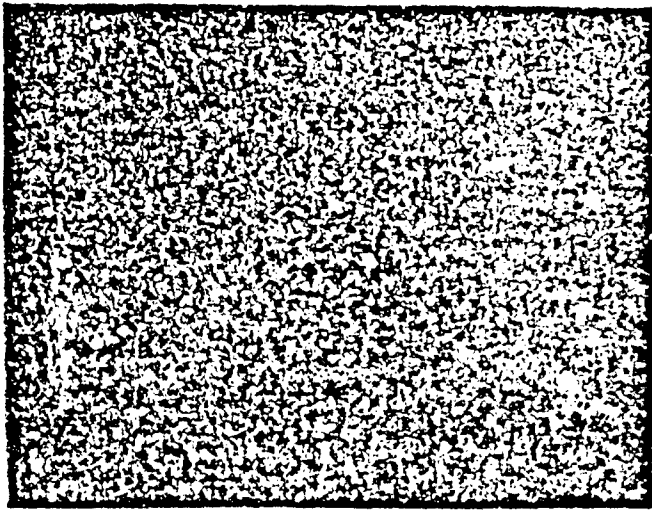
Acquire a new supply of the original Unicoat formulation and continue the painting and evaluation project.

Photographs

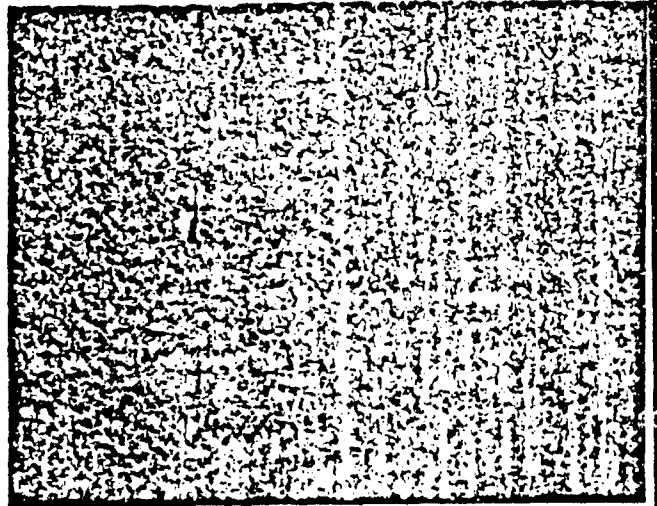
Photographs 1A-6A are close ups of the original formulation taken from test panels. Each photo displays a different sampling.

Photographs 1-7 are close ups of Batch #893242B looking from underneath the surface of the coating on KB-23.

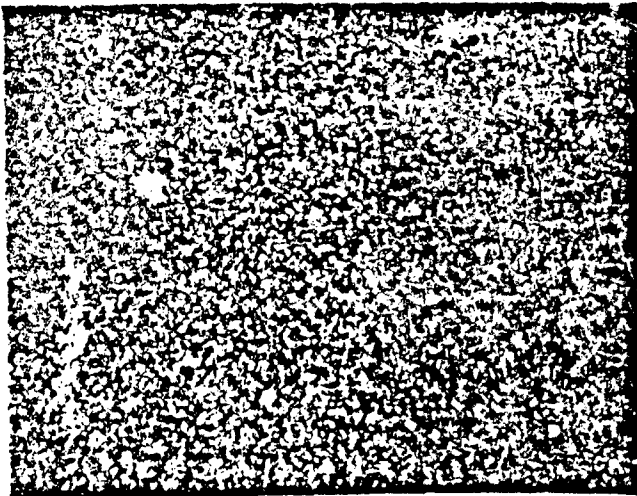
Photographs 8-10 are close ups of a sample also taken from KB 23.



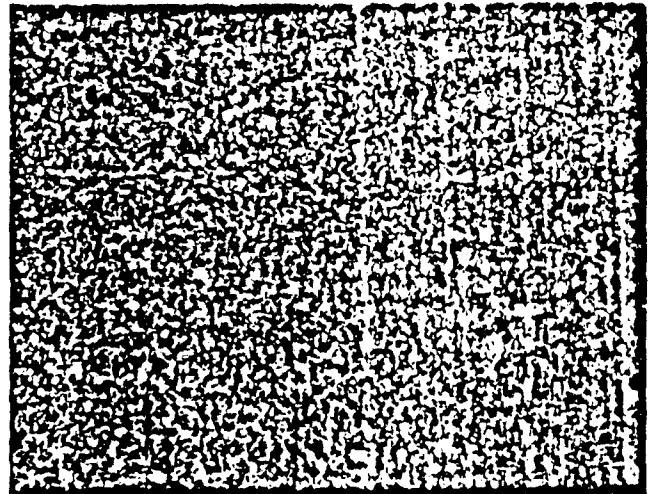
1A 80X



2A 80X



3A 80X

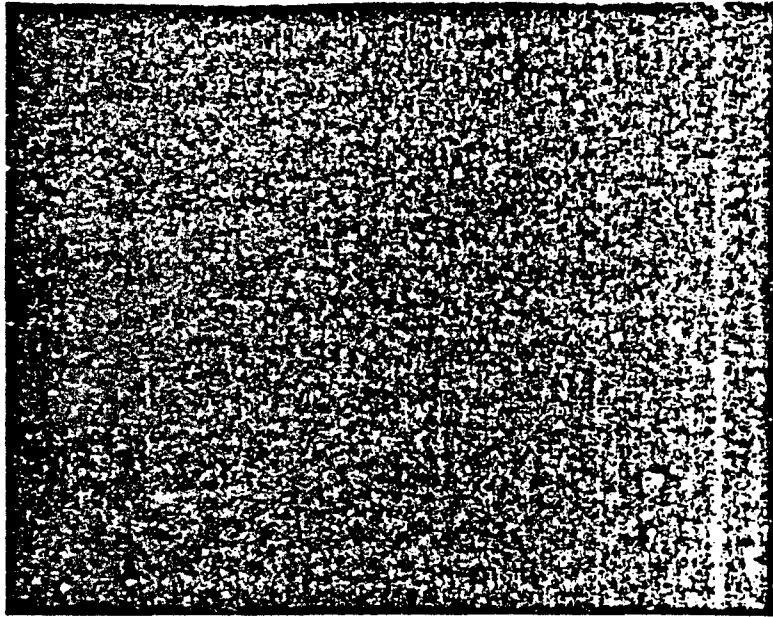


4A 80X

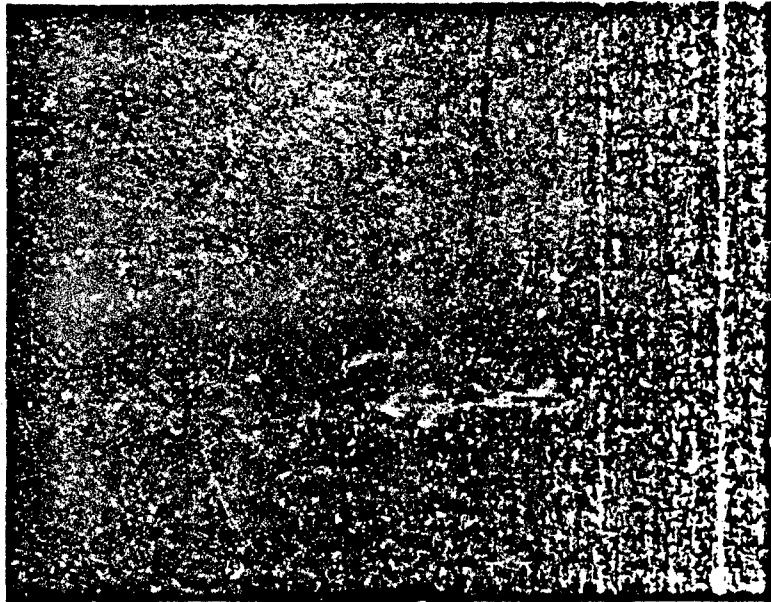
Enclosure (i)

CM

5A 8D

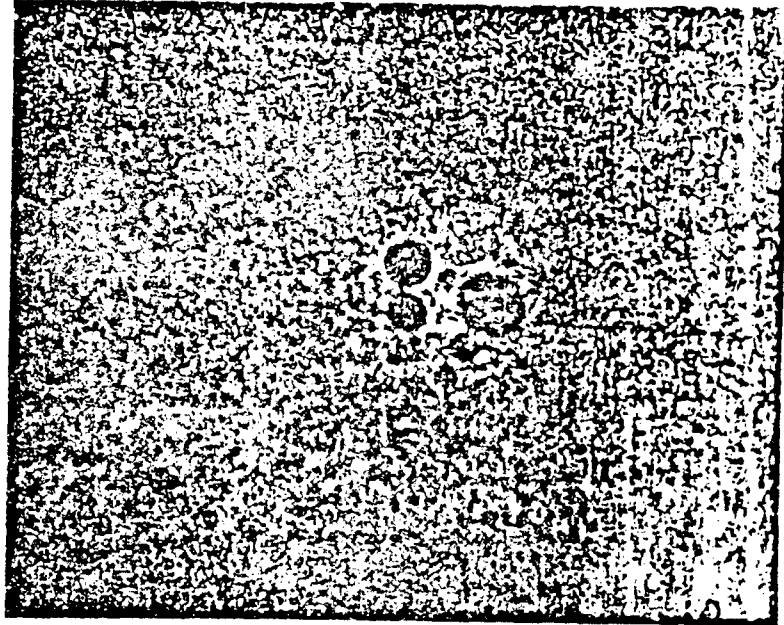


6A 8D



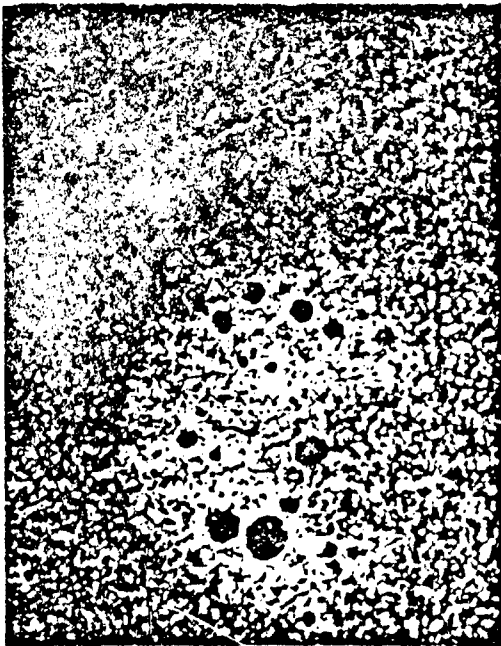
Enclosure (1)

X08



80 X

2



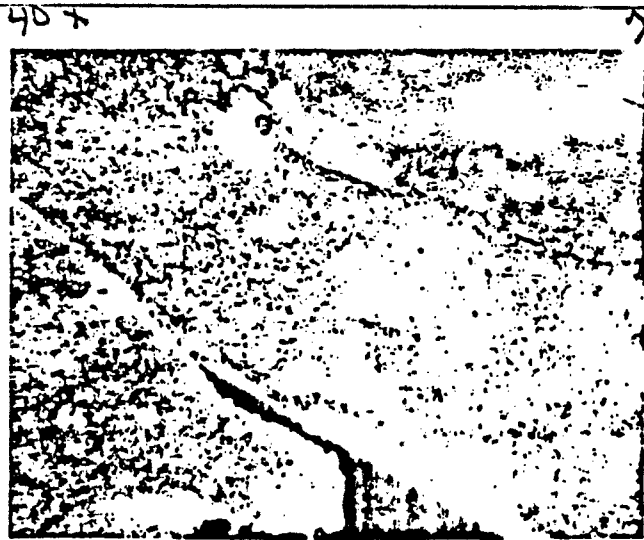
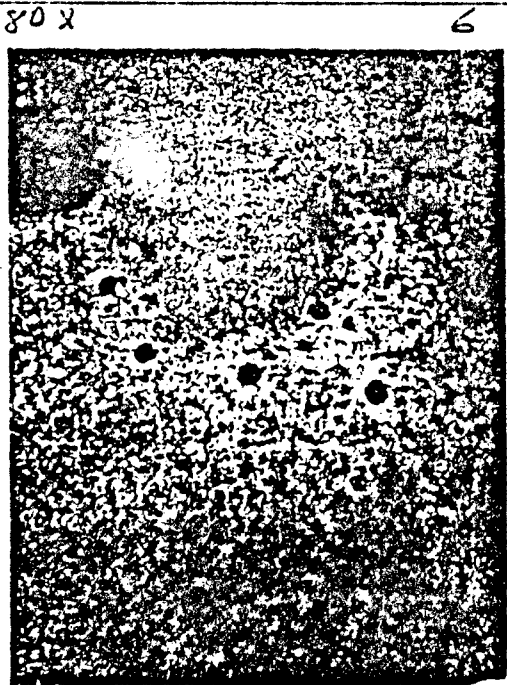
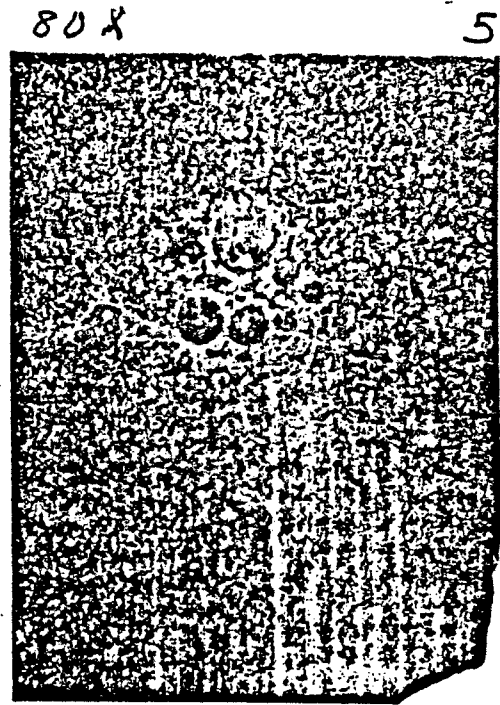
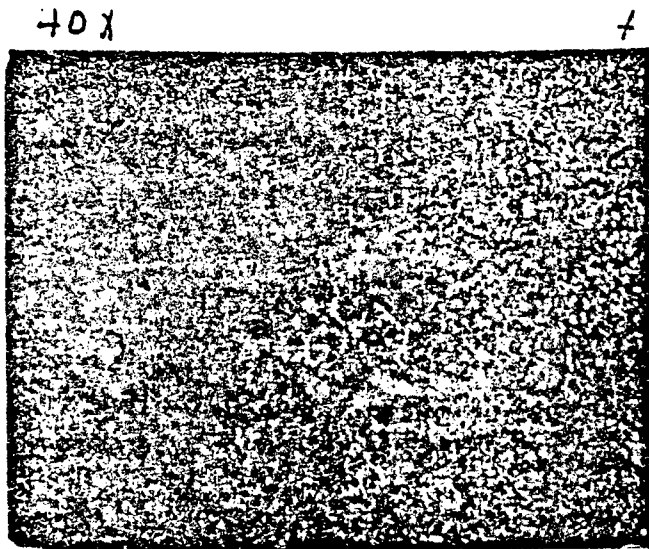
40 X

3

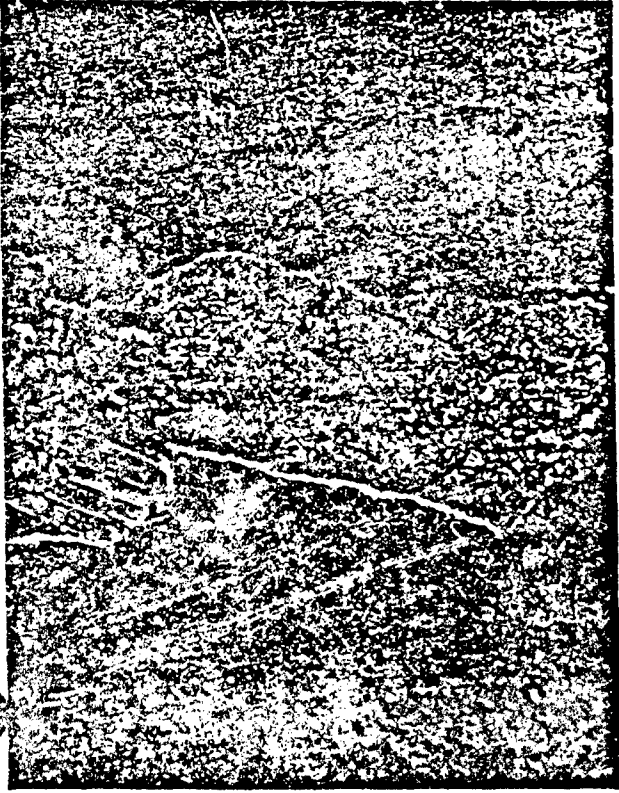


Enclosure (1)

C46



Enclosure (1)



6X

8



6X

9



10

4x

Enclosure (1)

MCV RSC R TIME RADAY
02547 0903 319/89

0010111012013014015016017018019020210220230240250260270280290303103203303403503603703803904041042043044045046047048049050051052053054055056057058059060061062063064065066067068069070071072073074075076077078079080081082083084085086087088089090091092093094095096097098099100
ACTION: _____
INFO: _____

RTTUZYUW RUC0SGG3473 319089-0000--RUE0FSA.
ZNR 00000

FM FTROH ONE ZERO THREE
TO RUC0SAA/COMNAVAVIRSYSOM WASHINGTON DC
INFO RUC0SAA/COMNAVAVIRLANT NORFOLK VA
RUC0EDA/LANTACVINGLANT OCEANA VA
RUC0EDA/COMFITWING ONE OCEANA VA
RHFJSKA/COMCARAIBLING SEVENTEEN
RUC0FSA/NAVAVIRDEVCEN WASHINGTON DC

UNCLAS //M13400// CNAL FOR CODE 528, NAVAVIRDEVCEN FOR CODE 6042
SUUJ: F-14 UNICOAT PAINT QUARTERLY REPORT
A. COMNAVAVIRSYSOM WASHINGTON DC 311707Z OCT 89
1. IAW REF A, FOLLOWING INFO PROVIDED ON UNICOAT PAINT SYSTEM FOR
UUMO 161430.
2. PRESENT EVALUATION SHOWS PAINT IS MAINTAINING ADHESIVENESS WELL.
IT SHOWS EXTREMELY GOOD WEAR IN AREAS WHERE FLUIDS ARE A CONTINUAL
PROBLEM. RESIDUES SEEM TO CLEAN OFF BETTER THAN ON OLD PAINT SYSTEM.
PAINT DOES NOT SHOW ANY SIGNS OF FADING AS DOES OLD PAINT SYSTEM.
THE UNICOAT SEEMS TO BLEND A LITTLE BETTER WITH OUR TOUCH-UP PAINT,
BUT STILL DOES NOT MATCH EXACTLY. THE OVERALL RESULTS OF THIS PAINT

PAGE 02 RUC0SGG3473 UNCLAS
SO FAR ARE VERY GOOD. SUMMARY OF PAINT SYSTEM AS FOLLOWS:
A) GOOD ADHESION
B) EASIER TO CLEAN
C) VERY LITTLE CHIPPING
D) VERY LITTLE FADING
E) FAIRLY GOOD BLEND WITH TOUCH-UP PAINT SYSTEM
3. POC THIS CMD, LT W. A. MALONEY, NMCC, AV/COM 433-5844
BT
83473 NMMH

PLACED IN FILE	INDEXED
FILED	FILED
FILED	FILED
FILED	FILED
FILED	FILED
FILED	FILED
FILED	FILED
FILED	FILED

15 NOV 1989

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian VF 103 Aircraft, BUN 161430 Date 11 SEP 89

Acft Flt Hrs: 16.4

Type Service () Ship Based () Shore Based (X)
AIRCRAFT WILL BE SHIP BASED IN FUTURE.

Performance Data	EX	GOOD	FAIR	POOR
Adhesion	()	()	()	(X)
Ease of Repair	()	()	(X)	()

Are there additional areas you wish included or deleted from this study?:

Additional Comments: *ADHESION POOR IN BILLY AREA DUE TO FOREIGN FLUIDS BETWEEN PRINT AND SURFACE (COOLANT). OTHER AREAS SEEM TO BE PERFORMING WELL. REPAIR WILL REQUIRE REMOVAL OF LARGE AREAS OF PRINT.*

Prepared by: AMMC (RW) J KUEBERGER Send to:

NAVAIRDEVGEN
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-88
Norfolk, VA 23511
ATTN: Code 36300

SELF-PRIMING TOPCOAT
EVALUATION REPORT

101

Custodian US-211 Aircraft BUN 161601 Date

Acft Flt Hrs: 109.4

Type Service () Ship Based () Shore Based (X)

General Appearance Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair: NONE

Type of repair required (Light, Touch-up, Corrosion removal, etc)
Light % work

Ease of Repair: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Overall Effectiveness: Excellent (X) Good ()

Fair () Poor ()

Additional Comments: complete % cycle Alk paint is holding up. Excellent -

Prepared by: James W. Brown
NAESR. D. Thir 2 AMM

Send to:

NAVAIRDEVCEM
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-00
Norfolk, VA 23511

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian VF-211 Aircraft BUN 161601 Date

Acft Flt Hrs: 109.4

Type Service () Ship Based () Shore Based ()

General Appearance Satisfactory () Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair: None

Type of repair required (Light, Touch-up, Corrosion removal, etc)
Light Corrosion control

Ease of Repair: Satisfactory () Unsatisfactory ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat: Satisfactory () Unsatisfactory ()

If Unsatisfactory, Why?

Overall Effectiveness: Excellent () Good ()
Fair () Poor ()

Additional Comments:

Complete Corrosion Control

Prepared by: [Signature]
c/c BO

Send to:

NAVAIRDEVCEM
Warminster, PA 18071-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-00
Norfolk, VA 23511

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian VF-211 Aircraft BUN 161608¹⁰² Date

Acft Flt Hrs: 53.8

Type Service () Ship Based () Shore Based (X)

General Appearance Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair: NONE

Type of repair required (Light, Touch-up, Corrosion removal, etc)

Ease of Repair: Satisfactory (X) Unsatisfactory () NONE

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Overall Effectiveness: Excellent (X) Good ()

Fair () Poor ()

Additional Comments: No Problems with Finish this time
no to 211 cycle

Prepared by: J.P. [Signature]
C/O P.O.

Send to:

NAVAIRDEVCEM
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-00
Norfolk, VA 23511

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian VF-211 Aircraft BUN 161608 Date 102

Acft Flt Hrs: 53.8

Type Service () Ship Based () Shore Based (X)

General Appearance Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair: None

Type of repair required (Light, Touch-up, Corrosion removal, etc)

Ease of Repair: Satisfactory () Unsatisfactory ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Overall Effectiveness: Excellent (X) Good ()
Fair () Poor ()

Additional Comments: no problems with paint. Based on 2 samples.

Prepared by: James L. [Signature]
VPACSO Det. MIAAAS

Send to:
NAVAIRDEVCEM
Warminster, PA 18074-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-00
Norfolk, VA 23511

OPNAV B216/144A (Rev. 8-81)
D/N 0107 LF-062 2320

DEPARTMENT OF THE NAVY
Memorandum

DATE: 30 November 1989

FROM: James W. Brown, Corrosion Specialist, NAESU Det Miramar

TO: Jim Thompson, Code 5304-B

SUBJ: F-14 UNICOAT (SELF-PRIMING TOPCOAT)

1. Here at NAS Miramar we have two aircraft attached to VF-211, Bureau numbers 161601 and 161608. As of this writing and speaking to AMS-1 Brenner, shop supervisor of work center 12C. His thoughts are that these two aircraft were smoother and easy to clean than the conventionally painted aircraft. So far there hasn't been any chipping of the paint other than normal wear and tear. Very little corrosion control has been performed on these two aircraft.

2. From my viewpoint both aircraft paint systems were in excellent condition and well intact. Would like to see more aircraft with this paint system in the future. This is an excellent way to save man hours, no more mixing primer and painting, having to wait for primer to dry, before top coat can be applied.


JAMES W. BROWN

NAVAL AIR DEVELOPMENT CENTER

29 JAN 90

TRIP REPORT

Prepared By

Stephen J. Spadafera (Code 6062)

(A/V) or (215) 441-2704

- SUBJ: (A) AEROSPACE CHROME ELIMINATION (ACE) TEAM MEETING AT KOHR IND., RIVERSIDE, CA, 23-24 JAN 90.
- (B) NADC LOW IR PROGRAM MEETING AT NORTHROP CORP., PICO RIVERA, CA, 25 JAN 90.
- (C) NON-CHROME PRETREATMENT EVALUATION MEETING AT GENERAL DYNAMICS-CONVAIR DIVISION, SAN DIEGO, CA, 26 JAN 90.
- (D) UNICOAT EVALUATION ON TWO F-14'S AT NAS MIRAMAR, SAN DIEGO, CA, 25 JAN 90.
- REF: (1) NADC REPORT #87016-80, "DEVELOPMENT OF A PRIMER/TOPCOAT AND FLEXIBLE PRIMER FOR ALUMINUM," CHARLES HEGEDUS, 20 MAR 87.
- (2) NADEP, NORFOLK, MELR NR. H-1631 "UNICOAT", APPLICATION OF, WALT MEHAFFEY (CODE 36300), 18 AUG 89.
- (3) NADEP ENGINEERING REPORT ON APPLICATION OF UNICOAT AT NADEP, NORFOLK, ANTHONY ENG AND DONALD HIRST (CODE 6062), 10 AUG 89.
- (4) MEMORANDUM FROM JIM BROWN, CORROSION SPECIALIST, NAESU DET, MIRAMAR TO JIM THOMPSON, NAVAIR CODE 5304-D, "UNICOAT EVALUATION ON F-14 A/C," 30 NOV 89.
- (5) AMERICAN SOCIETY FOR TESTING AND MATERIALS TEST METHOD #D-3359-72, STANDARD METHOD FOR MEASURING ADHESION BY TAPE TEST, METHOD A.
- ENCL: (1) AEROSPACE CHROME ELIMINATION PROGRAM AGENDA
- (2) HIGHLIGHTS OF PROGRAM PROGRESS BRIEFS
- (3) SURFACE TOPOGRAPHY CHART OF CLEAN CONVERSION COATING
- (4) SURFACE TOPOGRAPHY CHART OF CONTAMINATED SURFACE COATING
- (5) PICTURE OF GENERAL DYNAMIC'S HVLP SPRAY GUN

(D) UNICOAT EVALUATION ON F-14 AIRCRAFT AT NAS MIRAMAR

1. On January 26, 1990, I visited Jim Brown (Corrosion Control Specialist) NAESU Det Miramar and Chief Thornton (Wing Active Duty Corrosion Chief) at NAS Miramar, San Diego, CA to evaluate the coating systems on two F-14 aircraft stationed with the VF-211 Squadron. These F-14s, BU #'s 161601 and 161608, were painted with Unicoat (Ref. (1)) at NADEP Norfolk in June and July 1989, respectively. Reference (2) describes a potential problem with the batch of Unicoat used on aircraft BU# 161608. Walt Mehaffey (NADEP Norfolk) noted that the coating had a short pot life, about 1/2 hour, and also cited a cellular structure in the cured finishing system on the A/C. Therefore, he questioned the performance of the finishing system on this aircraft.

2. References (3) and (4) were issued in response to the situation identified in Ref (2), showing no decrease in performance of the subject coating system. In addition, the evaluation reports from the VF-211 squadron state that little to no corrosion problems have been noted on either F-14. However, NAVAIR AIR-5304 requested that an adhesion test be performed on the suspect coating system. Therefore, the squadron prepared one small area on each A/C on Thursday, 25 Jan 90, by applying a wet sponge (approximately 3' x 3') to the top center surface of the port wing about six feet in from the end. Then, on Friday, 26 Jan 90, I performed a wet tape test on both aircraft in accordance with Ref. (5). No coating removal occurred during the test on the 161601 A/C. On the 161608 A/C, there was coating removal up to 1/4 inch away from the scribe lines. However, there was no blistering or softening of the coating in the surrounding area.

3. Although there was some coating removal in this one spot test, the maintenance reports indicate that overall, the material is still performing well. Furthermore, when scanning both the F-14s, there were no obvious areas of corrosion maintenance or touch-up on either aircraft. Finally, during visual examination, I noted that the substrate where the coating was removed did not display the usual iridescence from the standard chromate conversion coating pretreatment. The absence of a conversion coating could lead to a loss of adhesion of the finishing system.

4. I have requested the latest maintenance data on this aircraft from Jim Brown. I would recommend that this maintenance data be examined in comparison to other aircraft with the standard paint system to determine if there is an excessive number of corrosion maintenance actions for this aircraft. Also, I would recommend that additional wet tape tests be performed on other surface areas of the F-14, before any decision is made regarding the fate of the coating system on this aircraft.


Stephen J. Spadatoro

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian J.F. 211 Aircraft: BUN 161601-451 Date 1-30-90

Acft Flt Hrs: _____

Type Service () Ship Based () Shore Based (X)

General Appearance Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair:

Type of repair required (Light, Touch-up, Corrosion removal, etc)

Light Touch-up + Corrosion Removal

Ease of Repair: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat:

Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Overall Effectiveness:

Excellent (X) Good ()

Fair () Poor ()

Additional Comments:

THIS SELF PRIMING ELASTOMERIC TOPCOAT SYSTEM SEEMS TO BE THE CORROSION CONTROL WORK CENTER'S DREAM. I LOOK FORWARD TO BE ABLE TO ADD UNICOAT TO OUR PAINT SYSTEM.

Prepared by: [Signature]
AV 577 4041

Send to:

NAVAIRDEVGEN
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6082

Naval Aviation Depot
Naval Air Station, Bldg V-08
Norfolk, VA 23511

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian VF-211 Aircraft BUN 161601-101 Date 1-29-90

Acft Flt Hrs: _____

Type Service () Ship Based () Shore Based ()

General Appearance Satisfactory Unsatisfactory
(X) ()

If Unsatisfactory, Why?

Area on Aircraft needing repair:

Type of repair required (Light, Touch-up, Corrosion removal, etc)
Light touch PCR

Ease of Repair: Satisfactory Unsatisfactory
(X) ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat: Satisfactory Unsatisfactory
(X) ()

If Unsatisfactory, Why?

Overall Effectiveness: Excellent Good
(X) ()
Fair Poor
() ()

Additional Comments:

Prepared by: Paul Williams Send to:
AU 577-1363

NAVAIRDEVCON
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 8082

Naval Aviation Depot
Naval Air Station, Bldg V-08
Norfolk, VA 23511

SELF-PRIMING TOPCOAT
EVALUATION REPORT

Custodian VF211 Aircraft BUN 161603-102 Date 1-29-90

Acft Flt Hrs: _____

Type Service () Ship Based () Shore Based (X)

General Appearance Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair: Port Wing upper surface failed tape test

Type of repair required (Light, Touch-up, Corrosion removal, etc)

Light Touch-up + CR

Ease of Repair: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat: Satisfactory ()

~~Unsatisfactory~~ See above

If Unsatisfactory, Why?

Overall Effectiveness: Excellent () ~~Good~~

Fair () Poor ()

Additional Comments:

Prepared by: Blennerhassett
AV. 577-1363

Send to:
NAVAIRDEVCEM
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6082

Naval Aviation Depot
Naval Air Station, Bldg V-08
Norfolk, VA 23511

**SELF-PRIMING TOPCOAT
EVALUATION REPORT**

Custodian VF-211 Aircraft BUN 161608-102 Date 1-30-90

Acft Flt Hrs: _____

Type Service () Ship Based () Shore Based (X)

General Appearance Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Area on Aircraft needing repair: Port - Upper Wing Failed TAPE TEST
1-26-90

Type of repair required (Light, Touch-up, Corrosion removal, etc)
Light Touch-up - Corrosion Removal

Ease of Repair: Satisfactory (X) Unsatisfactory ()

If Unsatisfactory, Why?

Adhesion of Self-priming Topcoat:

Satisfactory ()

Unsatisfactory

(X) Failed TAPE TEST - 1-26-90

If Unsatisfactory, Why?

Overall Effectiveness:

Excellent (X)

Good ()

Fair ()

Poor ()

Additional Comments:

THIS SELF PRIMING ELASTOMERIC TOPCOAT SYSTEM SEEMS TO BE THE CORROSION CONTROL WORK CENTER'S DREAM. I LOOK FORWARD TO BE ABLE TO ADD UNICOAT TO OUR PAINT SYSTEM.

Prepared by:

James W. Brown
NAESU Det Miramar
DU 577-4097

Send to:

NAVAIRDEVCON
Warminster, PA 18974-5000
Aero Materials Division
ATTN: Code 6062

Naval Aviation Depot
Naval Air Station, Bldg V-88
Norfolk, VA 23511

TRIP REPORT

Date of Report: 12 Feb 90

Reported by: Charles R. Hegedus (NADC, Code 6062, 215-441-1452, AV 441-1452)
Donald J. Hirst (NADC, Code 6062, 215-441-1473, AV 441-1473)

Facilities Visited:

NADEP North Island	Mark Kogel	26 Feb 90
NAS Miramar	VF-211, F-14 squadron	27 Feb 90
Rockwell	John Friday Mike Garaby	28 Feb 90
NADEP Alameda	Norm Amdur Connie Huffman	1 Mar 90

Purpose: Discuss UNICOAT's properties and application to additional fleet aircraft. Inspect two F-14's with UNICOAT at NAS Miramar. Perform UNICOAT spray application demonstrations at NADEP Alameda and Rockwell.

Discussion: On 26 Feb, we met with Mark Kogel of the Materials Engineering Division at NADEP North Island. We gave him a brief background and status report on UNICOAT and its performance on fleet aircraft. One of our primary objectives at this time is to paint an F-18 with UNICOAT at North Island. This objective is being fully supported by McDonnell Douglas since they are also interested in using the material. Mark said that he is also interested in this objective and that he would pursue approval of such an application. I have provided him with a contact at NAVAIR that may be able to expedite this issue (Maj. Randy Brickell). He informed us that they are currently using plural component application systems, but that they plan to go to high volume, low pressure (HVLP) equipment in 1991. This is being driven by the expectation of future regulations which will limit the transfer efficiency of paint spray equipment. He also informed us that he expects the use of chromates to be restricted in the near future.

Two F-14's painted with UNICOAT are deployed in VF-211 at NAS Miramar. (BUNOS 161601 and 161608). They were painted at NADEP Norfolk in June and July of 1989, respectively. At that time, there was a suspicion by NADEP personnel that the UNICOAT on the second aircraft, 161608, may be deficient due to a short pot life of the coating at that time. On 27 Feb, we visited NAS Miramar to inspect these two aircraft. We performed 4 dry tape adhesion tests over various sections on each aircraft, all indicating adequate adhesion. Although this test is usually performed after 24 hour exposure to water, this was impossible to perform since the aircraft are on constant flight status. In addition to the tape tests, the aircraft were thoroughly inspected both visually and with a 30X magnifying scope. Both aircraft were in excellent condition. One major observation was that there was minimal (less than usual) cracking of the paint around fasteners. Cracking usually leads to chipping and exposure of base metal. If there was an adhesion problem, it would certainly show around fastener patterns. We also interviewed several maintenance personnel, all of which stated that the

coating system was doing well, being more cleanable and requiring less maintenance than most aircraft. Therefore, based on this data, we feel that the UNICOAT on both aircraft is performing as well as expected and will continue to do so.

Rockwell is planning to paint the second X-31 with gloss white UNICOAT at its Palmdale, CA division. The aircraft is currently in production and painting is planned for April 1990. We visited the painting facilities to brief their personnel on UNICOAT's application and performance properties, and to witness a spray application of UNICOAT onto a test specimen. This facility uses conventional pressure pot application equipment and typical military aircraft epoxy primers (MIL-P-23377) and polyurethane topcoats (MIL-C-83286). UNICOAT would provide them with the opportunity to reduce volatile organic compound and chromate emissions. One of the production painters prepared and sprayed a 2 foot by 3 foot vertical test specimen with a gloss white UNICOAT. Two coats covered the specimen well. The painter purposely attempted to apply an excessive amount of material to one section of the specimen to determine the flow characteristics. To his satisfaction, the coating resisted running and sagging even at a high film build. In summary, they were pleased with UNICOAT's performance and are anxious to apply it to the next X-31.

On 2 March, we visited NADEP Alameda to observe a field application of UNICOAT with plural component, air assisted airless, electrostatic spray equipment. Personnel performing the test were Connie Huffman of the Materials Engineering Division, Rob Nixon of the Production Paint Shop, and Dennis Kerfeld of Graco, Inc. The major objective of this demonstration was to verify UNICOAT's ability to be applied with this state-of-the-art equipment. Plural component equipment proportions, meters, and blends the paint automatically during the application process. This avoids mixing excessive material which must be discarded. Air assisted airless with electrostatic has a paint transfer efficiency of 60% as opposed to 20% for conventional spray. Thus, this equipment significantly reduces waste. UNICOAT was applied to a wing drop cell approximately 6 feet long and 1.5 feet in diameter. The coating was applied to a wet film thickness of 4 mils (0.004 inches), resulting in a dry film thickness of approximately 2 mils. The coating displayed adequate electrostatic properties by wrapping around the cell and minimizing overspray. Both NADEP Alameda and Graco personnel were pleased with the application performance; however, the coating did not cure to a hard finish. Since a sample which was mixed by hand did cure properly to a hard finish, it is suspected that the improper cure was due to the application equipment. Either the mix ratio was not correct, or the mixing action was not adequate. Dennis Kerfeld said that he would investigate this issue along with personnel in the Graco Laboratory. Connie Huffman, Norm Amdur, and Rob Nixon said that they are anxious to paint an aircraft with UNICOAT using this application equipment when this problem is solved.

C. Hegdus
Donald Hirst

H-3 FIELD EVALUATION

D2



ROUTINE

TIME *GM* RADAY 248/87
 1020
 00107110120130140150160170180181102103104104310921074182183184101121051

6062

UZYUW RUCOSGG4521 2461235-UUUU--RUEOFSA.

.R UUUUU

0310232 SEP 87

~~NAVY DEPOT PENSACOLA FL~~
~~0 RUEOFSA/NAVAIRDEVCON WARMINSTER PA~~
~~HF RUCOSAA/COMNAVAIRLANT NORFOLK VA~~
~~UMFAAA/COMNAVAIRPAC SAN DIEGO CA~~

T NCLAS //N10365//

UBJ: SELF-PRIMING POLYURETHANE COATING

THIS DEPOT IS VERY MUCH INTERESTED IN EVALUATING THE SELF-PRIMING POLYURETHANE COATING. POTENTIALLY, THIS COATING MAY REDUCE PROCESSING TIME AS WELL AS REDUCE MAINTENANCE DUE TO CORROSION. REQUEST NAVAIRDEVCON SUPPLY THIS DEPOT WITH MATERIAL AND APPLICATION INSTRUCTIONS FOR THE SUBJECT COATING. WITH APPROVAL OF COMNAVAIRPAC AND COMNAVAIRLANT, THIS DEPOT WILL FINISH TWO SH-3H'S WITH THIS COATING AND EVALUATE ITS PERFORMANCE IN SERVICE.

10 GALLONS OF COLOR NO. 36320, 8 GALLONS OF COLOR NO. 35237, AND 8 GALLONS OF 36495 ARE REQUIRED TO FINISH A SINGLE AIRCRAFT.

POC ON THIS SUBJECT IS K. N. SANDERS, CODE 34200, AV 922-3553

T 4521

401	00014
402	0001
403	
404	
405	
406	
407	
408	
409	

NNN

08 SEP 1987

60-861





RCV MSG # TIME RADAY *R* ROUTINE
 07069 1411 259/87
 00107110120130140150160170180191102103104104310921074182183184101121051
 ACTION: *X*
 INFO: *X*

RTTUZYUM RUEOFSASD31 2591314-UUUU--RUEOFSAS.
 ZHR UUUUU
 R 161314Z SEP 87 ZYB
 FM NAVAIRDEVCEM WARMINSTER PA
 TO NAVAIRVDEPOT PENSACOLA FL
 INFO COMNAVAIRLANT NORFOLK VA
 COMNAVAIRPAC SAN DIEGO CA
 COMNAVAIRSYSOP WASHINGTON DC
 BT

UNCLAS //NID365//
 SUBJ: SELF-PRIMING POLYURETHANE COATING
 A. NAVAIRVDEPOT PENSACOLA 031823Z SEP 87
 1. REF A REQUESTED 52 GALLONS OF THE SELF-PRIMING TOPCOAT DEVELOPED
 AT THIS CENTER. THE COATING IS TO BE APPLIED TO TWO SH-3H'S FOR
 IN-SERVICE TESTING. WE ARE EXTREMELY INTERESTED IN FIELD
 TESTING OF THIS COATING AND WILL PROVIDE THE REQUESTED MATERIAL
 2. POC ON THIS SUBJ IS C. R. NEGEDUS, CODE 6062, AV 441-1452.
 BT
 05031

	<input type="checkbox"/> Action	<input type="checkbox"/> Log	<input checked="" type="checkbox"/> Info
401			4001A
500			4003
600			DF
604			
605			MF
606	<input checked="" type="checkbox"/>		
608			FU

NNNN

16 SEP 1987



TRIP REPORT

4/18/88

NADEP Pensacola message 091314Z of Oct 86 requested that NADC provide Self-Priming topcoat for application to three H-3 helicopters for field evaluation. 75 gallons of the material were subsequently manufactured by Koppers Chemical, Newark, NJ and shipped to NADEP Pens. On 12 - 15 April, C. Hegedus and D. Hirst visited NADEP Pensacola to witness the application of this coating to one H-3. On 13 April, we attended a 30 minute meeting with shop painters to describe the coating development, mixing - application procedures and properties. The shop personnel showed much interest and enthusiasm and indicated that this material would be welcome for its potential production time reduction while minimizing health hazards. (There are no lead or chromate pigments and the volatile solvent emissions is lower than the standard paint system.)

The H-3 was inspected prior to painting and it was found that this aircraft was a special assembly with various types of surfaces, including anodized and chromate conversion coated aluminum, previously primed surfaces, topcoated aluminum, and composites. All of the areas were clean and ready for paint except one door which was topcoated with a gloss white urethane. This area was scuff sanded to roughen the surface and enhance adhesion of the Self-Priming Topcoat. The aircraft had numerous raised rivets over the entire exterior surface, posing a potential problems of running or sagging of the topcoat if applied too heavy.

The aircraft was painted in the Navy multi-theater tactical camouflage scheme consisting of three shades of flat gray: 35237 on the top, 36320 on the sides, and 36495 on the bottom. During application of the coating onto the aircraft, several sections were "double coated" several minutes after the first coat was applied. Other sections were given a first coat and a second coat was applied 30 to 45 minutes later. Both methods were successful. However, if possible during painting, it is suggested that 2 full coats be applied allowing 15 to 60 minutes between coats. With this procedure, the desired coating thickness, 2 mils, can be obtained. The painters at Pensacola adapted to the Self-Priming Topcoat quickly and application was excellent. One area had several slight sags around the raised rivet heads due to a heavy "double coat" without allowing adequate time for solvent to flash off. Upon curing, these sags leveled out and were not discernible. During application, fluid seepage from the aircraft occurred twice. In one case, water was blown out of a cavity. This area was gently wiped and overcoated. In the second case, hydraulic fluid leaked out from seam during application. The area was wiped just prior to painting. After application, the fluid continued to flow but the coating remained intact and appeared to have good adhesion. While painting the aircraft, several "retain" panels were painted to evaluate the coating. One of these was bare aluminum with no conversion coating, which had only been cleaned and deoxidized. NADEP Pens is expecting that use of conversion coating will be prohibited and one proposed solution is to use the Self-Priming Topcoat. This panel will be used to evaluate the coating in a non-chromated finishing system.

The batch of paint used at Pensacola had a relatively short pot-life, 2 hours. Normally 6 hours is desired in order to give the painters adequate time to mix, apply, and clean-up, with extra time in case unexpected problems arise. During application of the 36320 color to the sides of the H-3, approximately 90 minutes after mixing, this batch of paint became viscous and application became difficult. We informed NADEP personnel that a solution is being studied and may

be available for the next aircraft to be painted. The coating was set-to-touch in approximately 45 minutes and it is expected that the solution to increasing pot life will not effect drying time.

The morning after application, K. Sanders of the Materials Lab at Pens. measured the Self-Priming Topcoat thickness to be approximately 2 mils and the 60° gloss to be 3-4, as desired. Stencil markings were applied using MIL-C-83286 polyurethane topcoat, although the Primer/Topcoat could have been used. Photos were taken of the entire process and will be available. An evaluation form will be attached to the aircraft log book for evaluation by fleet maintenance personnel. Copies of completed forms will be sent to NADEP Pens. and NADC.

Plans at NADEP Pens. are to paint 2 more H-3s. One of these will not be conversion coated if tests indicate the coating will provide sufficient protection against corrosion. One A-4 may be painted. A request was made that we provide samples of gloss white Self-Priming Topcoat (NADEP Norfolk has made the same request.)

Since application of the Self-Priming Topcoat has gone well on the F-14 and H-3 and the coating has performed well on the F-14 after two months in the field, we suggest more aircraft be painted with this coating, especially production models of the F-14 and F-18.

Charles R. Hegedus Donald J. King

TEMPORARY ENGINEERING INSTRUCTION

TEI

MOD A/C ETC. SH-3H	BUREAU/SEQUENCE NO. 148980 / P301	SUBJECT/NOMENCLATURE LOGBOOK ENTRY	
MANU. & PART #	QTY. AVAIL. TO SHOP	PUBLICATION #	DATE
ITEM UNIT COST		ESTIMATED MANHOURS REQUIRED/UNIT	

PROBLEM AND PROPOSED SOLUTION/REQUEST

THIS TEI IS ORIGINATED BY THE MATERIALS ENGINEERING DIVISION.

TEMPORARY ENGINEERING INSTRUCTION: CODE: 34000

Ref: (a) TEI 5230-88

Encl: (1) SELF-PRIMING TOPCOAT EVALUATION REPORT

1. As the result of excellent support from all hands in production, production control, quality assurance, and planning, the painting of P301 went well. Many thanks to all personnel. The engineers from NAUC appreciated your support and the enthusiastic work and questions by Shop 95120 painters.
2. P301 received a high quality finish. The dry and wet tape tests for adhesion were satisfactory. The paint is holding up well under the constant contact with hydraulic fluid.
3. As stated in ref (a), a logbook entry is required for the subject aircraft. Request EYE Code 54300 make the following logbook entry and attach encl (1):

SH-3H, Bureau No. 148900

Seq. No. P301

The NAVAIRDEVCON, Code 6062, Warminster PA, and NAVAVNDEPOT Pensacola FL, Materials Engineering Division, Code 34200 are evaluating a new aircraft coating. The NAVAIRDEVCON developed the Self-Priming Elastomeric Topcoat as a single polyurethane coating system comparable in performance with the epoxy/polyurethane currently used on the SH-3; while providing the same corrosion protection, it is more flexible and washable. This coating should reduce the maintenance effort for this aircraft. The self-priming topcoat is compatible with existing coating systems cited in NAVAIR 01-10-307 repairs.

Attached is a form for evaluating coating performance on the subject aircraft. Please submit an evaluation upon receipt of the aircraft and on three month intervals. Send evaluations to NAVAIRDEVCON and a copy to

NAVAVNDPOT, Pensacola.

SHOP # 34200		BLDG. # 741		PHONE # 2-9346	
EXPIRES 3 MO. FROM ISSUE DATE 27 APRIL 1988		LES/LPS/ECN/MCR/SDLM		SPECIAL MAT. OR TOOLS	
ENG. TECH. (Signature) <i>Kenneth M. Sanders</i> K. M. SANDERS		DIV. DIR. (Signature) D. N. HAYES		DATE 4/27/88	SERIAL 5289-88
DISTRIBUTION: (SHOP OR DIVISION)					
40000	4	50000	4	68000	93000 4 94000
95000	4	96000	70000	OTHER	42000 95120
ORIGINATOR 34200 4				54340 31300 54330 page 2 of 2	

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT
SH-3H, 148980

Custodian _____ Date: _____

Aircraft Flight Hours _____

Service Period Type: Coastal Based () Ship Based () In-land Based ()

General Appearance: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Adhesion of Self-priming topcoat: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Type of repair required, if any: (corrosion removal, spot touch up,
sectionalized repair, etc.)

Area of aircraft requiring repair, if any:

Ease of repair: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent () Good () Fair () Poor ()

Comments:

Prepared By: _____

Send to : NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Material Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

Encl: (1)

QUARTERLY FEEDBACK REPORT

.....

FROM: I. L. VILLALVA , CORROSION/MATERIALS SPECIALIST,
NAESU DET CECIL FIELD, NAS CECIL FIELD, FL 32215

TO: CHARLES HEDEGUS, CODE 6662, NADC WARMINSTER, PA

SUBJ: SELF- PRIMING ELASTOMERIC TOPCOAT SYSTEM

REF: NADC RPT. NO. 87816-68

Discussion Brief:

In compliance with NADC's Evaluation Report form for Reference material, these are the field monitoring's findings:

After our phonecon in early July, I went to HS-1 & HS-3 Maintenance Control offices to inquire about the aircraft (148080, 148049, 152134) with the new paint system I met with the following personnel from HS-1 to discuss the paint system and why I was making these inquiries ; Lt. Birch, the Maintenance Control Officer, ATCS Brun, the Quality Control Chief, and AMSI Wise, the Corrosion Work Center supervisor. I explained in more detail the paint system and what was expected from us in this evaluation.

The Corrosion Control Work Center supervisor and I looked at the aircraft, it looked great. I ask the Corrosion Control W/C supervisor when they would be doing their corrosion inspection and he said the following week. I informed him I would return later to see the results of the inspection.

I then went to HS-3 to inquire about the two aircraft in their custody, (148040 and 152134). I met with AZC Bailey, Maintenance Control, and I was informed that the squadron was deployed for a short period, they would return and leave again for approximately six to eight weeks. Chief Bailey also mention that the aircraft I wanted to see could very likely be on the ship.

Aircraft (140049) was in the hanger, but (152134) was on the ship. I looked at the one in the hanger and it was in excellent condition and it too was scheduled for a 28 day Corrosion inspection.

After a week's lapse, I return to look at the results of the inspections and look for myself at any action that the squadrons may have taken. Minor touch-up was done and the paint system was in excellent condition and well intact. Copies of the discrepancy sheets with corrective action were forwarded on to NADC as I have done with all subsequent inspections.

The two aircraft in HS-3's custody have now been out at sea for most of the past three months. The best test was probably the trip around Cape Horn and the mild storm they ran into!

HS-1's aircraft has not been deployed on a ship, but has made some low level flights over the ocean.

The paint and over all cosmetic appearance of the aircraft remain in excellent condition. HS-3's aircraft has had the most touch-ups included the one with the same new paint system. Had a little problem with the paints not matching, but after exposing an area under a fairing cover, both the touch-up and the solar protected paint color matched (very interesting).

As a matter of interest, the areas where the fuel hoses and blade cover stow lines (rope) make contact with the aircraft surfaces, were those touched up.

This Self-Priming Elastomeric Topcoat System seems to be the greatest thing coming down the pipe line since -81309, AMLOUARD, etc. The corrosion technicians (HS-3) said, 'the mixing and spraying only one paint is really the way to go!' And I concur, especially, in the fleet, where aircraft are such a great asset in the 'UP' status and this new paint system cuts the 'DOWN' time!!

Signature

Samuel W. Wiltschko

Date of Report

14 NOV 1988

Copy to:

6 APR 89

NAVAL AIR DEVELOPMENT CENTER

TRIP REPORT

SUBJECT: INSPECTION OF UNICOAT PAINTED H-3 HELICOPTERS

LOCATION: NADEP, Jacksonville, NAS, Jacksonville, FL

PREPARED BY: Stephen J. Spadafora and Anthony T. Eng (Code 6062)

ENCLOSURE: 1) Attendees List.

Around April of 1988, three H-3 helicopters were painted at NADEP Pensacola with an experimental coating (Unicoat - Self-Priming Topcoat) developed at the Naval Air Development Center. Two of these aircraft were assigned to HS-3 (Bureau Nos. 148049 and 152134) and the third was assigned to HS-1 (Bureau No. 148980). In addition, one of the two aircraft assigned to HS-3 (Bureau No. 148049) was not chromate conversion coated prior to paint application. In order to determine the effectiveness of the new coating system, an inspection team was assembled at NADEP, Jacksonville to assess the condition of these aircraft. The members of this team are listed in enclosure (1).

On 5 April 1989, the team met at NADEP, Jacksonville to discuss the coating service evaluation program and to inspect the three aircraft. The meeting began with an overview of NAVAIRDEVCCEN's Unicoat and Non-chromate conversion coating programs. Following these overviews, an explanation of the field service evaluation of the Unicoat painted H-3's was given by both Ken Sanders and Steve Spadafora.

After the initial meeting, the group proceeded to HS-3 to inspect the aircraft. However, the two aircraft which have been sea deployed were in ordnance and could not be evaluated up close. Arrangements were made to return the next day to carry out the inspection. Unfortunately, due to travel constraints, Tony Eng and Steve Spadafora from NADC could not stay over the extra day for the inspection. Therefore, the results from the inspection will be presented in reports from NADEP, Pensacola and NADEP, Jacksonville. In addition, the group investigated the H-3 helicopters in the squadron that is applying MIL-C-81309 to the aircraft to improve their appearance. Morris Reeves NADEP Pensacola was also there to evaluate these aircraft. Although the helicopters appeared to be much cleaner than those of other squadrons, they also looked very glossy. Ken Clark (NADC) will be evaluating these aircraft next week and a detailed report can be obtained from him. Finally, the one helicopter that is stationed at NADEP Jacksonville (non-sea duty) was examined. This aircraft had numerous touch-up areas, however most of these areas appeared to be the result of mechanical damage (rivets in these areas were worn flat).



NADEP Jacksonville

4 APR 89

Attendees List

NAME	FACILITY / CODE	PHONE #
1) Stephen Spadafora	NAVAIRDEVGEN / 8082	(215) 441-2704 (A/V) 441-2704
2) Anthony T. Eng	NAVAIRDEVGEN / 8082	(215) 441-3289 (A/V) 441-3289
3) Ken Sanders	NADEP, Pensacola / 342	(904) 452-3553 (A/V) 922-3553
4) Everlene Johnson	NADEP, Jacksonville / 342	(904) 772-4518 (A/V) 942-4518
5) Ralph Wheat	NADEP, Jacksonville / 342	(904) 772-4518 (A/V) 942-4518
6) Michael Linn	PSD, Jacksonville / 343	(904) 772-4519 (A/V) 942-4519
7) Patty Betzig	PSD, Jacksonville / 343	(904) 772-4519 (A/V) 942-4519
8) Luis Carney	PSD, Jacksonville / 343	(904) 772-4519 (A/V) 942-4519

ENCL. (1)

REPORT OF TRIP TO: HELANTISUBRON ONE, HELANTISUBRON THREE, HELANTISUBRON FIVE,
N.A.S JACKSONVILLE FL

DATE OF TRIP: 4 APRIL - 6 APRIL 1989
MADE BY: Kenneth M. Sanders, PSD Code 34200

PURPOSE OF TRIP: To evaluate the performance of Unicoat Polyurethane Coating of H-3 aircraft finished in spring of 1988

Ref: (a) Naval Air Development Center ITR 4123 Ser 6062/010242 of 16 Dec 1988
(b) Naval Air Development Center Trip Report to N.A.S. Oceana of 23 Feb 1989
(c) MCAIR Trip Report to N.A.S. Oceana of 23 Feb 1989
(d) Naval Air Development Center Trip Report to NAVAIRSYSCOM of 31 March 1989

Encl: (1) List of Attendees

1. BACKGROUND: SH-3H's BUNOS 148980, 152134, and 148049 were finished in the tactical paint scheme using NADC's polyurethane coating formulation, now dubbed "Unicoat", in colors 35237, 36320, and 36495. The material was provided by NADC for field test on rotary wing aircraft.

1.1 In April 1988 SH-3H, 148980, was the first rotary wing aircraft finished with Unicoat. This initiating process was overseen by NADC's engineers, Charles Hegedus, and Donald Hirst. The only significant problem encountered with the finishing process was the short 2 hour potlife. Before the second coat could be applied, the material had become quite viscous. Bunos 152134 and 148049 were subsequently coated using two pot batches. Film thickness measurements were made to verify adequate coverage. The thicknesses ranged between 1.5 to 3.0 mils. Gloss measurements were predominately 3%. NADC had determined that cleanability is best when the coating finish has a gloss of 4% or better.

1.2 The painters applying the new coating were very pleased with the application properties: hiding, wetting, and film leveling. The painter, who mixed the paint batches, found the mixing properties and the clean up satisfactory. Supervisory personnel found the elimination of the priming operation quite advantageous. The occupational advantages of the coating: no lead or chrome, low VOC's, and no priming step, were well received by all production personnel.

1.3 Aircraft 148049 was the last aircraft finished with Unicoat in June 1988. At this time, the industrial waste treatment plant on the naval air station no longer accepted chrome or cyanide salts for treatment. Following several salt fog studies of Unicoat, this Code saw Unicoat as an alternative to chemical conversion coating, "alodine". To test Unicoat's corrosion inhibiting capabilities, the Depot painted this aircraft after a phosphoric acid deoxidizing treatment and without alodine.

1.4 Aircraft 152134, and 148049 were assigned to HS-3 at N.A.S. Jacksonville. BUNO 148980 was assigned to HS-1 also at N.A.S. Jacksonville. Reports from these organizations have been intermittent and sketchy. The comments received were positive on the Unicoat performance.

1.5 References (a) and (b) reported good field evaluations of Unicoat applied to an F-14 by NADEP Norfolk. The evaluators reported no peeling, or other adhesion failures, and no negative change in the incidence of corrosion. Reference (c) reported evidence of macro and micro cracking.

Enclosure (2) page 1 of 3

1.6 The need for evaluations of the Unicoat finished H-3 aircraft was reported in references (a) and (d). This traveler desired to evaluate the subject aircraft so that the accumulated information would help the Depot and NAVAIR decide what action to take in the development of Unicoat.

2.0 The evaluation of the Unicoat finished aircraft began on the morning of April 5th, at the Materials Engineering Laboratory of NADEP Jacksonville, with a round table discussion of the developmental status of Unicoat. A list of attendees is provided in enclosure (1). Ish Villalva, Field Engineer, NAESU DET, Cecil Field was host for this evaluation. Anthony Eng and Steve Spadafora from NADC Code 6062 explained the problems attributed to Unicoat following the F-14 evaluation and passed out a draft of the Unicoat specification. NADEP engineers and NADC engineers discussed what pertinent information to collect when examining the Unicoat finished helicopters.

2.1 The evaluation group viewed two of the helicopters at the hangar of HS-3. BUNO 152134 was the second of the three aircraft finished with Unicoat, and 148049, the last, did not receive a chemical conversion coating prior to finishing. The aircraft were not cleaned; exhaust and petroleum products soiled the fuselage and cowlings. On comparison, the coating system on the aircraft looked as equally deteriorated as any other aircraft in the hangar.

2.1.1 BUNO 148049 was examined first. Several areas were repainted to obscure old markings, and for corrosion control. Unlike the F-14 aircraft, it had been overpainted frequently fore and aft. Most repairs were made in high traffic areas or areas subject to abrasion, i.e. the cargo door path, and tie down rings. Areas subject to corrosion, i.e. aft of the ice shield, were touched up and the corrosion arrested. Photographs were made to document these characteristics. Thickness measurements ranged from 1.5 to 3 mils in areas not having touch up, and 3-6 mils in areas having touch up. No seam to seam repainting had been attempted. Gloss measurements ranged from 3 to 5% depending upon the amount of residual oil on the measured area. Dry tape adhesion tests were performed on several overpainted areas and no lifting could be initiated. Though the epoxy topcoats did not match the color of the original paint well, touchup accomplished with Unicoat did match well.

2.1.2 BUNO 152134 was in a condition similar to 148049. There were no large areas of repainting, and touch up was generally confined along rivet lines. Corrosion did appear to be initiating around some rivets. Measurements for coating thickness and gloss were similar to 148049.

2.1.3 Discussion with the corrosion control team leader on the unimpressive condition of the aircraft resulted in a polite protest. He strongly held to the opinion that these aircraft required a fraction of the time his maintenance team expended on other aircraft. Ish Villalva seconded this opinion. HS-3 did not have any other aircraft undergoing SMLM coinciding with these.

2.2 HS-1 had the first H-3 painted with Unicoat, BUNO 148980. The paint scheme had the same appearance as HS-3's aircraft. Most noticeable were the areas on the fiberglass components which had overpainted repairs. As with HS-3 the HS-1 personnel believed that the Unicoat reduced their maintenance time. Differing from the HS-3 aircraft, HS-1 had begun coating the aircraft with corrosion preventative compound to help keep aircraft fluids from adhering to the aircraft surfaces. A neighboring squadron, HS-5, had consistently performed this practice, and their fleet had a "like new" appearance. Because 148980 had not been repainted prior to

application of the corrosion preventative compound, like HS-5's aircraft, the corrosion preventative compound did little to remove the soiling films already accumulated on the aircraft surface.

3. A comparison of the equipment condition data for the Unicoat finished aircraft, and all previous H-3 aircraft leaving SDLM in calendar year 1988, is as follows:

3.1 Unicoat finished aircraft:

BUNO	FLIGHT HOURS	SHIP TIME	TOTAL MMH	MMH/FLIGHT HRS**
148980 SH-3H	723 MAY 88-MAR 89	0	119	0.16
148049*SH-3H	428 JUN 88-MAR 89	268	176	0.41
152134 SH-3H	489 JUN 88-MAR 89	144	159	0.28

* No chemical conversion coating applied prior to application of Unicoat

** For comparison purposes

3.2 Previous five aircraft with standard coating system

BUNO	FLIGHT HOURS	SHIP TIME	TOTAL MMH	MMH/FLIGHT HOURS
148999 SH-3H	624 JAN 88-MAR 89	410	448	0.72
156499 SH-3D	398 JAN 88-MAR 89	70	9	0.02
148060 SH-3G	336 MAR 88-MAR 89	7	82	0.24
156499 SH-3D	118 APR 88-MAR 89	0	117	0.76
149006 SH-3H	409 MAY 88-MAR 89	275	271	0.66

4.0 To summarize, Unicoat did not have the clean and outstanding appearance one expected based on the F-14 evaluations, however based on the tests performed on the coating system during the field evaluation, the 3M data, and the opinions of the aircraft support personnel, Unicoat is performing well. This evaluator concludes the following:

4.1 The epoxy topcoat does adhere well to aged Unicoat and fleet personnel are satisfied with its paintability.

4.2 The squadrons are experiencing some reduction in manhours for corrosion control since the receipt of Unicoat finished aircraft. High traffic areas do not appear to resist wear any worse than the conventional coating system, and corrosion still attacks around rivet heads. No adhesion or corrosion problems were noted on steel members like the landing gear.

4.3 No macro cracking was identified anywhere. No micro cracking could be found around rivets using a 10X magnifying glass.

4.4 No case for greater cleanability could be made for Unicoat based on these aircraft. This Depot did not control the coating system gloss, continuing the cleanability problem the fleet experiences with conventionally finished aircraft.

5.0 Based on this evaluation, this evaluator recommends the Depot pursue an expanded use of the Unicoat system.

Kenneth M. Sanders

Enclosure (1)

Attendance Listing for: Unicoat Evaluation/ Chrome Elimination
at NADEP Jacksonville

Tony Eng	NADC	AV 441-3269
Steve Spadafora	NADC	215 441-2704
		AV 441-2704
Ken Sanders	NADEP Pensacola	904 452 3554
		AV 922-3553
Everlene Johnson	NADEP JAX/342	AV 942-4516
Ralph Wheat	NADEP JAX/342	AV 942-4516
Michael Linn	NADEP JAX/343	AV 942-4519
		904 772-4519
Patty Betzig	NADEP JAX/343	904 772-4519
Luis R. Carney	NADEP JAX/343	904 772-4519

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT
SH-311, 148780

Custodian HS-1 Date: 6/28/88 (2 wks)

Aircraft Flight Hours _____

Service Period Type: Coastal Based () Ship Based () In-Land Based ()

General Appearance: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Adhesion of Self-priming topcoat: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Type of repair required, if any: (corrosion removal, spot touch up, sectionalized repair, etc.) NONE

Area of aircraft requiring repair, if any: NONE

Ease of repair: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent () Good () Fair () Poor ()

Comments:

VERY GOOD (EXCELLENT) SHAPE

Prepared By: JSK

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Material Engineering Division
Code J4200, Bldg 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT

EVALUATION REPORT
SH-III, BUNO 148980Custodian 45-1 Date 7/27/88

Aircraft Flight Hours _____ 28 DAY INSP. (12)

Service Period Type: Coastal Based () Ship Based () In-Land Based ()General Appearance: Satisfactory () Unsatisfactory ()
If unsatisfactory, ... why?Adhesion of Self-priming topcoat: Satisfactory () Unsatisfactory ()Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.*SEE ATTACHED SHEETS*Area of aircraft requiring repair, if any: *ALL OVER !!*Ease of repair: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?*WOULD LIKE TO HAVE USED SAME TYPE PAINT.*Overall Effectiveness: Excellent () Good () Fair () Poor ()

Comments:

Prepared By: *Jeh*Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6862
Warminster, PA 18974-5800Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT

Custodian HS-1 Date 12 SEPT. 1988

SH-3H, BuNos 148049 () 148980 ~~()~~ 152134 () Aircraft Flight Hours _____

Service Period Type: Coastal Based (X) Ship Based () In-Land Based ()

General Appearance: Satisfactory (X) Unsatisfactory ()
If unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory (X) Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.

Area of aircraft requiring repair, if any:

Ease of repair: Satisfactory (X) Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent (X) Good () Fair () Poor ()

Comments: LIGHT TOUCH UP ON TOP OF SPINDERS AND OTHER VERY SMALL AREAS.

Prepared By: G. J. Villa

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT
SH-3H, 152134 (612) ^{MOBX}

Custodian HS-3 Date: 6/28/88

Aircraft Flight Hours _____

Service Period Type: Coastal Based () Ship Based () In-Land Based ()

General Appearance: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Adhesion of Self-priming topcoat: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Type of repair required, if any: (corrosion removal, spot touch up,
sectionalized repair, etc.)

Area of aircraft requiring repair, if any: TAIL WHEEL DOOR (LH) - FIBERGLAS

Ease of repair: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent () Good () Fair () Poor ()

Comments:

SQUADRON HAS HAD A/C FOR VERY SHORT TIME - 2 WKS

Prepared By: Orh

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Material Engineering Division
Corle 34200, Bldg 741
Naval Aviation Dept
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT

Custodian HS-3

Date 20 Oct 88

SH-3H, BuNos 148049 () 148980 () 152134 () Aircraft Flight Hours 8971.4

612

Service Period Type: Coastal Based () Ship Based (✓) In-Land Based ()

General Appearance: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory (✓) Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.

Area of aircraft requiring repair, if any: SPONSON AREAS

Ease of repair: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent (✓) Good () Fair () Poor ()

Comments: TOPCOAT EXT FULLY EFFECTIVE TO THIS POINT.

Prepared By: AMS [Signature]

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

D22
SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT
SH-3H, 148049

Custodian HS-3

Date: 25

(28 INSP.)

Aircraft Flight Hours _____

Service Period Type: ^(River) Coastal Based Ship Based () In-Land Based ()

General Appearance: Satisfactory Unsatisfactory ()
If unsatisfactory, why?

Adhesion of Self-priming topcoat: Satisfactory Unsatisfactory ()
If unsatisfactory, why?

Type of repair required, if any: (corrosion removal, spot touch up, sectionalized repair, etc.) *(none)*

Area of aircraft requiring repair, if any: *NONE*

Ease of repair: Satisfactory Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent () Good () Fair () Poor ()

Comments:

Prepared By: _____

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Material Engineering Division
Code 34200, Bldg 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT

Custodian HS-3 Date 20 Oct 88

SH-3H, BuNos 148049 () 148980 () 152134 () Aircraft Flight Hours 10788.3
214

Service Period Type: Coastal Based () Ship Based (✓) In-Land Based ()

General Appearance: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory (✓) Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.

Area of aircraft requiring repair, if any: EXTERIOR SKIN

Ease of repair: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent (✓) Good () Fair () Poor ()

Comments: TOPCOAT EXTREMELY EFFECTIVE TO THIS POINT.

Prepared By: Randy W. [Signature]

Send to: NAVAIR AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT
SH-3H, 148049

Custodian HS 3 Date: 24 Oct 88

Aircraft Flight Hours 10793

Service Period Type: Coastal Based () Ship Based (X) In-Land Based ()

General Appearance: Satisfactory (X) Unsatisfactory ()
If unsatisfactory, why?

Adhesion of Self-priming topcoat: Satisfactory (X) Unsatisfactory ()
If unsatisfactory, why?

Type of repair required, if any: corrosion removal, spot touch up,
sectionalized repair, etc.)

Area of aircraft requiring repair, if any:

SPONSOR, STUBWING, WINDSHIELD

Ease of repair: Satisfactory () Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent (X) Good () Fair () Poor ()

Comments:

SELF-PRIMING TOP COAT VERY EFFECTIVE ON FUSelage TO DATE.

Prepared By: AMSC/MDR/DA Day

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6052
Warminster, PA 18974-5000

Material Engineering Division
Code 34200, Bldg 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300



DEPARTMENT OF THE NAVY
 NAVAL AVIATION DEPOT
 BUILDING 82
 NAVAL AIR STATION
 PENSACOLA, FLORIDA 32508-6300

IN REPLY REFER TO

13080
 342/0030:KMS

From: Commanding Officer, Naval Aviation Depot, Pensacola, FL
 To: Commanding Officer, Naval Air Systems Command, (AIR 5304D), Washington,
 DC 20351-5300

Subj: PRODUCTION SCALE EVALUATION OF "UNICOAT" POLYURETHANE COATING SYSTEM

Encl: (1) Specification for Unicoat Polyurethane Coating System
 (2) Trip Report to HS-1, HS-3, HS-5, NAS Jacksonville

Ref: (a) Phoncon between COMNAVAIRSYSCOM (AIR 5304D) Heimann Wittmatt/
 NAVAVNDEPOT Pensacola (Code 34200) K.M. Sanders of 24 May 1989
 (b) MIL-STD-2161, paragraph 4.2.1 Finishes.
 (c) OPNAVNOTE 5090 Ser 451/8U584639 of 18 May 1988

1. As discussed in reference (a), this Depot requests authorization to deviate from reference (b) to use the Unicoat Polyurethane Coating System specified in enclosure (1) for the Schedule Depot Level Maintenance of H-53 program.

2. NAVAIR will benefit from the data base generated from having an entire program finished in this new coating system. Licensed manufacturers will have a demand on Unicoat and large batch formulations will finally be produced, a desire NAVAIR expressed in reference (a). Large batch formulations will enable aircraft manufacturers to judge Unicoat's production worthiness.

3. This Depot has issued this request expecting to reduce operating costs while improving product quality.

a. Three SH-3 helicopters were finished using the Unicoat system in spring of 1988. Enclosure (2) shows the reduced hours in corrosion control on rotary wing aircraft and improved customer satisfaction. Reference (a) stated the same findings for NADEP Norfolk's F-14 finished in February of 1988.

b. During the finishing of the first SH-3, Depot production was pleased with the performance of the Unicoat in application and resulting reduction of labor hours in eliminating the priming operation. The Depot can reduce 1/6th the manhours per aircraft for finishing H-53's by adopting this process. These aircraft will proceed directly to topcoat application from surface treatment.

c. Reference (c) established policy for minimizing hazardous waste generation. Each year aircraft finishing generates 15,000 gallons of paint related waste at NADEP Pensacola. By eliminating the priming process, the Depot can reduce the volume of primer related waste and save the \$7.00/gallon required for disposal.

Subj: PRODUCTION SCALE EVALUATION OF "UNICOAT" POLYURETHANE COATING SYSTEM

- d. A coating system minus a primer layer means that problems or questions concerning primer quality and performance are eliminated. This code has repeatedly tested the adhesive properties of the Unicoat system and found it to have adhesion comparable to MIL-P-86502, epoxy primer.
4. Other benefits from the introduction of Unicoat to production application are:
- a. The Depot will have a finishing product which is neither lead nor chrome pigmented.
 - b. When properly applied Unicoat coating is smoother; fleet personnel will find the coating easier to clean and repair. With the fleet spending less time on corrosion control, flight operations could increase.
5. Correspondence on this subject should be directed to K. M. Sanders, Materials Engineering Division, Code 34200, Bldg. 741.

C. N. Hayes
C. N. Hayes
By direction

Copy to: (w/o encls)
COMNAVAIRSYSCOM. (AIR-41121E/AIR-6164X/AIR-5115C) (w/encl (2))
NAVAIRDEVCEN (Code 6062)
NAVAVNDEPOT Alameda, CA (Code 054)
NAVAVNDEPOT Cherry Point, NC (Code 354)
NAVAVNDEPOT Jacksonville, FL (Code 340)
NAVAVNDEPOT North Island, CA (Code 340)
NAVAVNDEPOT Norfolk, VA (Code 360)

COMMENTS:

HS-1's Aircraft BuNo 148980, side # 449, has been in the water (sea) twice. The first time was in July 20, 1989 and water taxi for ten (10) miles causing much sea spray all over the aircraft. It was washed, rewashed and Emergency Reclamation procedures were conducted in accordance with procedures spelled out in the NAVAIR manuals, NA 01-1A-509 and NA 16-1-540. Aircraft Preservation manual, NA 15-01-500, was also used in represerving those components requiring such action. These procedures were started as soon as the aircraft was brought back to the Air Station.

The second time was August 12, 1989, and this time it water taxi for approximately fifteen (15) miles. A single engine lift off brought it in to the air station (Mayport). The same procedures as the first time were conducted.

Close scrutiny is being practiced on this aircraft because of the sea water exposure. The aircraft looks very good and the new paint system seems to have endured all abuse and abrasions.

Ish Vallalva
NAESU Corrosion Specialist
NAS Cecil Field, FL

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT

Custodian HS-3 Date 12/20/89

SH-3H, BuNos 148049 () 148980 () 152134 (✓) Aircraft Flight Hours _____
(612)

Service Period Type: Coastal Based () Ship Based (✓) In-Land Based ()

General Appearance: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory (✓) Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.

ROUTINE MINOR TOUCH UP

Area of aircraft requiring repair, if any:

Ease of repair: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, why?

NONE

Overall Effectiveness: Excellent (✓) Good () Fair () Poor ()

Comments: *(No CHEM. CONV. CTG.) THIS AIRCRAFT OPERATED OFF
A SHIP FOR SIX WEEKS.*

Prepared By: *J.P. Williams*

Send to: NAVAL AIR DEVELOPMENT CENTER
Acro Materials Division
Code 6062
Warminster, PA 18974-5000

Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5300

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT

Custodian ASC-7 Date 12/20/69

SH-3H, BuNos 148049 (✓) 148980 () 152134 () Aircraft Flight Hours _____
(66)

Service Period Type: Coastal Based () Ship Based (✓) In-Land Based ()

General Appearance: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory (✓) Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.

HAND TOUCH-UP

Area of aircraft requiring repair, if any.

NONE

Ease of repair: Satisfactory (✓) Unsatisfactory ()
If unsatisfactory, why?

Overall Effectiveness: Excellent () Good (✓) Fair () Poor ()

Comments:

THIS AIRCRAFT OPERATED OFF A SHIP FOR SIX (6) WEEKS

Prepared By: *J. Williams*

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Warminster, PA 18974-5000

Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5700

**"UNICOAT"
SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT**

Custodian HS-1 (449) Date 11/3/89
 SH-3H, BuNos 148049 ~~4~~ 148980 ~~5~~ 152134 () Aircraft Flight Hours 9907.6

Service Period Type: Coastal Based Ship Based () In-Land Based

General Appearance: Satisfactory Unsatisfactory ()
 If unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
 sectionalized repair, etc.

MINOR TOUCH-UP ON AIRCRAFT WING LEADS

Area of aircraft requiring repair, if any:

NONE

Ease of repair: Satisfactory Unsatisfactory ()
 If unsatisfactory, why?

Overall Effectiveness: Excellent Good () Fair () Poor ()

Comments: *AIRCRAFT ON FLIGHT STATUS, WILL BE INDUCTED FOR
 CORROSION INSPECTION AT A LATER TIME (3 WEEKS)*

Prepared By: *J. Williams*

Send to: NAVAL AIR DEVELOPMENT CENTER
 Aero Materials Division
 Code 6062
 Warminster, PA 18974-5000

Materials Engineering Division
 Code 34200, Bldg. 741
 Naval Aviation Depot
 NAS Pensacola, FL 32508-3000

SELF-PRIMING ELASTOMERIC TOPCOAT
EVALUATION REPORT

Custodian HS-1 (449) Date 12/11/89

SH-DH, BuNos 148049 () 148980 152134 () Aircraft Flight Hours _____

Service Period Type: Coastal Based Ship Based () In-Land Based ()

General Appearance: Satisfactory Unsatisfactory ()
IF unsatisfactory, ... why?

Adhesion of Self-priming topcoat: Satisfactory Unsatisfactory ()

Type of repair required, if any: Corrosion removal, spot touch-up,
sectionalized repair, etc.

MINOR TOUCH-UP

Area of aircraft requiring repair, if any:

NONE

Ease of repair: Satisfactory Unsatisfactory ()
IF unsatisfactory, why?

Overall Effectiveness: Excellent Good () Fair () Poor ()

Comments: *SEE ATTACHED SHEET*

Prepared By: *J. Wilton*

Send to: NAVAL AIR DEVELOPMENT CENTER
Aero Materials Division
Code 6062
Worminstler, PA 10074 5000

Materials Engineering Division
Code 34200, Bldg. 741
Naval Aviation Depot
NAS Pensacola, FL 32508-5000

Section III

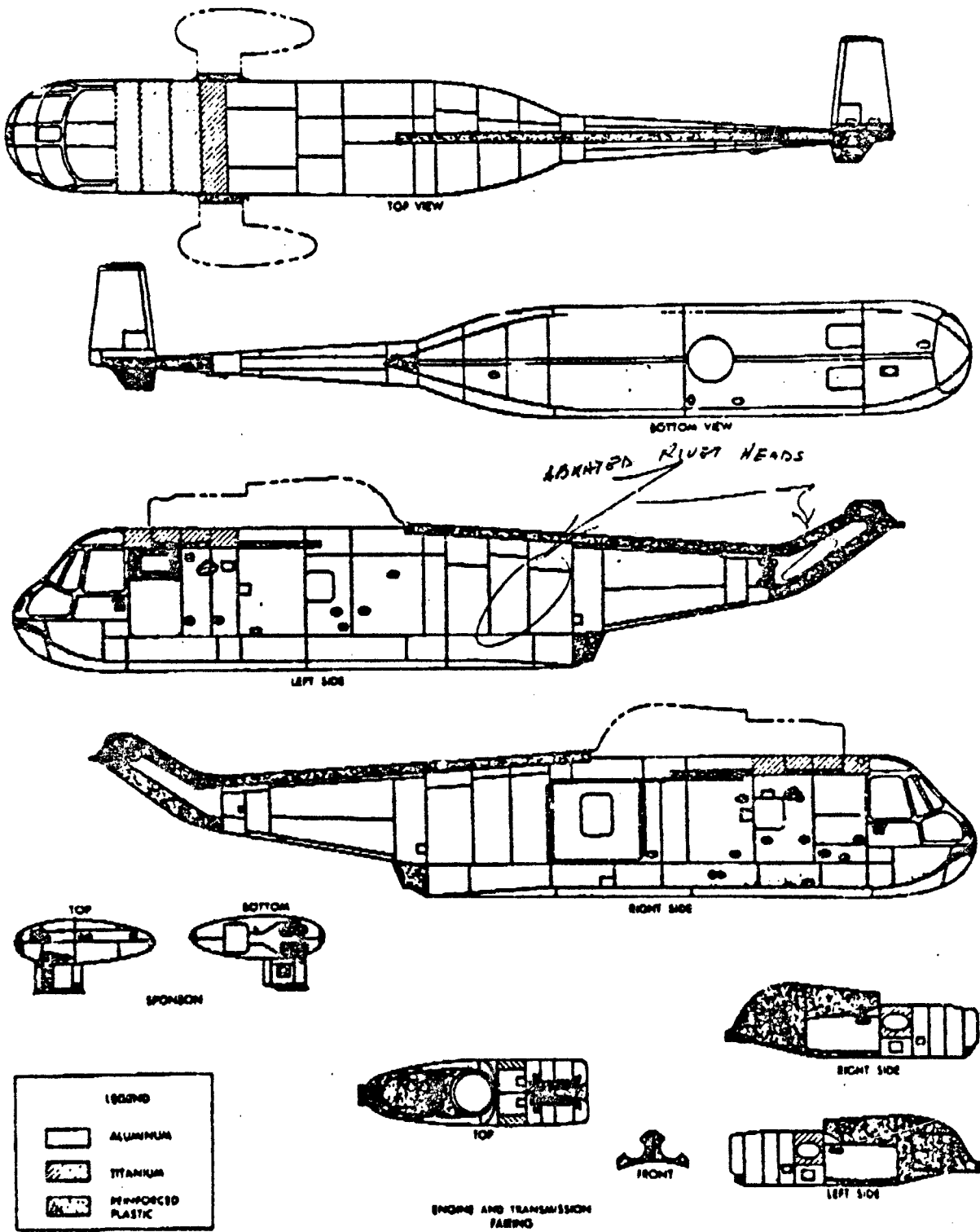


Figure 3-1. Skin Plating Diagram

F-18 FIELD EVALUATION

MEMORANDUM

Date: 30 Nov 88

From: James E. Spinks, Jr., Corrosion Specialist, NAESU Det Beaufort, SC

To: Charles Hegedus, NAVAIRDEVCCEN

Subj: FIELD EVALUATION OF POLYURETHANE PRIMER/TOPCOAT

1. Purpose: To evaluate subject coating for ease/difficulty of application and durability in a typical fighter aircraft community.

2. Facilities/Equipment: The coating was applied inside hangar space utilizing MIL-S-12877, Type II, Size 2, spray equipment which is the same facility/equipment used for the application of MIL-C-83286 Aliphatic Polyurethane and MIL-C-22750 Epoxy Polyamide at this activity.

3. Discussion:

a. Two aircraft were sprayed at this activity utilizing the new primer/topcoat. Areas sprayed on the two aircraft are as follows: L/E flaps, L/E of engine intakes, L/E of vertical stabilizers, and portions of radome.

b. The primer/topcoat was mixed/thinned per NAVAIRDEVCCEN recommendations. The first aircraft was sprayed within five minutes after mixing/thinning; consequently, the coating had a tendency to run. The second aircraft was sprayed after the admixed/thinned coating had set for 30 minutes, which eliminated the coating's tendency to run.

4. Findings:

a. Worker acceptance was high as the coating's tendency to run can be readily overcome through viscosity adjustment and increased dwell time.

b. The primer/topcoat is an obvious time-saver as the previous primer application and drying period is eliminated.

c. The inherently short pot life of the coating proved to be no problem with proper planning for typical touch-up applications in our Southern climate.

d. Durability of the coating is apparently equal to that of MIL-C-83286 as the applied primer/topcoat was no more eroded than that of previously applied coatings after 50 flight hours. The coating also exhibited very good adhesion with no chipping/cracking.

e. The polymerized primer/topcoat is much smoother than that of MIL-C-83286 which allows for greater cleanability.

f. Color match was excellent and very close to that of the DeSoto vesiculated bead coating applied by McDonnell Douglas.

30 Nov 88

5. Recommendations:

a. If laboratory and field corrosion tests prove the primer/topcoat to be as effective as the MIL-P-23377/MIL-C-83286 system, expedite availability of subject material to squadrons.

b. Increased pot life of the primer/topcoat would facilitate maintenance actions at the OMA/IMA levels and would be a necessity at the depots.


JAMES E. SPINKS

Copy to:

MALS-31 AMO
VMFA-115 AMO
VMFA-122 AMO
VMFA-312 AMO
VMFA-333 AMO
VMFA-451 AMO
NAESU Det Cecil Field

TRIP REPORT

FROM: J.J. Thompson, Code 6063, A/V 441-3503, (215) 441-3503

SUBJECT: Al-Li Access Doors, and Uniccoat Paint

PURPOSE: Deliver and monitor installation of 2090-T8E41 access doors on F/A-18 aircraft. Inspect aircraft on which an NADC developed paint is being field tested.

PLACE: NAS Cecil Field, Jacksonville FL; MCAS Beaufort, Beaufort SC; and NAS Jacksonville, Jacksonville FL

DATE: 3-6 Jan 1989

REPORT BRIEF:

Al-Li Access Doors

Access doors were successfully installed on six F/A-18 aircraft at NAS Cecil Field, and on two F/A-18 aircraft at MCAS Beaufort. Two doors were installed on each aircraft, one made of conventional aluminum alloy 7075-T6 and one made of aluminum-lithium alloy 2090-T8E41. The aircraft at NAS Cecil Field will be carrier deployed, the aircraft at MCAS Beaufort will be land based. Details concerning the aircraft and the panels are listed in the following table.

Table 1: F/A-18 Aircraft On Which Al-Li Access Doors Are Being Tested

Custodian	Bureau Number	Side Number	Door Material	Panel ID	Part Number	Side
VFA-82	163427	304	7075-T6	1	74A-313103-2003	L
			2090-T8E41	12	51A-313103-5004	R
VFA-82	163438	302	7075-T6	11	74A-313103-2004	R
			2090-T8E41	1	51A-313103-5003	L
VFA-82	163442	303	7075-T6	9	74A-313103-2003	L
			2090-T8E41	11	51A-313103-5004	R
VFA-86	163437	401	7075-T6	6	74A-313103-2003	L
			2090-T8E41	10	51A-313103-5004	R
VFA-86	163439	402	7075-T6	7	74A-313103-2004	P
			2090-T8E41	5	51A-313103-5003	L
VFA-86	163443	400	7075-T6	8	74A-313103-2004	P
			2090-T8E41	2	51A-313103-5003	L
VMFA-312	163173		7075-T6	2	74A-313103-2003	L
			2090-T8E41	9	51A-313103-5004	R
VMFA-312	163171		7075-T6	10	74A-313103-2004	P
			2090-T8E41	6	51A-313103-5003	L

The fasteners were sprayed with VV-L-800 General Purpose Oil prior to installation per NAVAIR 01-1A-509. An entry was made in the logbook of each aircraft noting the door installation and the planned removal after one year. Local VIDS/MAF forms were filed stating that the covers removed were to be retained for reinstallation after the test covers were returned to NADC. The installation was photographed. Maintenance personnel were informed the prototype doors were to be treated as conventional doors would be treated. For example, if the entire nose barrel is to be repainted, the prototype covers should also be repainted. Any problems with the panels are to be reported to NADC. The fasteners on the panels will be painted by Corrosion Control personnel before deployment and operation.

Excellent cooperation was received at both NAS Cecil Field and MCAS Beaufort. On-site points of contact are as follows:

NAS Cecil Field: Jim Moorhead, NADA, A/V 860-5107
Ish Villalva, NAESU, A/V 860-6161
Bill Cromer, McAir, (914) 778-6074

MCAS Beaufort: Captain Kreps, AAMO MALS 31, A/V 832-7699
Jim Spinks, NAESU, A/V 832-7141
Jerry Lienhop, McAir, (803) 522-7463

Unicoat Paint Inspection

As time allowed, aircraft were inspected which had a new paint system developed at NADC called Unicoat. This paint is being field tested on rotary wing aircraft at NAS Jacksonville, and on fixed wing aircraft at MCAS Beaufort. The Unicoat paint was unconditionally supported for helicopters, and advantages were appreciated on F/A-19 aircraft.

At NAS Jacksonville, two aircraft were inspected from Helicopter Squadron HS-1. An aircraft with the new paint (Side Number 616) was compared with an aircraft with a conventional paint system (Side Number 610). The inspection was performed with Ish Villalva, NAESU Detachment, Corrosion Specialist.

The difference between aircraft was dramatic. The Unicoat painted aircraft appearance far superior. The conventionally painted aircraft exhibited numerous areas where corrosion maintenance and touch-up were required. Problem areas were around fasteners, at break points, on leading edges and exhaust areas, and where abrasion occurred e.g. where the helicopter tie-down ropes abrade the tail, where fuel lines rest on refueling, and on steps. Approximately 25% of the conventionally painted aircraft appeared to have touch-up paint applied.

The Unicoat painted aircraft exhibited far superior performance on leading edges, break points, and around fasteners. No difference was noted at exhaust areas and abrasion areas. The aircraft appeared cleaner. A slight color difference was noted in a compartment not exposed to the sun. The unexposed area had a blue tint, compared to the exposed area having a gray appearance.

An interview with AMS1 Day, Corrosion Control Center Supervisor for HS-1 A/V 772-4703 Ext 4706, reinforced the conclusions of the aircraft inspection. He gave the following maintenance data for the aircraft he was responsible for maintaining:

Table 2: Time Expended on Corrosion Maintenance of Aircraft in HS-1 During December 1988.

Side Number	Faint System	Corrosion DMMH
612	Unicoat	7.6 Hours
616	Unicoat	4.7 Hours
610	Conventional	34.3 Hours
613	Conventional	26.1 Hours

One helicopter (610) had recently deployed on a frigate. It was therefore exposed to more severe conditions than those aircraft which remained at NAS Jacksonville. Upon its return, 21 man-hours were required to perform corrosion maintenance. Even excluding this maintenance, the Unicoat painted aircraft required only 25% of the maintenance of the conventionally painted aircraft.

The Unicoat paint had the fullest confidence of the Corrosion Work Center of HS-1. Significant application and drying time was saved using the one coat Unicoat verses the two coats for the conventional paint system. They experienced none of the typical conventional paint problems of chipping, chalking, or fading. The Unicoat paint retained the desired blue color much longer than the conventional paint. The short pot life of Unicoat was not a factor. The only concern was "Where can I get more?"

At MCAS Beaufort, only one F/A-18 aircraft (Side Number 11) with the Unicoat paint was on base. One hundred-fifty days had elapsed since paint application. The aircraft was inspected with Jim Spinks, NACSO Detachment Corrosion Specialist. This aircraft had been painted with Unicoat on only a few areas. Much of the aircraft had been repainted, as was expected. The only Unicoat areas which remained were the leading edges of the engine intake. These areas were smoother and cleaner than the conventionally painted surfaces. The short pot life of Unicoat was not considered a problem for touch-up or small jobs. By waiting approximately one-half hour between mixing and application, the viscosity of the paint could be controlled to avoid runs.

CONCLUSION/AGREEMENT: The prototype Al-Li panels were successfully installed to begin field testing. Field testing of Unicoat shows large improvement in performance over present paint system.

COMMITMENTS:

NADC:

1. Maintain contact with squadrons to follow access door performance.
2. Contact squadrons after approximately one year to have access doors removed.

NAS Cecil Field and MCAS Beaufort:

1. Corrosion Control personnel will treat fastener areas in newly installed panels as required.
2. VFMA-312 will forward negatives of access door installation to NAAC through Jim Spinks, NAESU.
3. Squadrons will treat prototype doors as called for in present procedures. Corrective maintenance procedures will be performed per per NAVAIR 01-1A-509 Aircraft Weapon Systems Cleaning and Corrosion Control. Where required, maintenance actions will be documented by OPNAV 4790/60 VIDS/MAF forms.
4. Squadrons will retain the access doors which were removed. These doors will be reinstalled at the end of field testing when the prototype doors are removed.

Jim Spinks 10 Jan 89

Copies: NAAC

60C2
606
6062, R. Gargan, C. Hegedus
6063, 60631, 60632

NAVAIR 5304B4 W. Fogel
41121E D. Jamison

COMNAVAIRLANT 5221 LtCol J.W. Summerlin
528 G. Browne

COMLAWINGONE

NAS Cecil Field, COMLAWINGONE, VFA-02, VFA-06
M4DA J. Moorhead
NAESU I. Villalva

MCAS Beaufort MAG-31, MAES-31, VMFA-312
NAESU J. Spinks

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F 1

P-3 FIELD EVALUATION

20 APR 89

FROM: Maintenance Material Control Officer, Naval Air
Development Center, Warminster, PA.

TO: Commanding Officer, Naval Aviation Depot,
Naval Air Station, Jacksonville, FL.

INFO: Commander, Naval Aviation Maintenance Office,
Naval Air Station, Patuxent River, MD.
Commander, Naval Air Systems Command (NASC),
NASC HDQTRS, Washington, DC.


SUBJ: AMENDMENT, SPECIAL WORK REQUEST, SDLM FOR UP-3A 148889.

REF A: Phoncon between Mr. Mike Lynn, NADEP JAX, AV 942-4519 and
LT. R. J. Toth, NADC, AV 441-3375.

Encl 1: Ammendment to NADC's SDLM Special Work Request
submitted on 09 March 1989.

Encl 2: NADC information sheet for painting with UNICOAT.

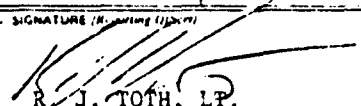
1. As discussed and agreed upon in ref A, Request NADC s SDLM
Special Work Request, special work item number nine (9) be
modified as per Encl 1, item 1.
2. This is to evaluate the product UNICOAT which was developed
at NADC.
3. Encl 2 applies.


R. J. TOTH
LT USN



O. SPECIAL WORK ITEMS

ITEM NUMBER	DISCREPANCY	REMARKS
1.	REQUEST AIRCRAFT BE STRIPPED AND REPAINTED WITH <u>UNICOAT</u> PAINT.	

P. SIGNATURE (In printing if possible)  R. J. TOTH, LP.	Q. TELEPHONE AUTOVON 441-3375 COMMERCIAL (215) 441-3375	R. DATE (In printing if possible) 20 APR 89
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COPY TO
COGNIZANT WING
TYPE COMMANDER
NAVAIRSYSCOMREP

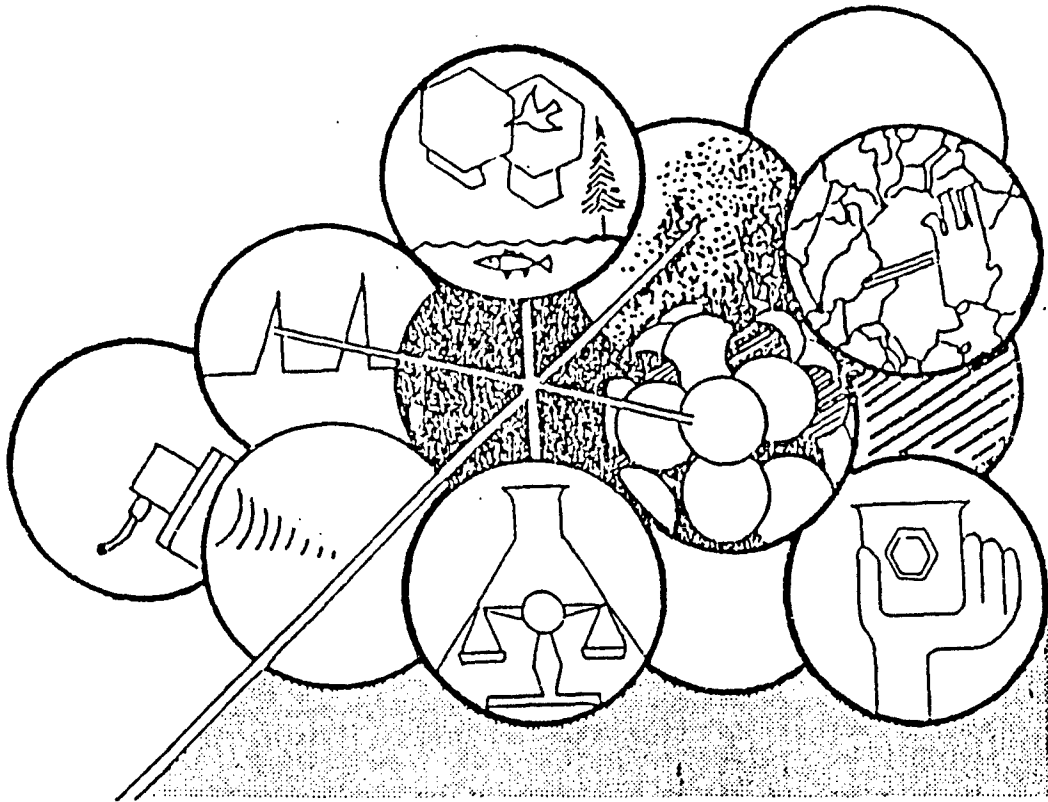


F4

INFORMATION REQUIRED TO PAINT A P-3 WITH UNICOAT AT NADEP Jacksonville

The aircraft should be handled in the same manner as if the standard paint system were being applied except for the application of a primer. The paint system on the inducted aircraft should be entirely stripped. The surface should be inspected and corroded areas should be treated accordingly. Then the aircraft should be thoroughly washed, rinsed, conversion coated, and rinsed again. At this time UNICOAT can be mixed and applied directly to the surface. The UNICOAT can be purchased from Coatings for Industry, Mr. Jim Klotz, Souderton, PA, 215-723-0919. The appropriate color must be specified. NADC materials specialists (code 6062) will visit NADEP JAX at the time of painting to witness and provide advise if necessary. NADC maintenance personnel should contact Mr. Mike Lynn at NADEP JAX 904-772-4519 or AUTOVON 942-4519. He can and will arrange everything from the depots side. For additional information on UNICOAT please contact Charles Hegedus 215-441-1452 or Don Hirst 215-441-1473 (NADC Code 6062).

Encl: (2)



MATERIALS ENGINEERING LABORATORY

LABORATORY REPORT NO. 343-5-89

SUBJ: UNICOAT, self-priming topcoat

DATE: August 2, 1989



NAVAL AVIATION DEPOT
Naval Air Station
Jacksonville, Florida 32212-0016

2 AUGUST 89

BACKGROUND

Unicoat is a self-priming topcoat developed by NADC. The two component polyurethane high solids coating is a corrosion resistant coating for use on aluminum, graphite/epoxy composites and stainless steel substrates. Benefits of Unicoat include that it is lead and chromate free, has decreased VOC emissions, lowers the weight of the coating system and reduces application time and labor. Initial field evaluations have been conducted on F-14 and SH-3 aircraft with good results. Code 343 has examined these aircraft and has conducted tests on Unicoat with various combinations of coatings. A non-rinsing conversion coating was also evaluated along with the Unicoat system.

SUMMARY OF TEST RESULTS

Testing was performed in order to determine the adhesion of Unicoat to the conventional primer/topcoat system (MIL-P-85582/MIL-C-85285) and the adhesion of the conventional primer/topcoat system to the Unicoat material. Adhesion was evaluated after water immersion. Coatings were applied to mechanically deoxidized aluminum. Adhesion test results were excellent for both samples. This is important due to touch-up applications which may not use the same coating as was originally applied to surfaces. Lap shear results of Unicoat with conventional primer/topcoat samples averaged 900 lbs/in². This is lower than conventional primer/topcoat systems applied over a similar primer/topcoat system, which have typical values of 1200 lbs/in². There are no coating requirements for lap shear testing incorporated in standard test methods however, this method, which was developed locally many years ago, has been used very successfully for quantitative comparison of systems (sample numbers 2A through 2C).

Evaluation was performed in order to compare Unicoat to conventional primer/topcoat (MIL-P-85582/MIL-C-85285) systems. Wet and dry adhesion of the coatings to 2024-T3 aluminum substrate was selected as the basis of comparison. The samples were prepared with and without conversion coating, MIL-C-5541. Water immersion tests showed excellent results, all samples passed tape tests. Lap shear test values were comparable to conventional systems with and without conversion coatings (sample numbers 1A through 1F).

Evaluation of non-rinsing chromate conversion coating, Intex 8600, consisted of applying various paint systems over conversion coatings formed by application of the INTEX material to aluminum test panels and allowing to dry without rinsing. All samples showed blisters and poor paint adhesion after water immersion for 4 days at 120 degrees F. Lap shear results on dry panels were well below results for the other systems being tested, except for those sprayed with Unicoat. The Unicoat samples were not adversely affected by the Intex conversion coating and had an average lap shear value of 1230 lbs/in², similar to normally processed conventional coating systems (sample numbers 3A through 3C).

RECOMMENDATIONS

Continue to expand field evaluation of Unicoat including follow-up on aircraft previously coated with Unicoat. Areas of concern include the short pot life, which is approximately one hour, the high viscosity at VOC compliance thinner concentration, and production scale repeatability of batches.

EXPERIMENTAL

MATERIALS:

2024-T3 Alum. panels

Conversion Coatings:

- a) Intex 8680 non-rinsing
- b) MIL-C-81706, form 1, method C, Class 1A

Primer:

- a) Koroflex
- b) MIL-P-85582, Type 1, Class 1, water borne epoxy

Topcoat:

- a) MIL-C-85285, Type I & II, high solids polyurethane
- b) Unicoat, high solids primer/topcoat polyurethane

PANEL PREPARATION

Panels were cleaned with detergent, water, and green Scotch Brite type pads, LP 0050C, Type II, Class 1, until the surface was water break free. Panels treated with Intex 8680 conversion coating were abraded while submerged in a 3 oz. per gallon concentration and allowed to stay in the solution 3 minutes. They were not water rinsed. Some panels were hung vertically and others hung horizontally to simulate on aircraft application of conversion coating. Panels treated with conversion coating MIL-C-81706 were processed in production shop 93113 using a current production batch of material. The panels were dipped/rinsed in water after chemical treatment per standard procedures. Panels were primed using conventional air spray equipment to a dry film thickness of .6 to .9 mils, then topcoated using air spray to a total dry film thickness of 2 to 2.5 mils. Unicoat panels were prepared by mixing the material in the ratio of 4:1, thinning to a viscosity of 20 seconds in a #2 Zahn cup, then spraying to a dry film thickness of 2 to 3 mils using conventional air equipment. The coating as mixed was not VOC compliant.

TESTING

Lap Shear: After coating, samples were cured 7 days at room temperature, then bonded in 1 inch width by 0.5 inch overlap dimensions. Shear values were converted to lbs/in². Samples were tested on an Instron with crosshead speed of 0.05 in/min.

Water Immersion & Tape Test: After coating, samples were cured 7 days at room temperature then scribed and immersed in deionized water at 120 degrees F for 4 days. After removal they were visually inspected for defects such as softening, wrinkling, blistering or any other coating deficiency. Samples were air dried at room temperature for 2 hours and then tape tested using MIL-T-21575 masking tape over the scribed area.

SAMPLE ID:	EVALUATION:	EVALUATION:
II, MATERIAL	SHEAR, PSI	a) WATER IMMERSION b) TAPE
1A MIL-C-81706 KOROFLEX PRIMER MIL-C-85285	MEAN=2833, STD DEV=70	a) VERY GOOD b) PASS TAPE TEST PRIMER FAILURE
1B MIL-C-81706 MIL-P-85582 MIL-C-85285	MEAN=1253, STD DEV=92	a) GOOD b) PASS TAPE TEST PRIMER FAILURE
1C MIL-C-81706 UNICOAT	MEAN=1973, STD DEV=127	a) EXCELLENT b) PASS TAPE TEST COHESIVE FAILURE IN UNICOAT
1D KOROFLEX PRIMER MIL-C-85285	MEAN=1733, STD DEV=115	a) POOR; BLISTERS b) FAIL TAPE TEST PRIMER FAILURE
1E MIL-P-85582 MIL-C-85285	MEAN=1183, STD DEV=104	a) VERY GOOD b) PASS TAPE TEST PRIMER FAILURE
1F UNICOAT	MEAN=1160, STD DEV=144	a) EXCELLENT b) PASS TAPE TEST UNICOAT FAILURE
2A UNICOAT MIL-P-85582 MIL-C-85285	MEAN=827, STD DEV=23	a) EXCELLENT b) PASS TAPE TEST
2B MIL-C-81706 UNICOAT MIL-P-85582 MIL-C-85285	MEAN=1080, STD DEV=432	a) EXCELLENT b) PASS TAPE TEST
2C MIL-C-81706 MIL-P-85582 MIL-C-85285 UNICOAT	MEAN=705, STD DEV=396	a) EXCELLENT b) PASS TAPE TEST
3A INTEX 8680 KOROFLEX PRIMER MIL-C-85285	MEAN=587, STD DEV=101	a) POOR; SEVERE BLISTERS b) FAIL TAPE TEST PRIMER FAILURE
3B INTEX 8680 MIL-P-85582 MIL-C-85285	MEAN=560, STD DEV=53	a) POOR; GRAINY b) 2 FAIL, 2 PASS TAPE TEST PRIMER FAILURE
3C INTEX 8680 UNICOAT	MEAN=1227, STD DEV=110	a) POOR; BLISTERS, GRAINY b) FAIL TAPE TEST CONVERSION COAT FAILURE

INVESTIGATED BY:

Luis Carney

LUIS CARNEY
Student Trainee,
Materials Engineer

REVIEWED BY:

Michael Linn

MICHAEL LINN, Supervisor
Polymeric/Special Projects Branch

PREPARED BY:

Patricia Betzig

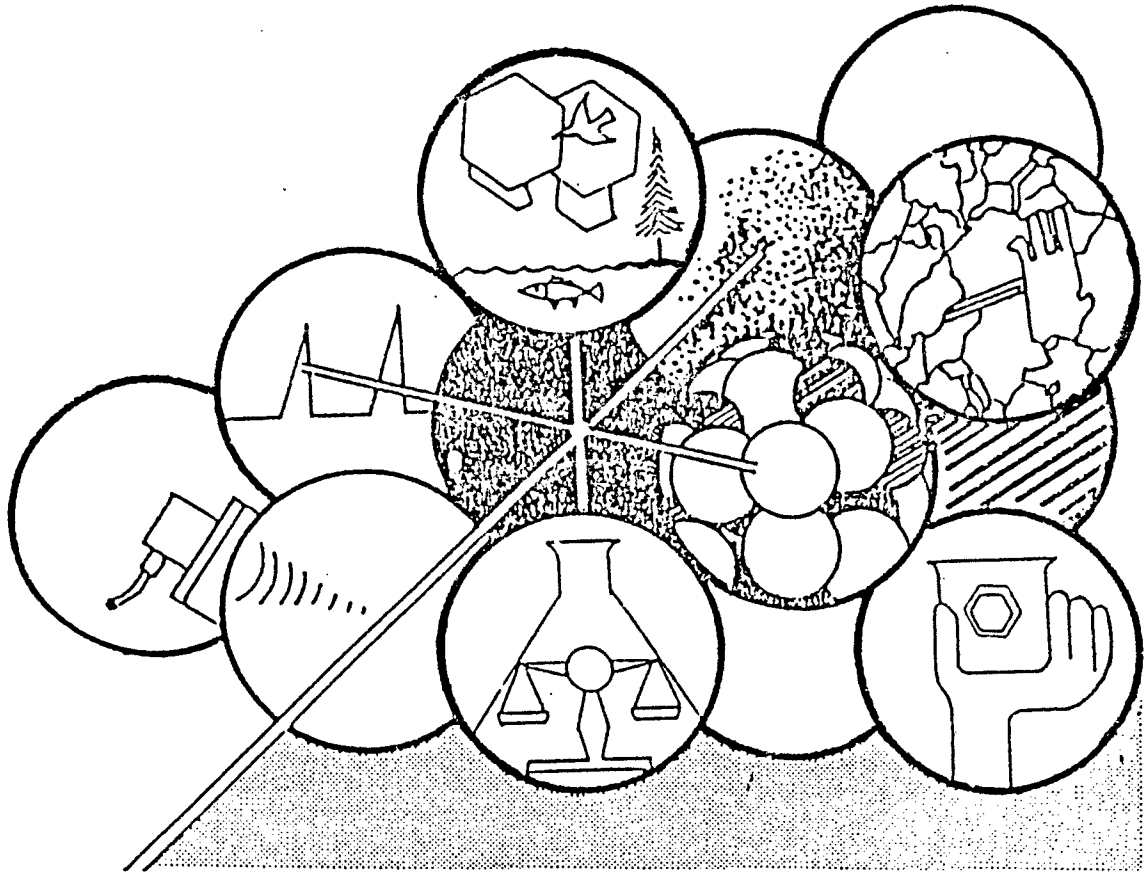
PATRICIA BETZIG
Materials Engineer

APPROVED BY:

F. W. Thomas

F. W. THOMAS, Director
Materials Engineering Division

F 10



MATERIALS ENGINEERING LABORATORY

LABORATORY REPORT NO. 343-7-89

SUBJ: UNICOAT, SELF-PRIMING TOPCOAT
NADC P-3 BUNO 148889

DATE: AUGUST 31, 1989



NAVAL AVIATION DEPOT
Naval Air Station
Jacksonville, Florida 32212-0016

Code 343:PB
3 September 89
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PURPOSE: An experimental coating (UNICOAT) was applied to P-3 aircraft BUNO 148889 at the request of the operating squadron. The coating system used was a two part polyurethane developed by the Naval Air Development Center (NADC). The major advantage that this system has over the conventional MIL-P-85582/MIL-C-85285 is that it contains no chromates, is lead free and requires no primer. The following report gives the application parameters used to coat the aircraft, deficiencies noted and recommendations concerning the use of this new material.

BACKGROUND: NADC initially requested that NADEP JAX Code 343 test their new coating formulation in March of 1989; their biggest concern was our response to the adhesion of the coating over common aircraft materials. In response, tests were conducted to determine the wet and dry adhesion properties of the material over deoxidized and deoxidized/conversion coated aluminum. The results of our effort are given in enclosure (1), which essentially concludes that the new coating has excellent wet and dry adhesion to both types of surfaces. Code 343 made changes to the priming/painting materials in 1982 and has made it known throughout the Navy and industry that no material changes to the present system be made locally unless it demonstrates excellent wet adhesion over deoxidized (no conversion coating) aluminum. It is believed that to do so would seriously jeopardize the effectiveness of the paint system to adequately protect aircraft exteriors from corrosion; that any proposed new system that could not offer the advantages gained in 1982 would be a step in the negative direction.

Tests were also conducted on the adhesion of the proposed coating to the standard coating, in case the need should arise to overpaint an existing system. These test results were also excellent and are also given in enclosure (1).

NADEPs Pensacola and Norfolk have applied the new UNICOAT paint system to several aircraft including three H-3 helicopters and one F-14. Code 343 personnel had the opportunity to inspect all of these aircraft. In every case, including one H-3 that was painted without the benefit of a conversion coating, the UNICOAT appeared to be performing well. Enclosure (2) summarizes our inspection results of the F-14.

The operating activity for P-3 BUNO 148889 is NADC, since the aircraft was scheduled into NADEP JAX for SDLM, we were requested to apply the new paint system to the aircraft so that NADC could closely monitor its effectiveness. NADC agreed to supply the paint to NADEP JAX.

APPLICATION PARAMETERS: P-3 BUNO 148889 was processed as follows:

-THE SURFACES; ailerons, flaps, and rudder; were removed and routed for stripping, corrosion treatment and rework. After

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rework, these surfaces were cleaned and conversion coated IAW LPS/JX 343-108, and painted using UNICOAT, Batch #893242, manufactured by Coatings For Industry (CFI). Code 343 conducted tests on the paint prior to application (enclosures 3 and 4). These tests showed that the pot life of the material was less than one hour, and that the initial viscosity was too high for spray application. Thinning the material with MIL-T-81772 to 420 VOC did not reduce the paint to a sprayable consistency. In order to obtain a sufficient reduction in viscosity of the material, 21 to 23 seconds in a #2 Zahn cup, the material was thinned above 420 VOC and was applied to the surfaces. Application of the coating went smoothly, painters were favorably impressed with the wetsability and flowout. Representatives from NADC and Code 343 were present when the material was mixed and applied. Code 343 conducted water break free tests on isolated areas of the surfaces 2 hours prior to painting to assure cleanliness; there was no evidence of any water breaks. A test panel was forwarded to CFI so that the company could precisely color match the batch of paint needed to paint the airframe with the color applied to the surfaces.

-THE AIRFRAME, was stripped, corrosion treated and conversion coated IAW LPS/JX 342-124-89 and LPS/JX 342-151-89 prior to rework. After rework, the aircraft was cleaned IAW LPS/JX 343-108 in Hanger 868 (paint facility) and, within 8 hours, was transported to Hanger 101S where the starboard side of the aircraft received a conversion coating. The following day, the aircraft was transported back to Hanger 868 and was recleaned using a detergent wash IAW LPS/JX 343-108. The materials used for these process steps are given in enclosure (5).

UNICOAT Batch #893297, was received from CFI two days prior to application. Tests were conducted by Code 343 to determine viscosity, pot life, dry time, gell time, wet and dry tape adhesion tests. As with the previous material, Batch #893297 failed to meet the pot life and VOC requirements and gelled within 2 hours after thinning with MIL-T-81772 to 420 VOC (enclosure 6). Examination of the pot life sample showed considerable foaming of the material.

A second test was performed to determine if the UNICOAT could be successfully sprayed on the aircraft. The test was performed in the paint hanger where the temperature was in excess of 88 degrees F and the humidity was greater than 90 percent. Five gallons of the material were mixed. Two 2.5 gallon samples were thinned, one using approximately 1 quart of MIL-T-81772 thinner to attain 420 VOC, the other using 2 quarts of MIL-T-81772 to attain a sprayable viscosity of 23 seconds in a #2 Zahn cup, which was approximately 474 VOC. Each of the portions were placed in a paint pot and the stirrer was turned on. Viscosity readings were taken 15 minutes after thinning and then every 5 minutes to determine the useful pot life of the material. The results of the time/viscosity data

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are given in Enclosure (7). From this data the pot life was defined as one hour from the time of mixing until end of clean-up. The mixing instructions used in production were derived from this experiment and are defined in enclosure (8). There was evidence of gassing in both of the samples mixed. Gassing was noted after 38 minutes in the sample which was thinned to the VOC compliance of 420 g/l. In the second sample, which was thinned to 23 seconds in a #2 Zahn cup (approximately 474 VOC) gassing was not observed until 60 minutes after mixing. While testing has not yet verified the reason for this phenomenon, it is suspected that moisture, possibly from one or some of the pigments in the paint may be the cause.

During mixing of the UNICOAT to be applied to the airframe each sample of 2.5 gallons was thinned to 23 seconds in a #2 Zahn cup and recorded. No sample was used for longer than 30 minutes after mixing. The airframe was painted within 50 minutes after starting. The temperature was 85 degrees F and 55 percent relative humidity. After curing, thickness measurements were taken at random on several areas of the airframe utilizing an eddy current device. Results were: LH Fuselage 3.7 mils, RH Fuselage 3.9 mils., Vert. Stab. 3.7 mils, Horiz. Stab. 4.0 mils, Flaps 3.9 mils, Rudder 3.6 mils. These measurements meet the desired 2 to 4 mils dry film thickness. 60 degree Gloss readings were taken on the airframe with a range of 6 to 7. This fails the preliminary MIL specification for camouflage colors which requires a maximum value of 5. Wet tape tests were also performed with good adhesion results except in an area where oil contamination was suspected.

RECOMMENDATION: The UNICOAT paint system can, potentially, solve a great number of problems for the NADEPs, specifically problems associated with hazardous waste minimization. In addition, time and material savings can also be expected with this new material. However, the present formulation presents problems for the NADEP that cannot be overlooked. While the pot life problem could be resolved by using plural component mixers, the initial viscosity is too high to be sprayed within the 420 VOC requirements for aircraft exteriors. These application problems may be resolved by other coating manufacturers in the near future as interests in the new technology grows throughout the industry. Presently, NADEPs Pensacola and Norfolk are going forward with plans to utilize the material in production despite the deficiencies. Locally, Code 343 plans to pursue the use of this material by using plural component equipment (NADEP JAX does not presently own any of this equipment) to spray small parts. Since most of the aircraft initiatives in the component paint shop seem a logical choice to work out processing problems.

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Code 343:PB
Page 4 of 18

PREPARED BY:

Patricia Betzig

PATRICIA BETZIG
Materials Engineer

APPROVED BY:

F. W. Thomas

F. W. THOMAS, Director
Materials Engineering Division

REVIEWED BY:

Michael Linn

MICHAEL LINN, Supervisor
Polymeric/Special Projects Branch

TEI 343-1178-89
NADC P-3A, B/N 148889

343:PB *PB*
6/1/89

Unicoat is a 2 component urethane self-priming topcoat developed by NADC. It is a corrosion resistant coating for use on aluminum, graphite/epoxy composites and carbon and stainless steel substrates. Benefits of Unicoat include that it is lead and chromate free, has decreased VOC emissions, reduced weight of the coating system and application time and labor.

NADC has requested their P-3A, B/N 148889 aircraft be painted with Unicoat at this facility. Paint IAW this TEI.

1. Upon receipt of Unicoat material, submit a sample to 343 for analysis.
 2. Request all exterior control surfaces be painted at one time if possible.
 3. 1 week prior to painting aircraft inform 343 to arrange a meeting with NADC, CFI, 3M and Alameda.
 4. DO NOT apply primer to any exterior control surfaces.
 5. Strip, clean and conversion coat all exterior control surfaces IAW LPS/JX 343-108 and TEI 342-0491-89.
 6. Mixing Unicoat.
 - 6.1 Add slowly while stirring 1 Volume of component II to 4 Volumes of component I. DO NOT THIN.
- NOTE: Pot life is aprox. 1 hour at 70F, 50% RH.
7. Apply Unicoat to control surfaces to a final dry film thickness of 2 to 4 mils.
 8. DO NOT USE UNICOAT ON RADOME AND BLADE ANTENNA. Per TEI 332-228-89 item 2.7, on these areas, prime and topcoat as required using Deft clear primer 01-X-5 and MIL-C-83286 or MIL-C-85285.
 9. After SDLM rework, clean aircraft IAW LPS/JX 343-108 using green Scotch Brite type pads.
 10. Conversion coat only STBD side of aircraft, IAW LPS/JX 343-108. Masking is not necessary on Port side of aircraft to prevent overspray.
 11. Clean aircraft prior to paint IAW LPS/JX 343-108 using white Scotch Brite type pads.
 12. Dry and Mask.
 13. Mix Unicoat IAW step 5.
 14. Apply Unicoat to aircraft to a final dry film thickness of 2 to 4 mils.
 15. Stenciling shall use Unicoat to mark the aircraft.
 16. Apply rain erosion tape 3M Co. #8650, adhesion promotor 3M Co. #86, and edge sealants 3M Co. #EC2216 and #EC3532, per on-site instructions from 343 and 3M Co. representative.

REQUEST ENGINEERING INFORMATION/TEMPORARY ENGINEERING INSTRUCTION

R-E-I

PART NAME & NO. OR SUBJECT **P3 UNICOAT PAINT EVALUATION/APPLICATION** MODEL & BU NO. **P3 B/W 148889**

APPLICABLE REFERENCES
 (a) **343-1178-89** (b) **343-1291-89** (c) **343-1290-89** INFO. REQUIRED DUE TO PRODUCTION STOP OR ANTICIPATED DELAY BY

THE INFORMATION REQUESTED ON (Provide complete detail)

For Surfaces

For additional information contact **P. BETZIG** Est. **4519**

SHOP NO. (Originating)	SHOP SUPERVISOR	PHONE NO.	APPROVAL	DATE
343	M. LINN	4519		

ROUTING INSTRUCTIONS

Problems which involve material shall be forwarded direct to the Material Management Department (Material Planning Division) for verification of material shortages before submission to the NESO

MATERIAL SHORTAGE EXISTS (Return to originating shop)	<input type="checkbox"/> YES (Forward to NESO)	ANTICIPATED DELIVERY DATE (Compress)	MATERIAL PLANNER
<input type="checkbox"/> NO	<input type="checkbox"/> YES		

TEMPORARY ENGINEERING INSTRUCTION
 PERMISSION GRANTED PERMISSION DENIED **T-E-I** DATE **6/21/89**

Unicoat batch #893242 was tested per preliminary Military Specification MIL-C-XXXX(AS) dated 15 DEC 1988 sec. 3.6.4 Viscosity and 3.6.5 Pot Life, ref. MESR 343-1290-89.

The material when mixed and thinned to VOC compliance of 420 g/l failed both viscosity and pot life.

- 3.6.4 Viscosity requirement:
After thinned to maximum VOC content (420) grams/liter of paint) not to exceed 45 sec. in a #4 Ford cup.
Test results: 57 sec.
- 3.6.5 Pot Life requirement:
Paint prepared as in 3.6.5 after 1 hour in a closed container not to exceed 70 sec.
Test results: 207 sec.

NADC will be present to assist during the application of Unicoat to the external control surfaces. The Lab test results and concerns have been discussed with NADC.

DISTRIBUTION		EFFECTIVE DATE	CANCELLATION DATE	ENGINEER
DEPARTMENT	133 SHOP (S)	6/21/89	10/21/89	P. Betzig
NESO	332	IMMEDIATE	URGENT	W. J. Jones
QUALITY & RELIABILITY ASSUR.	420/430/421		ROUTINE	
PRODUCTION PLAN. & CONTROL	551	COMPLIANCE		SERIAL
PRODUCTION ENGINEERING		P3 148889	343-1348-89	
PRODUCTION	93116/93115			

(SUBMIT ORIGINAL AND ONE COPY)

FROM: (Shop/Activity/Location) 343	PHONE NO. 4519	SUBMITTED BY P. BETZIG	DATE 6/14/89
TO MATERIALS ENGINEERING DIVISION, NAVAL AVIATION DEPOT NAVAL AIR STATION, JACKSONVILLE, FLORIDA 32212-0016	JOB NO.	REQUIRED FOR <input type="checkbox"/> EF <input type="checkbox"/> 1ST ART. <input checked="" type="checkbox"/> OTHER	
PART/SAMPLE NAME UNICOAT SELF-PRIMING TOPCOAT	<input type="checkbox"/> URGENT <input checked="" type="checkbox"/> ROUTINE	A/C MODEL & BU. NO. P3 B/M 148889 (NADC)	
SERVICE DESIRED:			

Test Unicoat For : Viscosity, Pot life, drytime, tape test per mixing and testing instructions attached.

NOTE: FOR USE ON SURFACES
BATCH # 39324Z

ATTACH & list all applicable correspondence (NARFJAXINST 4730 2 Series)

EI Control No.:

REPLY

The Unicoat self-priming topcoat was tested as follows:

1. Viscosity - required in preliminary specification to be < 45 seconds. The initial viscosity of this material was 57 seconds.
2. Pot life - a viscosity after 1 hour in a closed container is required to be < 70 sec. The final viscosity of this batch of material was 207 sec. The coating mix gelled within 6 hours of mixing.
3. Dry time - the coating was set to touch within 2 hours and dry hard within 8 hours.
4. Tape test - after 8 hours drying time in air, 1" wide masking tape was applied and removed one hour later. No marring of the surface occurred.
5. Wet tape test - There were blisters on the surface of the coating after 4-day immersion in 120 F tap water. The tape removed small chips of the coating.

ENGINEER <i>Marilyn D. Miller</i>	REVIEWED BY	APPROVED BY <i>Michael J. ...</i>	DATE OUT 7/18/89	REQUEST NO. 1290-89
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PROCESSING PROCEDURES FOR UNICOAT AIRFRAME B/N 148889

1. SCRUB:

Cleaning Compound	Butyrate
NSN: 6850-01-184-3182	NSN: 8010-00-165-5592
MIL-C-87936 TY I	MI T-6069A

3M Co. #7447 abrasive Red Scotch Brite Pads - Open Purchase

Water Rinse when finished.

2. STEAM CLEAN:

Steam Cleaning Compound	Normally use:	Spartan Soap SD20
Heavy Duty # 101		Open Purchase
Gator Sales, Inc.		
Jacksonville, FL 32210		

3. WASH:

Cleaning Compound
NSN: 6850-01-184-3182
MIL-C-87936 TY I

3M Co. #7447 abrasive Red Scotch Brite Pads - Open Purchase

4. CONVERSION COAT:

ONLY Starboard Side of airframe
MIL-C-81733, Class 1A, Form II, Method A

5. WASH:

Cleaning Compound
MIL-C-87936 TY I
NSN: 6850-01-184-3182

Port Side of airframe:
3M Co. #7447 abrasive Red Scotch Brite Pads - Open Purchase

Starboard side of airframe:
3M Co. non-abrasive White Scotch Brite Pads
NSN: 7920-00-171-1534, 7920-00-151-6120

6. MASK:

3M Co. Masking Tape - Open Purchase Sizes: 1/2", 1", 2"
MIL-T-21595

Barrier Paper, Size: 12"	Size: 36"
NSN: 8135-00-543-6573	NSN: 8135-00-224-8885
MIL-B-121 TY II	MIL-B-121 TY II

Kraft Paper, Size: 36"	Size: 48"
NSN: 8135-00-160-7769	NSN: 8135-00-160-7769
CID AA-203-A TY I	CID AA-203-A TY I

7. PAINT:

AIRFRAME:
Unicoat Gray Self-Priming Topcoat, Color #36375
Batch #893297 (Surfaces used Batch #89242)
MFG. By: Coatings For Industries

MARKINGS:

Camo Blue Polyurethane Topcoat, Color #35237
NSN: 8010-01-117-7693
MIL-C-23286B

PROPELLER TIPS:

Primer 44-GN-7, Deft
MIL-P-85582
TY I Class I

Red Lacquer Topcoat

NSN: 8010-00-634-7320
TT-L-32A, AM 1, TY 2

ANTENNA COVERS:

Clear Epoxy Primer 01-X-5, Deft

Camo Gray Polyurethane Topcoat, Color #36375

MIL-C-83286B
NSN: 8010-01-017-2480

8. MISCELLANEOUS WORK

LEADING EDGES:

Rain Erosion Protection
3M Co. #8650 Rain erosion resistant tape
3M Co. #86 Adhesive film promoter
3M Co. #EC3532 Edge Sealant

MATERIALS ENGINEERING SERVICES REQUEST

(SUBMIT ORIGINAL AND ONE COPY)

FROM (Shop/Activity/Location) 343	PHONE NO. 4519	SUBMITTED BY P. Betzig	DATE 8/2/89
TO MATERIALS ENGINEERING DIVISION, NAVAL AVIATION DEPOT NAVAL AIR STATION, JACKSONVILLE, FLORIDA 32212-0016	JOB NO.	REQUIRED FOR <input type="checkbox"/> EI <input type="checkbox"/> 1ST ART. <input checked="" type="checkbox"/> OTHER	
PART/SAMPLE NAME Unicoat Batch # 393297 for a/c	<input checked="" type="checkbox"/> URGENT <input type="checkbox"/> ROUTINE	A/C MODEL & BU. NO. P3 B/W 148889 (NADC)	
SERVICE DESIRED:			

Test paint for: Voc Compliant + (420 g/l) viscosity,
Pot life, dry-time, ² wet tape test.

Test per preliminary Mil Spec attached.

ATTACH & list all applicable correspondence (NAVFJAXINST 4730.2 Series)

EI Control No.:

REPLY

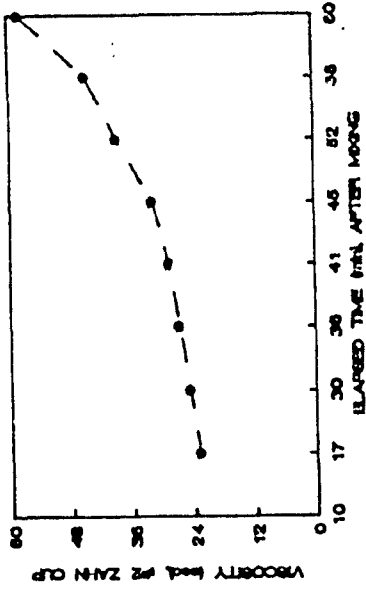
The Unicoat self-priming topcoat was tested as follows:

1. Viscosity - required in preliminary specification to be < 45 seconds. The initial viscosity of this material was 41 seconds in the #4 Ford cup.
2. Pot life - a viscosity after 1 hour in a closed container is required to be > 70 sec. The final viscosity of this batch of material was unable to be tested. The material had partially gelled within the hour.
3. Dry time - the coating was set to touch within 2 hours and dry hard within 8 hours.
4. Tape test - after 8 hours drying time in air, 1" wide masking tape was applied and removed one hour later. No marring of the surface occurred.
5. Wet tape test - The wet tape test results will be reported after the test is complete.

ENGINEER Marilyn D. Miller	REVIEWED BY	APPROVED BY M. L. Linn	DATE OUT 8/31/89	REQUEST NO. 343-1644-89
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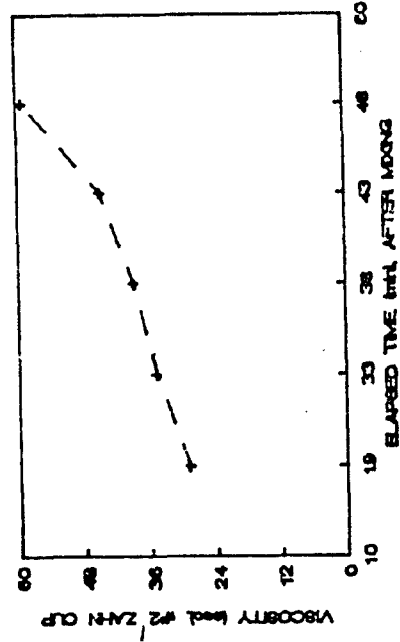
NAVFJAX 4730/58 (15 MAR) FORMERLY BND HAS JAX 4730/58 (Rev. 12-80)

UNICOAT BATCH #893297
THINNED ABOVE VOC



SAMPLE A
17MIN 23SEC
30 25
36 27
41 29
45 32
52 39
56 45
60 58

UNICOAT BATCH #893297
THINNED TO VOC



SAMPLE B
19MIN 29SEC
33 35
38 39
43 45
48 59

REQUEST ENGINEERING INFORMATION/TEMPORARY ENGINEERING INSTRUCTION			
R-E-I			
PART NAME & NO. OR SUBJECT NADC P3 UNICOAT MIXING INSTRUCTIONS		Batch # 893297	MODEL & QU NO. P3 B/N 148889
APPLICABLE REFERENCES TEI 343-1178-89 (a) TEI 343-1291-89 (a)		<input type="checkbox"/> INFO REQUIRED DUE TO PROD. STOP, OR ANTICIPATED DELAY BY	
INFORMATION REQUESTED ON: (Provide complete data)			
For additional information contact <u>P. Betzig</u> Est. <u>X 4519</u>			
SHOP NO. (Engineering) 343	SHOP SUPERVISOR M. LIND	PHONE NO. 4519	APPROVAL DATE
ROUTING INSTRUCTIONS			
Problems which involve material shall be forwarded direct to the Material Management Department (Material Planning Division) for verification of material shortages before submission to the NESG			
MATERIAL SHORTAGE EXISTS <input type="checkbox"/> YES (Forward to NESG) <input type="checkbox"/> NO (Engineering shop)		ANTICIPATED DELIVERY DATE (Forward)	MATERIAL PLANNER
TEMPORARY ENGINEERING INSTRUCTION <input checked="" type="checkbox"/> PERMISSION GRANTED <input type="checkbox"/> PERMISSION DENIED		T-E-I	DATE 4 AUG 89

Mix UNICOAT Batch # 893297 as follows:

ONE HOUR POT LIFE, timed from the adding of the catalyst to resin until the end of clean-up.

1. Do not shake resin on a paint shaker.
2. Add catalyst to resin in a 1 to 4 volume ratio.
3. Mechanically stir for 5 minutes.
4. Thin paint to 23 to 25 sec. in a #2 Zahn cup using MIL-T-81772. This should be approx. 2 quarts of thinner for each 2.5 gallons of paint (4 quarts thinner for 5 gallons paint).
5. Mix first batch of paint at one time, then wait 15 minutes, and mix the next batch, due to the short pot life.
6. Using conventional air spray equipment apply one crosscoat to aircraft.
7. If paint begins to spray poorly, or too thick, discontinue use and begin with a more recently mixed batch of paint.

(R)

DISTRIBUTION		EFFECTIVE DATE 8/4/89	CANCELLATION DATE 12/4/89	ENGINEER P. Betzig
DEPARTMENT NESG	SHOP (S) 332	IMMEDIATE <input checked="" type="checkbox"/>	URGENT <input type="checkbox"/>	APPROVED BY M. Lind
QUALITY & RELIABILITY ASSUR. 420.430		COMPLIANCE P3 B/N 148889		SERIAL NO. 343-1678-89
PRODUCTION PLAN. & CONTROL				
PRODUCTION ENGINEERING				
PRODUCTION 93116				

NAVAL AIR DEVELOPMENT CENTER
Aerospace Materials Division
Warminster, PA 18974-5000

TRIP REPORT

FROM: William J. Green, Code 6062, A/V 441-1644, (215)441-1644

PURPOSE: Observe and assist in the application of UNICOAT to a F-3

PLACE: NADEF Jacksonville, FL

DATE OF REPORT: 16 August 1989

On 2-5 August 1989, Mr. William J. Green visited NADEF Jacksonville to observe and aid in the painting of a F-3 from NADC with UNICOAT. 80 gallons of UNICOAT were sent to NADEF Jax from Coatings For Industry on 1 August 1989. Prior to painting, Mr. Michael Linn of the Materials Lab at NADEF Jax tested this batch of UNICOAT to determine the pot life for 2 varied initial spray viscosities. One sample was prepared by thinning UNICOAT with Mil-I 81772 to an initial spray viscosity of 29 seconds using a Zahn#7 viscosity cup which corresponds to a volatile organic compounds (VOC) content of 470 g/l (topcoat compliant). The viscosity increased to 35 seconds after a duration of 30 minutes. After 45 minutes the viscosity increased to 60 seconds. The second sample was thinned to an initial spray viscosity of 23 seconds or a VOC of 470 g/l. The viscosity increased to 25 seconds after 30 minutes, 31 seconds after 45 minutes, and 59 seconds after 60 minutes. Based on this information, Mr. Linn decided to paint the F-3 with UNICOAT at an initial spray viscosity of 23 seconds since this provides a useable pot life of about 45 minutes.

On 3 August 1989, at 0700, the F-3 was pretreated using a chromate conversion coating (Mil-C-81706) on the right side only. Prior to this, the F-3 had been stripped, cleaned and deoxidized. Thus the left side of the F-3 had no pretreatment other than a cleaned and deoxidized surface.

On 4 August 1989, just before painting, UNICOAT was thinned with Mil-I 81772 to a viscosity of 23-25 seconds in 5 pressure pots. The temperature was 85°F with a relative humidity of 55%. At 1820, 10 painters started painting the F-3 with UNICOAT using conventional air atomizing equipment. The entire painting process took 55 minutes, however the supply of UNICOAT was used and replenished at such a rapid rate that at no point was UNICOAT allowed to set in the pressure pots for more than 30 minutes. Only 30 gallons of the 40 gallons of thinned UNICOAT (28 gal base, 7 gal catalyst, and 7 gal thinner) was used to paint this aircraft.

Upon completion, the entire aircraft was examined. The paint finish appeared to be smooth and uniform. There were no signs of outgassing. There was a 5 inch sag on the tail on the left side of the F-3. There were less than a dozen minor blemishes (runs or sags) detected. The painters were pleased with the ability of this material to flow out and to form a smooth finish. The thickness over the entire aircraft was between 2.2 to 2.8 mils.

William J. Green

NAVAL AIR DEVELOPMENT CENTER
AEROSPACE MATERIALS DIVISION (CODE 606)
WARMINSTER, PA 18974-5000

From: Anthony T. Eng, Protective Coatings Team, (215)441-3269

Subj: Evaluation Of UNICOAT On NADC P-3

Date: 29 December 1989

1. On 3 August 1989, the NADC P-3 (Buno 148889) was stripped, cleaned, and physically deoxidized at NADEP Jax. Subsequently, the starboard side was pretreated using a chromate conversion coating. On 4 August, low gloss UNICOAT (thinned to 24 seconds in a Zahn #2 viscometer) was applied to the P-3 via conventional air atomizing equipment. Thus the port side of the P-3 consists of a chrome and lead-free finishing system.

2. On 27 - 28 December 1989, the P-3 was examined for film thickness, gloss, adhesion, and general appearance by NADC Protective Coatings Team personnel. The thickness was between 2.0 and 2.6 mils on the fuselage and from 1.8 to 3.5 mils over the wings. The 60° gloss ranged from 2 to 3. UNICOAT passed a 1 day wet adhesion test with a 5A and a 4A adhesion rating (ASTM D3359) on the starboard side and the port side, respectively. UNICOAT passed a 1 day water resistance test with no coating defects such as cracking, blistering, softening or discoloring on both sides of the aircraft. The thickness of UNICOAT over the test area on the starboard side was 1.8 mils compared to 2.2 mils for the port side. The general appearance of the P-3 was good for both sides. In summary, the coating system on this aircraft is in good condition and possesses good adhesion over the standard chromate conversion pretreatment as well as the chrome-free deoxidized pretreatment.

Anthony T. Eng

T-34 FIELD EVALUATION

01 02 281631Z JUL 89 RR UUUU

2090820

NAVAVNDEPOTOPSCEN PATUXENT RIVER MD
CNATRA CORPUS CHRISTI TX
INFO COMNAVAIRSYS COM WASHINGTON DC
NAVAIRDEV CEN WARMINISTER PA
COMTRAWING FOUR CORPUS CHRISTI TX
COMTRAWING FIVE MILTON FL

UNCLAS //N13080//

SUBJ: EVALUATION OF UNICOAT PAINT ON T-34C AIRCRAFT

- A. CNATRA CORPUS CHRISTI TX 231500Z JUN 89
B. PHONCON NAVAVNDEPOTOPSCEN (NADOC-112) R. TAYLOR/CNATRA (N-5111)
H. SPRINKLE OF 21 JUL 89
1. IRT REF A AND AS LAST DISCUSSED REF B, WE HAVE NO OBJECTIONS TO FURTHER PARTICIPATION IN THE EVALUATION OF UNICOAT IF CONDUCTED AS PART OF, AND UNDER THE AUSPICES OF, NAVAIR/NADC PLANS.
 2. THE ABILITY OF UNICOAT PAINT TO RESOLVE THE REPORTED UNSATISFACTORY PERFORMANCE OF THE CURRENT PAINT SYSTEM SHOULD ONLY BE DETERMINED THROUGH A PROPERLY STRUCTURED AND EXECUTED EVALUATION PLAN.
 3. INFORMATION FROM UNICOAT PAINT EVALUATIONS TO DATE ARE ENCOURAGING, BUT ARE INCONCLUSIVE, AND THE OBSERVED PERIOD

R. N. TAYLOR, NADOC-112, X3696

TYPIST: CANDY, X3975, 28 JUL 89

J. L. BAUMAN, NADOC-110, X3975

J. L. Bauman

UNCLASSIFIED

281631Z JUL 89



JOINT MESSAGEFORM,

UNCLASSIFIED

02 02 281631Z JUL 89 RR

UUUU

2090820

INSUFFICIENT. MANY QUESTIONS REMAIN TO BE ANSWERED BEFORE A COMMITMENT SHOULD BE MADE TO INCLUDE LARGE NUMBERS OF T-34C AIRCRAFT.

4. TO ENSURE THAT THE UNICOAT SYSTEM WILL PERFORM AT LEAST EQUAL TO THE NAVY STANDARD SYSTEM, THE EVALUATION PERIOD SHOULD BE OF SUFFICIENT LENGTH UNDER CONDITIONS CALCULATED TO BOTH ACCELERATE AND SIMULATE A TYPICAL ACI PERIOD.

5. A FORMALLY STRUCTURED TEST AND EVALUATION PLAN IS NOW UNDER DEVELOPMENT BY NAVAIR/NADC. THE ROLE OF THE T-34C WILL BE DETERMINED BASED ON THE EXTENT OF CONTRIBUTION TO THE EVALUATION OF UNICOAT AS A POSSIBLE NAVY STANDARD SYSTEM.

6. NAVAVNDEPOTOPSCEN POC IS MR. R. N. TAYLOR (NADOC-112), AV 356-3676 OR COMM (301) 863-3676.

R. N. TAYLOR, NADOC-112, X3676

TYPIST: CANDY, X3975, 28 JUL 89

J. L. BAUMAN, NADOC-110, X3975

UNCLASSIFIED

281631Z JUL 89



G 5

01 03

RR

UUUU

2411130 SLH

COMNAVAIRSYS COM WASHINGTON DC
CNATRA CORPUS CHRISTI TX
INFO NAS CORPUS CHRISTI TX
NAVAVNDEPOTOPSCEN PATUXENT RIVER MD
NAVAIRDEVGEN WARMINSTER PA
NAVAVNDEPOT PENSACOLA FL
NAVAVNDEPOT JACKSONVILLE FL
NAVAVNDEPOT CHERRY POINT NC
NAVAVNDEPOT NORFOLK VA
NAVAVNDEPOT ALAMEDA CA
NAVAVNDEPOT NORTH ISLAND CA

UNCLAS //N13080//

SUBJ: EVALUATION OF UNICOAT ON T-34

A CNATRA 231500Z JUN 89

B NAVAVNDEPOTOPSCEN 291631Z JUL 89

C MTG NAVAIR CODE AIR-5304 (J. COLLINS)/CNATRA CODE N5111 (H.
SPRINKLE) OF 29 AUG 89

D NAVAVNDEPOT PENSACOLA LTR LPS/PN 234E OF 15 DEC 87

E CNATRA N2 LTR :42AM OF 21 AUG 89

65304D265304530P65304565304641121E6FC

H. VARMALL65304D26X26025

CAPT M. W. O'BAR65306X23547

UNCLASSIFIED

1. DUE TO THE UNIQUE SITUATION WITH THE CURRENT CORROSION PROBLEMS BEING EXPERIENCED BY NATRACOM T-34 ACFT, REQUEST FOR EVALUATION OF UNICOAT ON 30 ACFT IS APPROVED. REFS A AND B GERMANE.

2. AS DISCUSSED REF C, 30 EVALUATION AND 10 CONTROL (STANDARD PAINT) ACFT WILL BE TRACKED UTILIZING THE 56 DAY CORROSION CYCLE INSPECTION. EVALUATION AND CONTROL ACFT WILL BE ASSIGNED AS FOLLOWS:

	EVALUATION ACFT	CONTROL ACFT
NAS CORPUS CHRISTI	20	06
NAS WHITING FIELD	10	04

3. THE FOLLOWING PROCEDURES SHALL BE ACCOMPLISHED DURING SUBJECT EVALUATION:

A. SURFACE SHALL BE PREPARED PER REF D WITH THE EXCEPTION OF ALODINE APPLICATION.

B. MIXING INSTRUCTIONS AND APPLICATION PROCEDURES OF UNICOAT PER NADC/COATING FOR INDUSTRIES INSTRUCTIONS.

C. INSPECTION PROCEDURE REPORTING SHALL BE DOCUMENTED AS PER APPENDIX I OF MIL-F-18264D AND CORROSION FORMS IDENTIFIED REF E.

4. REQUEST CNATRA PROVIDE:

A. MIXING INSTRUCTIONS AND PAINT APPLICATION PROCEDURES TO

NAVAIR PRIOR TO EVALUATION START.

B. RESULTS OF ONGOING EVALUATION/56 DAY CORROSION CYCLE
INSPECTION TO NAVAIR AND NADC.

5. NAVAIR POC IS MR. H. VARMALL (AIR-530402), AY 222-6025 OR COM
202-652-6025.

UNCLASSIFIED

QUALITY ASSURANCE REPRESENTATIVE'S CORRESPONDENCE

1. TO: Milton Frontera CNAIRA, Contract Administration N233B NAS Corpus Christi, TX 78419		2. FROM: (Name, address, ZIP Code, and office telephone number) William J. DeGraw CCAR-4 N233B45 NAS Corpus Christi, TX 78419	
3. CONTRACT, P. O., OR O. I. NUMBER N68520-85-D-0033		4. ITEM AIRCRAFT PAINTING	
5. PRIME CONTRACTOR NAME, ADDRESS AND ZIP CODE DynCorp Aerospace Operations P.O. Box 921004 Fort Worth, TX 76116		6. PLANT NAME, ADDRESS AND ZIP CODE NAS Corpus Christi Corpus Christi, TX 78419	

SUBJECT: EVALUATION OF UNICOAT PAINTING SYSTEM ON T-34 AIRCRAFT

The evaluation obtained from the contractor on Unicoat Paint System is being forwarded to you for proper dissemination.

7. SIGNATURE OF CAR <i>William J. DeGraw</i>	8. DATE 12 SEP 1989
---	------------------------

DD FORM 1232
1 APR 77
0102-LF-001-2320

EDITION OF 1 OCT 68 MAY BE USED UNTIL EXHAUSTED

U.S. GPO: 1985-488-009/26628 2-1

DynCorp

Corpus Christi Branch

REH89-078

September 12, 1989

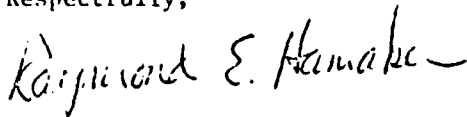
FROM: Raymond E. Hamaker
Maintenance ManagerTO: Mr. Bill DeGraw
CCAR T-34C/T-44A ProgramSUBJ: EVALUATION OF UNICOAT PAINTING SYSTEM ON T-34C AIRCRAFT
Contract N68520-85-D-0033

REF: (a) Mr. Milton Frontera, N2 CNATRA, Memo dated August 21, 1989

ENCL: (1) T-34C BUNO's 161840 and 161841 corrosion charts dated
September 12, 1989

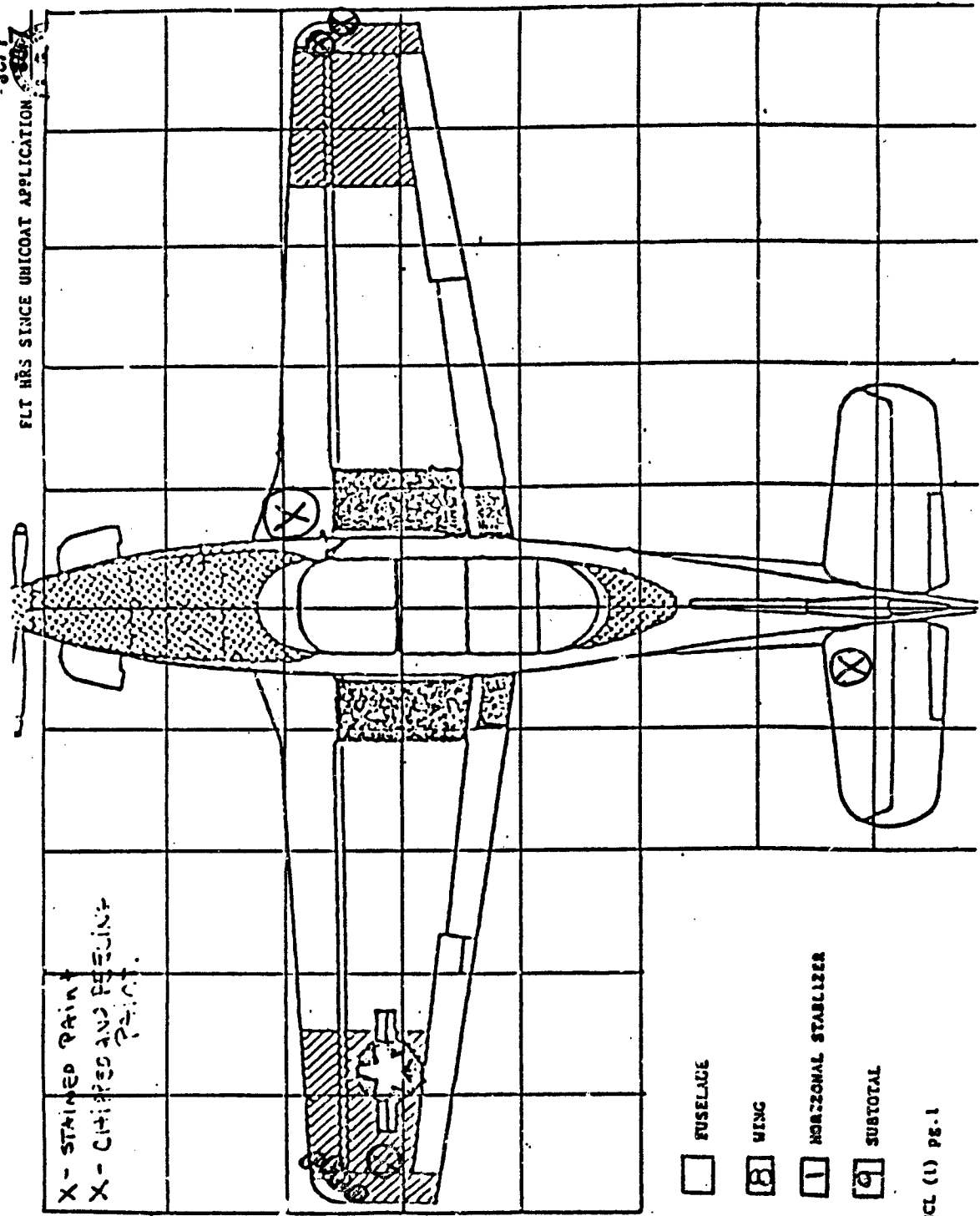
1. As requested by reference (a), Enclosure (1) is submitted for the first 56 day inspection after receipt from ACI.

Respectfully,

Raymond E. Hamaker
Maintenance Managercc: T. C. Wimberly
D. Whitehead

REH/es

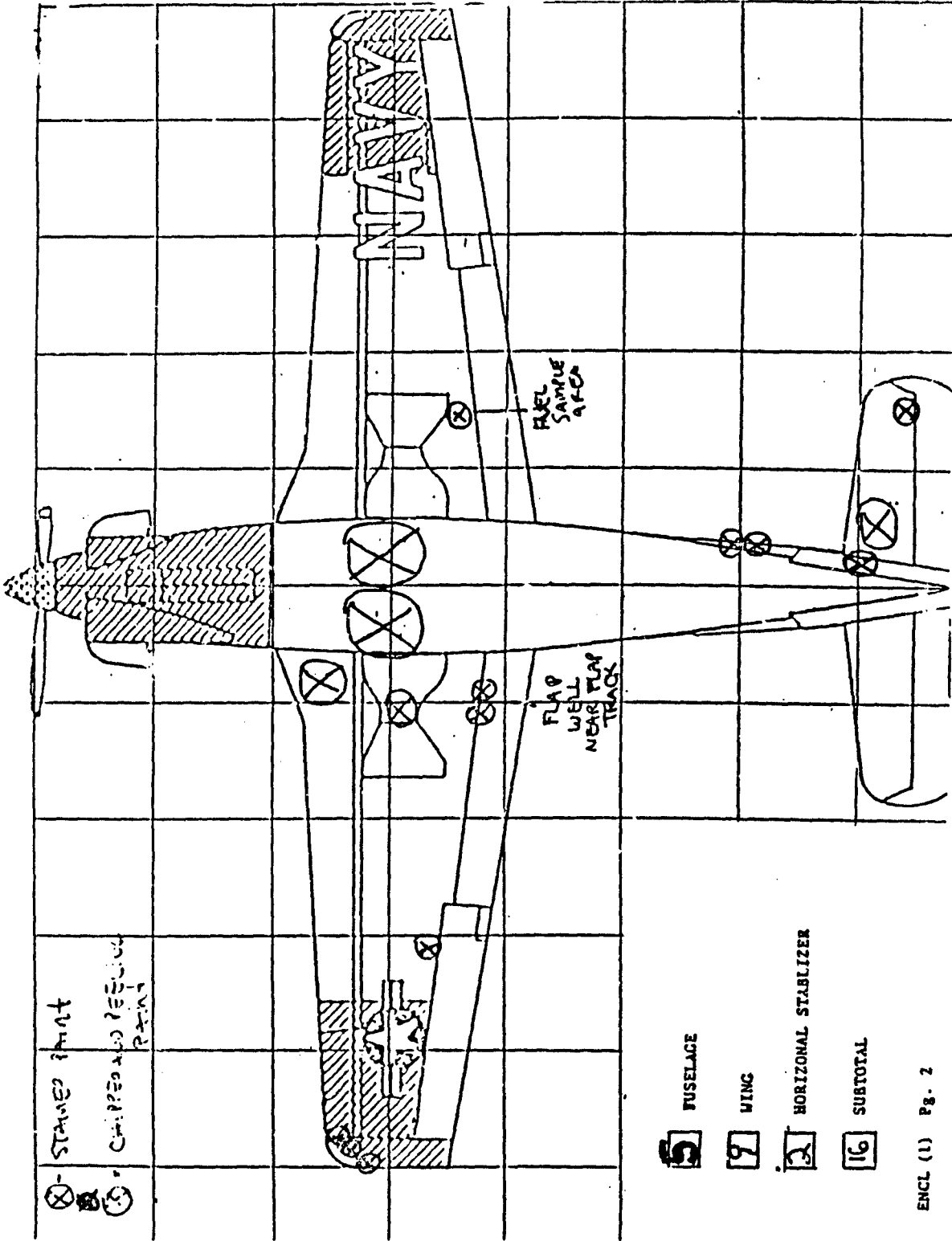
FLT HRS SINCE UNICOAT APPLICATION



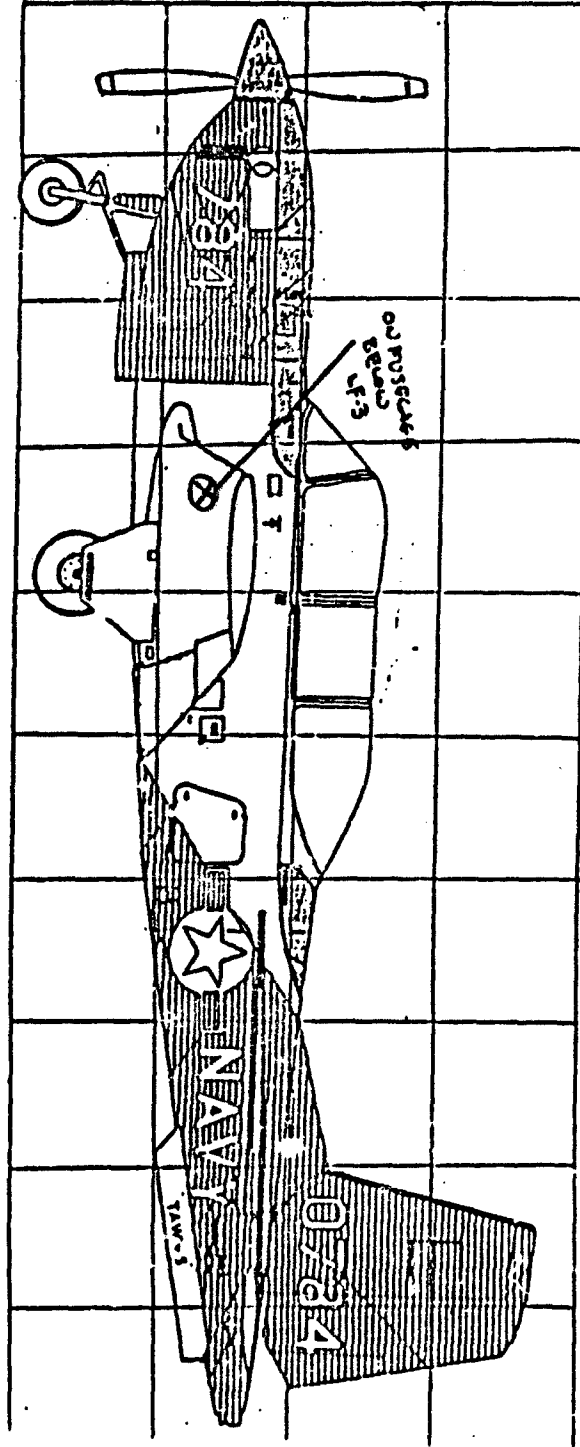
X - STAINED PAINT
 X - CHIPPED AND PEELING PAINT.

- FUSELAGE
- WING
- HORIZONTAL STABILIZER
- SUBTOTAL

ENCL (1) PG. 1



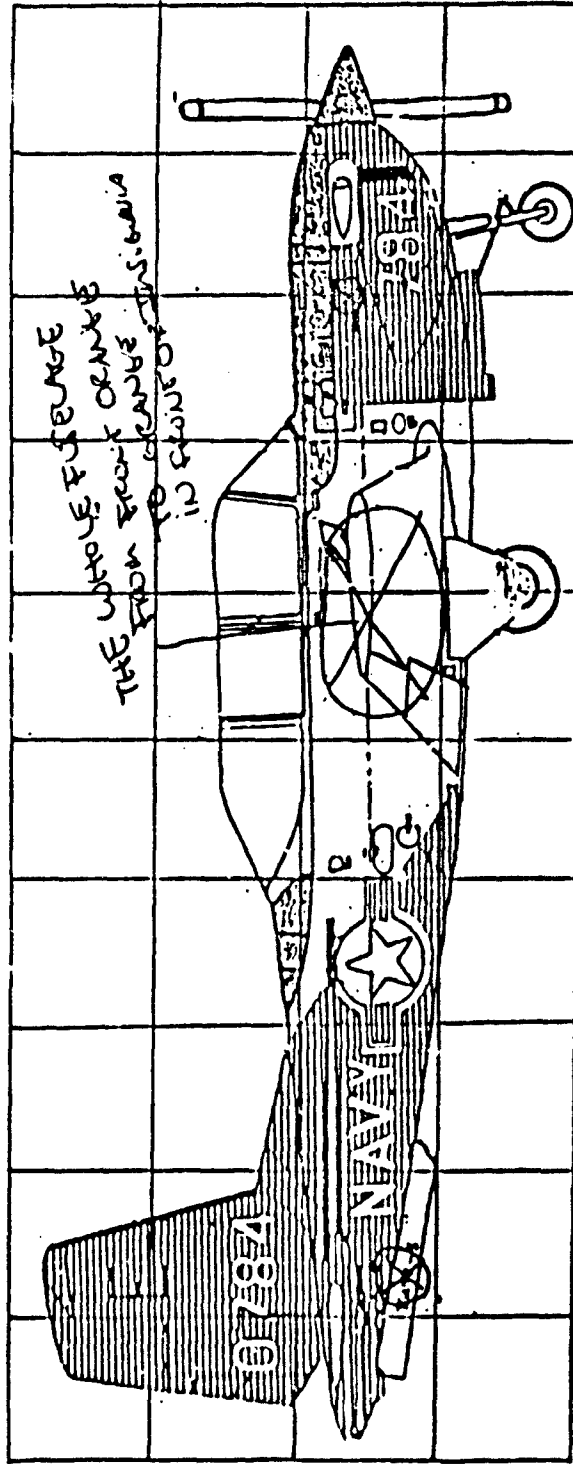
X - STAINES PAINT
X - CHIPPED AND PEELING PAINT



- FUSELAGE
- VERTICLE STABILIZER
- SUBTOTAL

ENCL (1) Pg. 3

X - Stained print
X - Chipped and peeling print.



- FUSELAGE
- VERTICLE STABILIZER
- SUBTOTAL

ENC. (1) P 4.

NAVAL AIR DEVELOPMENT CENTER
Aerospace Materials Division
Warminster, PA 18974-5000

TRIP REPORT

FROM: Anthony Eng, Code 6062, A/V 441-3269, (215)441-3269

PURPOSE: Observe application of UNICOAT to a T-34

PLACE: NAS Whiting Field, FL

DATE: 12 July 1989

On 12 July 1989, personnel from NADC, CNATRA, NADOC, and NADEP Pensacola visited NAS Whiting Field to observe the painting of a T-34 (Buno 161841) with a gloss white UNICOAT. This A/C had been stripped, cleaned, surface treated (phosphoric acid etched previous day) and masked prior to our arrival. After our arrival, the A/C was dusted with an air gun, and wiped down with MEK. Two of the more experienced Dyncorp painters were instructed to apply UNICOAT in the same manner (spray technique and thickness) that they would use for the standard polyurethane topcoat. One painter applied UNICOAT on the right side of the aircraft and the other on the left. The general direction of application was from the nose to the tail and from the bottom to the top of the T-34. The material was thinned with a standard polyurethane thinner (Mil-T-81772, type I) to a Zahn #2 viscosity of 25 seconds and applied using conventional siphon feed equipment (1 Qt capacity).

After two coats were applied, Ken Sanders from NADEP Pensacola performed thickness measurements and found the values to range from 0.5 to 1.5 mils. The paint was thin (0.5 - 1.0 mils) in the front third (nose area) and the rear third (tail area) of the aircraft. The paint in the middle third of the aircraft (wings and cockpit area) was approximately 1.0 - 1.5 mils. The painters were then instructed to apply another full coat to the entire aircraft. After allowing the coating to attain a near tack free condition (about 1 hr), 60° gloss and thickness were measured. The average gloss over the entire aircraft was 88 which is comparable to the gloss value required for the standard gloss white topcoat (90). Thicknesses were measured at approximately 1.5 mils in the fore and aft sections and about 2.3 mils in the main wings and cockpit areas. The lower thicknesses in the fore and aft areas was deemed satisfactory since these areas will be subsequently topcoated with a standard polyurethane. The hiding power (opacity) appeared to be quite good at these thicknesses. This level of hiding was supported by previous laboratory generated contrast ratio data of 0.9 at two mils which is superior to the value required of white topcoats (0.85). It was also noted that a test panel of the gloss white UNICOAT visually appeared to be whiter than the standard gloss white polyurethane topcoat.

Only 2.5 gal of the admixed UNICOAT was used to paint the entire aircraft. The paint was supplied in one gal kits and mixed on an as needed

basis in order to lessen the pot life problem (sprayable after 90 minutes). Since each kit was consumed in approximately 40 minutes, no application viscosity problem was encountered. The other major area of concern involved the sagging or running of the paint. The sagging problem (5 or 6 sag areas) seemed to be concentrated on the right side of the aircraft whereas the left side showed only one minor sag area. The painter on the left side had a quicker and wider spraying motion while producing less application defects (sags or runs) and thus a superior finish compared to the painter on the right side. This suggests that the application procedure and not the paint itself was the cause for the sagging problem. (Note: all the defect areas will be sanded and touched up with gloss white UNICOAT on the following day). Also, the sag problem was not considered to be a problem by NADEP Pensacola personnel since they want to apply this material at no more than a Zahn #2 viscosity of 25 seconds using application equipment (air-assisted airless with pressure pots) that would be able to more effectively atomize this material and prevent sagging compared to the conventional equipment used at Whiting Field.

One painter (left side) liked the applicability while the other painter (right side) was unsure of her impression. All personnel on hand were most impressed with the fact that this gloss white version of UNICOAT would cut maintenance costs and time via the elimination of the chromate conversion pretreatment and the standard epoxy primer (producing a completely non-chromate non-lead finishing system) and also provide good gloss, hiding, and color comparable to the standard polyurethane topcoat.

Anthony T. Eng

Copy To: NADC / I. Shaifer (60C)
NAVAIR / J. Collins, H. Verrall (AIR-5304)
NAVAIR / D. Jamieson (AIR-4111)
CNATRA / H. Srinkle (N5111)
NADOC / R. Taylor, W. Quinlan (112)
NADEP Pens. / K. Sanders (34200)
Coatings For Industry / J. Klotz

MATERIALS ENGINEERING LABORATORY
PRODUCT SUPPORT DIRECTORATE
NAVAL AVIATION DEPOT
NAVAL AIR STATION
PENSACOLA, FLORIDA 32508-5300

From: Kenneth M. Sanders, Code 34200, AV 922-3553
To: Code 6062, Naval Air Development Center,
Attn: Anthony Eng
Purpose: Evaluation of new gloss white formulation of Unicoat

Subject: TRIP REPORT ON T-34C UNICOAT APPLICATION, AT NAS WHITING

1. INVITATION: At the request of Harry Sprinkle, CNATRA Code N5111, this writer and three aircraft finishing painters were present for the first application of gloss white Unicoat in aircraft finishing.
2. BACKGROUND: In the spring of 1988, NADEP Pensacola was the first organization to apply Unicoat on more than one aircraft. One of the three aircraft the Depot painted was not alodined after deoxidizing. Evaluation of test panels from this experiment indicated that long term adhesion can not be assured without alodine.
3. PAINTING CONDITIONS: The subject aircraft had been deoxidized the previous evening, and was being solvent cleaned prior to paint application. The paint hangar used in this operation had no environmental controls, and outside air was used as make up air for the cross draft booth. Little assurance could be made that the aircraft would be kept clean during the painting operation.
4. DEMONSTATION: Tom Fuqua and Robert Lloyd of NADEP Pensacola assisted the DYNACORP painters in the mixing and reducing of the Unicoat. NADC had established the application viscosity at 25 seconds.
5. Using quart cup guns, rather than conventional air spray equipment, two painters finished the aircraft. The DYNACORP painters were encouraged to apply heavy coats to accomplish hiding and gloss. The two painters were not able to achieve the same levels of success. While one was able to apply a uniform heavy finish, the other was not able to accomplish the same finish, as a few runs and sags ruined the fine Unicoat finish.
6. A sample of the first batch of Unicoat was allowed to sit while the aircraft was painted. The viscosity rose from 25 to 41 seconds, measured in a number 2 Zahn cup, in one hour. The increasing viscosity appeared to bother the slower painter and to be advantageous to the faster one.
7. Because hiding was not obtained in two coats, a third coat of Unicoat was applied. This resulted in the desired coating thickness. Film thickness measurements were between 2-3 mils. The



thickness. Film thickness measurements were between 2-3 mils. The coating reflectance, at 60°, measured between 85 - 92%. The white color was outstanding, whiter than US PAINTS' topcoat formulation.

8. POST PAINTING TESTS: Two sets of aluminum anodized panels were prepared for coating at this demonstration. One set was scotchbrite abraded, deoxidized, and alodined. A second set was scotchbrite abraded, and deoxidized. These were then finished by the DYNACORP painters using the Unicoat. After a seven day curing period, a panel from each set was immersed for four days in a 120° water bath. The two sets of panels were tested for adhesion. No adhesion loss was seen in the alodined panels, while one failure was seen in a unalodined panel which was exposed to the hot water bath. This test was repeated and no failures occurred.

9. CONCLUSIONS: All NADEP personnel were pleased by the performance of the Unicoat and would eagerly accept the opportunity to use the same material on all CNATRA aircraft. Unicoat enables the finisher to obtain a smoother finish and greater gloss than the Navy's standard coating system. Tests performed at this Depot showed the adhesion of Unicoat to be greater than the epoxy/polyurethane system, but adhesion without alodine is preparation dependent.

Tom Riley, Tom Fuqua, and Robert Lloyd, NADEP Code 95120 offered the suggestion that mixing the Unicoat thinner and applying the material in more even coats would result in a better finish. Cup guns do not provide the flexibility DYNACORP needs to finish large surfaces, uniformly. The DYNACORP painting team used US PAINT's polyurethane paint reducer T0006, which could be a slower blend of solvent thus more likely to slow down the setting of the paint film. The standard polyurethane paint reducer MIL-T-81772 Type I, might permit a faster setting time for the Unicoat.

Kenneth M. Sanders

Copy To: Harry Sprinkle, CNATRA Code 45111
 Hermon Vermall, NAVAIR-5304D
 Dave Jamieson, NAVAIR-4111
 Robby Taylor and Wes Quinlan, NADOC-112





DEPARTMENT OF THE NAVY
 NAVAL AVIATION DEPOT
 BUILDING 52
 NAVAL AIR STATION
 PENSACOLA, FLORIDA 32508-5300

IN REPLY REFER TO

13070

342/0100:KMS

28 NOV 1989

From: Commanding Officer, Naval Aviation Depot, Pensacola
 To: Commanding Officer, Naval Air Systems Command, Washington D.C.
 (Attn: J. Thompson AIR-5304B3)
 Commanding Officer, Chief of Naval Aviation Training, Naval Air Station,
 Corpus Christi, TX (Attn: H. Sprinkle N5111)

Subj: LABORATORY REPORT ON THE EVALUATION UNICOAT FINISHED AIRCRAFT, BUREAU
 NUMBERS 162623 AND 162631

Ref: (a) Meeting with CNATRA, NADC, and NAVAVNDEPOT PNCLA, in NAS Corpus
 Christi, of 10 October 1989

Encl: (1) One copy of NAVAVNDEPOT PNCLA Materials Laboratory Report N488-89 of
 6 November 1989

1. As requested in reference (a), an evaluation of the subject aircraft had been
 performed. The report of this action is forwarded in enclosure (1).

O.N. Hayes
 O.N. HAYES
 By direction

Copy to:
 Naval Air Development Center, Warminster PA (6062)



MATERIALS ENGINEERING LABORATORY
 NAVAIR ENGINEERING SUPPORT OFFICE
 NAVAL AVIATION DEPOT
 NAVAL AIR STATION
 PENSACOLA, FLORIDA 32508-5300

IN REPLY REFER TO
 Code 34200

LABORATORY ANALYSIS

REQUESTOR COMNAVAIRSYSCOMS (AIR-5304), NATC (CODE N5111)	RECEIPT DATE
REFERENCE NAS Corpus Christi Trip Report of 10 Oct 89	REPORT DATE 06 NOV 1989
CONTROL NO. N/A	REPORT NO. N488-99

IDENTIFICATION

EVALUATION OF GLOSS WHITE UNITCOAT ON T-34C OVER NON-ALODINED ALUMINUM SURFACE

- Ref: (a) Phoncon between Paul Rippe, U. S. PAINTS, (817)498-6185, and K. M. Sanders, Code 34200, NADEP Pensacola, of 12 October 1989
 (b) Meeting between Steve Harrington, AKZO Coatings, (803)783-6283 and K. M. Sanders, at NADEP Pensacola of 26 October 1989
 (c) Phoncon between Ron Conti, DeSoto Coatings, Chicago, (312) 391-9527 and K. M. Sanders, NADEP Pensacola of 13 October 1989
 (d) Phoncon between Bud Levine, Deft Coatings, (714)474-0400, and K. M. Sanders, NADEP Pensacola of 27 October 1989

- Encl: (1) Corpus Christi Trip Report of 10 October 1989
 (2) T-34 Silhouette showing locations of adhesion tests
 (3) U. S. Paints product data sheet for ALUMIPREP 33
 (4) U. S. Paints product data sheet for AWL-PREP

1. Background: This Depot evaluated two T-34C aircraft finished for the Navy by its contractor, DynCorp, using the newly formulated gloss white Unicoat, self-priming topcoat.

1.1. DynCorp had not surface treated these aircraft with the chemical conversion coating, alodine, prior to paint application. With the contractor located on the Naval installation at NAS Whiting Field, which does not have a treatment facility for handling chrome containing effluent, use of alodine was not permitted.

1.2. T-34C, Bu. No. 161841, had previously been finished by this contractor using Unicoat, and experienced significant adhesion failures. The coating failures had resulted from inadequate preparation of the aluminum skins prior to painting. See enclosure (1).

SEE CONTINUATION SHEET

ORIGINATED K. M. SANDERS <i>K. M. Sanders</i>	REVIEWED R. A. FAORO <i>R. A. Faoro</i>	APPROVED O. N. HAYES <i>O. N. Hayes</i>
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1.3. Mr. Harry Sprinkle, CNATRA, Code N5111, monitored the surface preparation and Unicoat application of the next two consecutive aircraft processed by DynCorp to ensure that appropriate procedures were followed. After the failures incurred by Bu. No. 161841, Mr. Sprinkle requested this Depot, due to its close proximity to NAS Whiting Field and previous use of Unicoat, to evaluate the the coating system on these aircraft.

1.4. Adhesion tests were performed on Bu. No. 162623 on 12 October 1989. The second aircraft had been flight tested and showed no signs of coating failure.

2. Tests and Measurements performed on Bu. No. 162623:

- 2.1. Wet tape adhesion testing IAW MIL-F-18264, paragraph 8.5
- 2.2. Dry Tape Adhesion Test IAW ASTM method D3359
- 2.3. 60° Specular Reflectance IAW ASTM method D523
- 2.4. Total Film Thickness Measurements IAW ASTM method E376

3. Wet Tape Adhesion Test: The upper inboard wing surfaces were prepared over night by DynCorp personnel with wet gauze pads to test water resistance of the painted surface. See the locations shown in enclosure (2). Each location had complete adhesive failure between the coating and the aluminum substrate.

4. Dry Tape Adhesion Tests: Cross-hatched coating adhesion tests were performed around the locations of the wet compresses, and on aircraft fuselage. Tests were performed in flat assessable locations.

4.1. The test score, according to ASTM method D3359 is established as follows: 5 - Perfect adhesion, no paint removed from cross-hatch, to 0 - greater than 65% removal of paint from the cross-hatched pattern.

4.2. The adhesion scores for the right upper wing panels ranged from 3 to 1, always less than 65% of the paint removed. On the left upper wing panel the adhesion was better ranging from 5 to 3. The left fuselage side tested as a 2. See enclosure (2).

5. Film Thickness Measurements: The average total film thickness for the entire aircraft was between 2.0-3.0 mils.

5.1. On the upper wings the coating thickness was generally thin, with measurements ranging from 1.8 to 3.2 mils. The coating on the bottom of the wings was like the upper surfaces ranging 1.9-2.7 mils.

5.2. The control surfaces exhibited better coverage with thicknesses of 2.5-3.3 mils.

5.3. The coating thicknesses on the sides of the fuselage differed from left and right; the right side ranging 2.4 to 3.2 mils, and the left 1.1 to 2.0 mils. The bottom of fuselage varied widely from 1.9 to 4.0 mils.

6. Specular Reflectance Measurements: Gloss ranged from 81 to 90 for the Unicoat, and the mean was 86.

7. Visual Inspection of Second Aircraft: This aircraft, Bu. No. 162631, was finished with Unicoat in the same time frame as 162623. Because this aircraft was in flight test, no destructive tests were performed on the coating system. Exhaust and aviation fluids had stained the coating as was seen on the aircraft at NAS Corpus Christi, Bu. No. 161841, (enclosure (1)). Specular gloss measurements were attempted on cleaned unstained surfaces and these ranged from 75 to 85. No breaks in the coating were noted.

8. Discussion: The coating failures on 162623 usually result from insufficient substrate preparation, and/or a coating deficiency to form bonds with its intended substrate. Because DynCorp coated four test panels from this batch of Unicoat, (two alodine treated and two chemically deoxidized; all panels prepared and surface treated at this Depot), and adhesion tests were perfect for alodine treated panels and good for the untreated panels, a coating deficiency can be ignored. The procedure DynCorp used to process these aircraft was evaluated.

8.1. The two aircraft were cleaned and surface treated as follows:

- 8.1.1. aircraft alkali detergent wash
- 8.1.2. immediate deoxidizing acid treatment, using U. S. Paints' ALUMIPREP 33, P/N 73001. See enclosure (3).
- 8.1.3. water break test
- 8.1.4. drip dry, and cheese cloth wipe down
- 8.1.5. final masking
- 8.1.6. solvent wipe down using U.S. Paints' AWL-PREP, surface cleaner, P/N T0008. See enclosure (4).
- 8.1.7. Unicoat application

8.2. This process was estimated to take 5 hours, and less than one hour elapse between the application of the deoxidizing solution and the application of the Unicoat. Mr. Sprinkle confirmed these time estimates.

8.3. DynCorp reported applying 3 and 4 coats of Unicoat to obtain the desired film thickness previously reported.

8.4. The cleaning and painting hangar was inspected. Differing from the conditions used to paint Bu. No. 161841, the hangar was clean, air filters were in place, and the concrete floor was covered with polyethylene sheeting. Good housekeeping appeared to be in practice.

8.5. U. S. Paints was contacted in reference (a) to review the DynCorp paint preparation process. Mr. Rippe related only one comment concerning the DynCorp process. If a conversion coating could not be used after deoxidizing, then, as

DynCorp has been employing, washpriming before painting becomes necessary. DynCorp's preparation is consistent with the typical process given in U. S. Paints' literature, see enclosure (3).

9. Conclusions: The purpose of the aircraft evaluation at NAS Whiting Field was to determine the satisfaction of DynCorp's preparation and Unicoat application.

9.1. Coating adhesion is not satisfactory, according to paragraph 8.5 of MIL-F-18264.

9.2. Because this batch of Unicoat has passed suitability testing before transportation to DynCorp, as well as testing at time of aircraft application, the breakdown in the mechanics of adhering Unicoat to these aircraft skins must be the quality of the aluminum surface following the aluminum preparation process.

10. Recommendations:

10.1. A water break free surface can be obtained over a oxide-coated surface, free of grease and oil. Since oxide coatings are a weak boundary in the coating and aluminum bond, these must be removed during the deoxidizing process or improved through chemical conversion coating. Chemical conversion is not possible, therefore DynCorp must assure oxide removal. Recommend testing an aircraft surface before painting by applying alodine by sponge or atomization and observing whether a uniform orange/tan film develops. A uniform film indicates a clean surface.

10.2. DynCorp needs adequate finishing equipment (i.e. pressure pots and guns) which will allow its personnel to spray more uniform films.

10.3. Recommend NADC evaluate the UV resistance as well as the cleanability of this formulation of Unicoat. The second aircraft inspected appeared to suffer detrimental effects by both.

10.4. Finally, as was discussed in references (b), (c), and (d), Unicoat as formulated by NADC has advanced military aviation finishing. Its advances over the current Navy coating system does not require repeating here. However, the current formulation has the following barrier to its introduction to marketing: a short pot life. The industry representatives in the above references do not see this as a great barrier to their chemists, however each has their own way of overcoming it. This Depot recommends that the NAVAIR contract its own laboratory to formulate a system with a stable usable potlife. This may include changing the pigment to resin ratio, or changing resin systems. None of these vendors have the primary interest of protecting the Navy's weapon systems as NADC has had, therefore the most responsible agent for overcoming the potlife barrier is the Navy.

MATERIALS ENGINEERING DIVISION
PRODUCT SUPPORT DIRECTORATE
NAVAL AVIATION DEPOT
NAVAL AIR STATION
PENSACOLA, FLORIDA 32508-5300

From: Kenneth M. Sanders, Code 34200, AV 922-3553
To: Code N5111, Naval Air Training Command
Attn: Harry Sprinkle
Purpose: Inspection of Gloss White Unicoat Failure

Subj: TRIP REPORT ON UNICOAT FAILURE ON T-34C, BU. NO. 161841, AT NAS
CORPUS CHRISTI

Ref: (a) Naval Air Development Center request of 6 October 1989
(b) NAS Whiting Field Trip Report of 12 July 1989, same author

1. Per Reference (a), I joined Donald Hirst and Charles Hegedus of NADC, and Mr. Sprinkle to inspect the subject aircraft.
2. Background: As reported in reference (b), no alodine was used in finishing the aircraft because NAS Whiting, location of T-34 overhaul, lacks waste treatment facilities for treating effluent containing chrome. Therefore, CNATRA is evaluating Unicoat with the expectation that satisfactory adhesion may be obtained without the surface treatment. The adhesion failures experienced on 161841 were assumed not to have resulted from deficient Unicoat material, because DynCorp coated four test panels, (two alodine treated and two chemically deoxidized, prepared and surface treated at this Depot), and adhesion tests were perfect for alodine treated panels and good for the untreated panels. No blistering occurred during water immersion tests.
3. I gathered the following information from the inspection:
 - a. Metal surfaces in areas of Unicoat failures had a good mechanical tooth, i.e. the surfaces were not a hard anodized or unprepared new metal.
 - b. As previously stated, no alodine was used in the preparation of the aluminum surfaces, and none was evident in the failed areas.
 - c. All failures originated at edges of aluminum skins. The coating at the edges of these skins was typically thick. Adjacent to failures the coating was easily peeled from the aluminum surfaces. Most failures occurred in areas where the coating was chipped or subject to high stresses during flight.
 - d. Coating thicknesses varied greatly over the surface of the aircraft, from 1.5 to 6.0 mils. Areas where peeling occurred had thicknesses greater than recommended limits, (>3.0 mils). Dry tape adhesion tests performed on these areas found the potential for lifting greater than those in thinner film thicknesses, (< or = 3.0 mils).
4. DynCorp personnel also reported difficulty to remove fuel, oil, and exhaust stains using standard aviation cleaning compounds.
5. I conclude from this inspection and the experience reported in reference (b), the loss of coating adhesion results from the absence of

a satisfactory surface for molecular adhesion. Reference (b) reported the difficulty the DynCorp personnel had in removing organic surface contaminants and the long delay, (greater than eight hours) between the deoxidizing process and the actual finishing of the aircraft. A reactive surface for paint adhesion was not possible. Therefore, once the coating was broken, or a heavy edge reached critical stress, peeling action resulted.

6. Action:

a. I was requested by the inspection team to evaluate two T-34's recently painted at DynCorp (Whiting Field), which were stringently treated and finished, and report the effectiveness of coating adhesion.

b. NADC will provide CNATRA information on a non-rinse chromated conversion coating for establishing an effective surface treatment for use at NAS Whiting Field.

c. NADC suggested DynCorp evaluate MIL-C-85570 Type V, thickened aviation detergent for removing coating stains. NADC's Ken Clark will be POC for additional assistance.

Kenneth M. Sanders

BU. NO. 162623

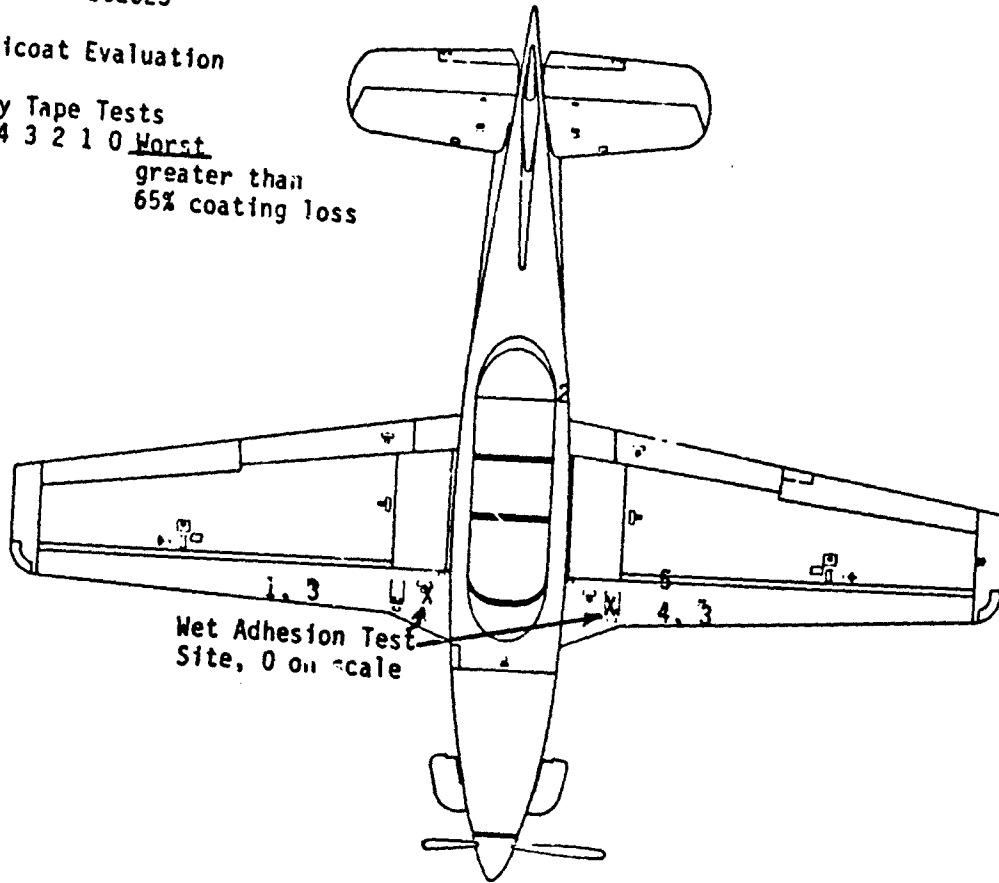
G 25

Unicoat Evaluation

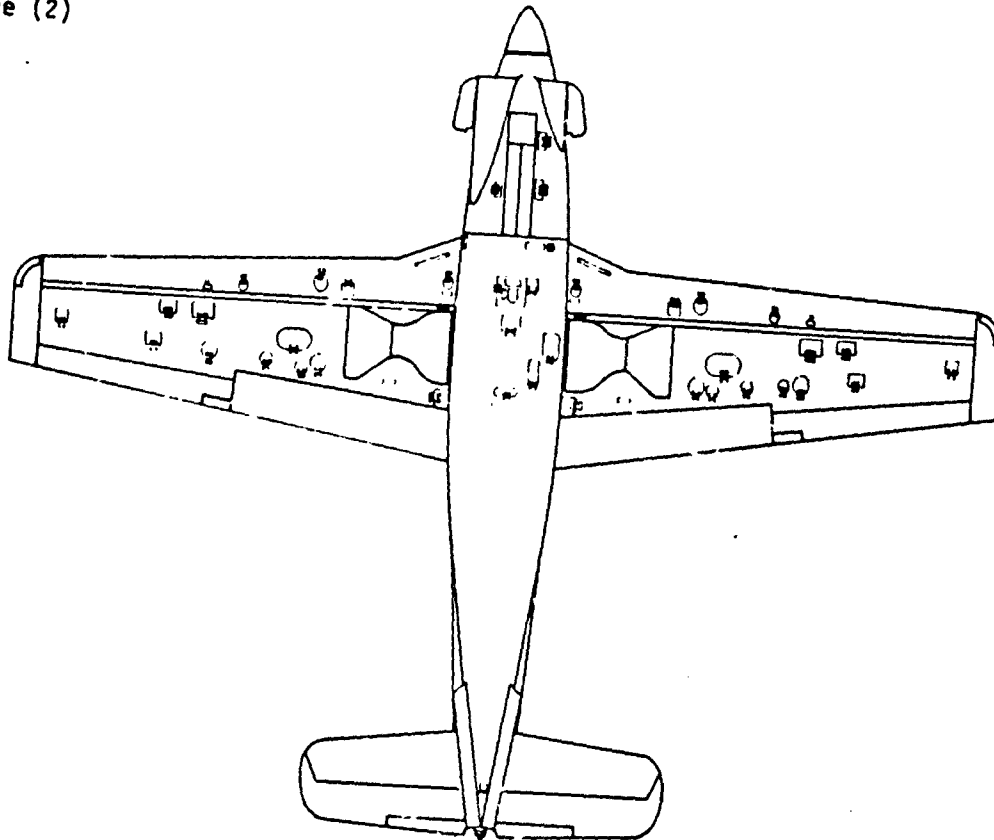
Dry Tape Tests

Best 5 4 3 2 1 0 Worst

greater than
65% coating loss



Enclosure (2)





Features & Uses

ALUMIPREP® 33 is a non-flammable phosphoric acid based cleaning, brightener and prepaint condition for aluminum. ALUMIPREP® 33 should not be used on high copper bearing aluminum alloys or aluminum castings. ALUMIPREP® 33 cleaning and conditioning chemical leaves the aluminum surface chemically clean and corrosion free.

ALUMIPREP® 33 can be used to deep clean and brighten an aluminum surface prior to welding, painting or to prepare the surface for a subsequent chemical coating. ALODINE® 1201 (opaque) and ALODINE® 1001 (invisible) coating chemicals produce the best affordable substrate for both paint adhesion and corrosion resistance.

Summary of Operating Data

Brush Application: For light oxidation and corrosion removal dilute one part ALUMIPREP® 33 with five parts of water.

For heavy oxidation and corrosion removal dilute one part ALUMIPREP® 33 with two parts water.

Immersion Application: For each 100 parts of bath, add 25 parts of ALUMIPREP® 33 to 75 parts water.

Spray Application using 62-G Applicator®: Set dilution control on 3 allowing a mix of one part ALUMIPREP® 33 to three parts of water.

*Product from Amchem.

Process Sequence

To clean and condition aluminum:

Step No. 1—Apply the diluted ALUMIPREP® 33

Step No. 2—Allow the solution to react

Step No. 3—Thoroughly rinse with water

Step No. 4—Dry

To prepare the aluminum for a chemical coating:

Step No. 1—Apply the diluted ALUMIPREP® 33

Step No. 2—Allow the solution to react

Step No. 3—Thoroughly rinse with water

Step No. 4—Apply ALODINE® per label instructions

Step No. 5—Thoroughly rinse with water

Step No. 6—Dry

The work, after processing and drying, is ready to be painted.

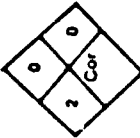
Application

Selecting the size area to be treated at one time will depend on the method of application, condition of the metal surface, method in which the surface was cleaned, temperature and part configuration. A typical treatment time is where ALUMIPREP® 33 cleaning and conditioning chemical is in contact with the aluminum between one and two minutes. The ALUMIPREP® 33 cleaning and conditioning chemical should not be allowed to dry on the metal surface or permitted to reoxidize prior to a thorough rinse.

ALUMIPREP® 33 cleaning and conditioning chemicals normally applied at temperatures between room and 120°F. (49°C). Enough temperature to clean within two minutes time without drying is optional. If drying does occur, rewet with the diluted ALUMIPREP® 33, prior to water rinsing.

A thorough rinse with clean water is necessary to remove both residual ALUMIPREP® 33 cleaning and conditioning chemicals and oils that have been lifted from the metal surface.

ANCHEM PRODUCTS, INC.
 Division of Harsco Corporation
 300 Brookside Avenue
 Allentown, PA 19102



MATERIAL SAFETY DATA SHEET

PRODUCT TRADE NAME: Anchemp 23 73801
 DOT PROPER SHIPPING NAME: Rust Preventing Compounds
 DOT HAZARD CLASSIFICATION: Corrosive
 TECHNICAL CONTACT (NAME): Charles Grubbs
 TELEPHONE NUMBER (215) 429-1384 EMERGENCY NUMBER (215) 638-1000

1 HAZARDOUS INGREDIENTS

MATERIAL	CAS NO	CONTENTS (N.WT/WT)	HAZARD	TLV
Phosphoric Acid	7664-38-2	20-30	Corrosive	1 mg/m ³
Sulfur Compounds	111-76-2	10-15	Irritant	120 mg/m ³
Potassium Fluoride	7789-23-3	1-3	Irritant	N/A

2 PHYSICAL DATA

APPEARANCE: Clear, odorless liquid
 SOLUBILITY IN WATER: Complete
 ODOR @ 80°F: Slight acetone
 PH OF CONCENTRATE: 1-2
 SPECIFIC GRAVITY @ 80°F: 1.13-1.15
 BOILING POINT °F: >212
 OTHER: N/A

3 FIRE AND EXPLOSION DATA

FLASH POINT: 145°F TEST METHOD: TCC EXTINGUISHING MEDIA: Water
 UNUSUAL FIRE OR EXPLOSION HAZARDS: None
 SPECIAL FIRE FIGHTING PROCEDURES: None

4 REACTIVITY DATA

STABLE UNSTABLE

CONDITIONS TO AVOID: N/A

INCOMPATIBLE MATERIALS: Alkalis and strong oxidizers

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
 WILL OCCUR

HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of phosphorus and carbon

5 HEALTH HAZARD DATA

Skin: Will irritate and may burn
 Eyes: Will irritate and may burn
 Ingestion: Will irritate and may burn mucous membranes
 Inhalation: VMA irritate and may burn mucous membranes if prolonged

6 FIRST AID RECOMMENDATIONS

Skin: Wash with soap and water and rinse thoroughly. Anyone who appears to suffer skin burns from this product should be seen by a doctor.
 Eyes: Flush immediately with copious amounts of water for at least 15 minutes. Call a doctor.
 Ingestion: Drink milk of magnesia, aluminum hydroxide gel, or water. Followed by several glasses of water. Call a doctor. Do not induce vomiting unless directed by a doctor.
 Inhalation: Remove from contaminated area to fresh air.



7 SPILL PROCEDURES & WASTE DISPOSAL

August 1993

SPILL PROCEDURES

Transfer any excess to a clear, 20-gal. waste container. Neutralize remaining residue with dilute soda ash or lime to pH 7-9.

WASTE TREATMENT

Flush neutralized material to treatment plant with plenty of water and with approval of regulatory agency.

8 PERSONAL PROTECTION

VENTILATION REQUIREMENTS

- GENERAL AREA EXHAUST
- LOCAL EXHAUST
- NO EXHAUST NECESSARY

PERSONAL PROTECTIVE EQUIPMENT

- EYE PROTECTION Safety goggles
- SKIN PROTECTION Rubber gloves and rubber apron
- RESPIRATORY PROTECTION Acid mist mask - NIOSH approved
- OTHER REQUIRED EQUIPMENT None

9 SPECIAL PRECAUTIONS AND STORAGE

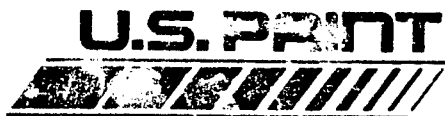
Store in a cool place

PREPARED BY Charles Cruzikas
TITLE Senior Chemist

DATE 3 31 86 R 11 10 86

SHEET 3 OF 3





AWL-PREP™

Surface Cleaner

T0008

Shipping

Freight Classification: Compound Reducing Liquid
NA1142 Flammable

Packaging: 4 qts., 4 gals.

Shipping Weights: 8 lbs., 34 lbs.

Specification Data

Color: Clear

Solids: 0

Flash Point: 40°F. (T.C.C.)

Wt./Gal: 6.7-6.9 lbs.

Mixing and Thinning

Not Applicable

Application

Saturate a clean cloth with AWL-PREP™ Flood surface with solvent. Blot dry with a second clean cloth, lifting the solvent and contaminants off the surface rather than rubbing them in. Do not let solvent dry on the surface. Change cloths frequently! DO NOT USE SHOP TOWELS. They are frequently contaminated with hydrocarbons and cleaning chemicals.

Safety

CONTAINS: ETHYL ALCOHOL, ALCOHOL, ESTERS.

WARNING! FLAMMABLE

VAPOR HARMFUL. BREATHING OF VAPOR MAY CAUSE IRRITATION. CAUSES EYE IRRITATION. LIQUID CAUSES EYE BURNS. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. CANNOT BE MADE NON-POISONOUS.

FIRST AID: In case of skin contact, flush with plenty of water; for eyes, immediately flush with plenty of water for 15 minutes and get medical attention. If exposed to high concentration of vapor, remove to fresh air. If swallowed, CALL A PHYSICIAN IMMEDIATELY. Induce vomiting.

Keep away from heat, sparks and open flame. Do not use in confined area or near pilot lights or non-explosion-proof electrical equipment. Use only with adequate ventilation. Avoid breathing of vapor or spray mist. Avoid contact with eyes and skin. Wear eye protection and impervious clothing and equipment. Exposure controls may require the use of a NIOSH/MSHA approved combination vapor/particulate or air supplied respirator. Do not take internally. Keep closures tight and upright to prevent leakage. Keep container closed when not in use. In case of spillage, absorb and dispose of in accordance with local applicable regulations.

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Date 7 February 1984

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ENCLOSURE (4) SHEET 1 of 3

831 South 21st Street
St. Louis, Missouri
63103-3092

Telephone 314 621-0525
TWX 910 761-1209
(U.S. Paint Std.)



Division of Grow Group, Inc.

MATERIAL SAFETY DATA SHEET

FOR COATINGS, RESINS, AND RELATED MATERIALS

DATE OF PREPARATION -- 10-14-1985 R12-16-1985

SECTION I

MANUFACTURER U. S. PAINT
DIVISION OF GROW GROUP, INCORPORATED
831 S. 21st Street
St. Louis, Missouri 63103

INFORMATION (314) 621-0525

EMERGENCY (314) 621-0525

PRODUCT CLASS SOLVENT BLEND

TRADE NAME AM-FREX Surface Cleaner

CODE T0008

SECTION II -- HAZARDOUS INGREDIENTS

INGREDIENT [COMMON NAME] [CHEMICAL NAME]	WEIGHT %	ACGIH TLV (PPM)	OSHA PEL (PPM)	VAPOR PRESSURE (mm Hg)
DEAETHYL ETHYL ALCOHOL	100	1000	1000	40
ETHANOL	100	1000	1000	40

* Values given are in mg/m³

MA -- Not available

ME -- Not established

Care should be taken when handling pigmented paints. Airborne substance particulates have an ACGIH TLV of total dust a 10 mg/M³.

This material does not contain intentionally added ingredients which are based on compounds of antimony, arsenic, cadmium, lead, mercury, selenium, or water soluble barium.

SECTION III -- PHYSICAL DATA

WEIGHT PER GALLON 5.59 lbs. **VOLUME PERCENT VOLATILE** 100

BOILING RANGE 167°F -- 172°F

EVAPORATION RATE -- Slower than Ether

VAPOR DENSITY ----- Heavier than Air

SECTION IV -- FIRE AND EXPLOSION HAZARD DATA

DANGER! -- FLAMMABLE

VAPORS MAY CAUSE FLASH FIRE

FLASH POINT 41°F TCC

LEL 3.30

EXTINGUISHING MEDIA -- Dry Chemical or Foam

UNUSUAL FIRE AND EXPLOSION HAZARDS -- Keep away from heat, sparks, and flame. Do not smoke. Extinguish all pilot lights and turn off all sources of ignition, including heaters, fans, and other non-explosion-proof electrical equipment, during use and until all vapors are gone. Vapors may ignite explosively. Vapors may spread long distances and beyond closed doors. Prevent build up of vapors by maintaining a continuous flow of fresh air.

SPECIAL FIREFIGHTING PROCEDURES -- Self contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. In case of fire, use CO₂ Dry Chemical Foam, or other approved method for treating Class B fire. Summon professional firefighters.

SECTION V -- HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE (ACUTE)

EYES Can cause severe irritation, redness, tearing and blurred vision.
SKIN Prolonged or repeated contact can cause moderate irritation, defatting, and dermatitis.
BREATHING Excessive inhalation of vapors can cause nasal and respiratory irritation, dizziness, weakness, fatigue, nausea, headache, possible unconsciousness, and even asphyxiation.
SWALLOWING INGESTION IS HARMFUL and can cause a burning sensation, nausea, vomiting, and diarrhea.

ADDITIONAL EFFECTS OF OVEREXPOSURE (CHRONIC)

WARNING: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

Primary Route(s) of Entry (x)skin (x)breathing (x)swallowing



WASTE DISPOSAL METHOD

Allow volatile portion to evaporate in hood being sure to allow sufficient time for vapors to completely clear hood duct work. Dispose of contaminated absorbent, containers, and unused contents in accordance with local, state, and federal regulations. Do not incinerate closed containers.

SECTION VIII - PROTECTIVE EQUIPMENT

VENTILATION/RESPIRATORY PROTECTION

Use only with adequate ventilation. Maintain continuous flow of fresh air. Do not breathe vapors, spray mists, or seeding dusts. Wear appropriate, properly fitted respirator (NIOSH/MSHA approved) during and after application unless air monitoring demonstrates vapor, mist, and particulate levels are below applicable limits. Follow respirator manufacturer's directions for respirator use. Engineering or administrative controls should be implemented to reduce exposure. Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below TLV(a).

PERSONAL PROTECTIVE EQUIPMENT

Do not get in eyes, on skin, or on clothing. Use solvent resistant safety eyewear with splash guards. Solvent impermeable gloves, clothing, and boots are recommended to prevent skin contact.

SECTION IX - SPECIAL PRECAUTIONS AND ADDITIONAL COMMENTS

Keep closure tight and upright to prevent leakage. Keep container closed when not in use. Do not store above 120°F. Do not transfer contents to bottles or other unlabeled containers. Containers of this material may be hazardous when emptied because they retain product residues (vapor, liquid, and/or solid). All hazard precautions given in this data sheet must be observed. **IMPOURABLE!** This product may be blended with other products prior to use. Read all warnings and precautions on the labels of all products being blended as the combination may contain the hazards of each component.

NON-WARRANTY

The information presented herein, while not guaranteed, is to the best of our knowledge true and accurate. No warranty or guarantee expressed or implied is made regarding the performance of any product, since the manner of use is beyond our control. No suggestion for product use, nor anything contained herein, shall be construed as a recommendation for its use in infringement of any existing patent, and Grew Group assumes no responsibility or liability for operations that do infringe any such patents.

FOR INDUSTRIAL USE ONLY
By professionals, trained personnel using proper equipment. Not intended for sale to, or use by, the general public.

FIRST AID

IN CASE OF SKIN CONTACT: Wash area thoroughly with soap and water. Remove soiled clothing. Get medical assistance if irritation persists. Wash clothing before reuse.

IN CASE OF EYE CONTACT: Flush with large amounts of water for at least 15 minutes. Get medical assistance.

IF SWALLOWED

Induce vomiting immediately by giving two glasses of water and sticking fingers down throat. **GET MEDICAL ATTENTION IMMEDIATELY.** Never give anything by mouth to an unconscious person.

IF INHALED

If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, summon medical assistance immediately. If breathing ceases, restore using approved CPR techniques and summon medical help immediately.

SECTION VI - REACTIVITY DATA

HAZARDOUS POLYMERIZATION -- Can not occur. **STABILITY** -- Stable.

MATERIALS TO AVOID

Excess heat and/or oxidizing materials.

HAZARDOUS DECOMPOSITION: NONE KNOWN

SECTION VII - SPILL OR LEAK PROCEDURES

SMALL SPILL Absorb liquid on inert material such as paper, vermiculite, floor absorbent, and transfer to hood.

LARGE SPILL Eliminate all ignition sources (flares, flames including pilot lights, electrical sparks). Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed. Stop spill at source, contain area of spill to prevent spreading. Pump liquid to salvage tank. Remaining liquid may be absorbed with inert materials such as sand, clay, earth, or floor absorbent, and shoveled into containers. Prevent run-off to sewers, streams, or other bodies of water. If run-off occurs, notify the proper authorities as required that a spill has occurred.



NAVAL AIR DEVELOPMENT CENTER
AEROSPACE MATERIALS DIVISION
WARMINSTER, PA 18974-5000

ENGINEERING REPORT

FROM: Protective Organic Coatings Team, Code 6062, (215)441-3269

PREPARED BY: Donald Hirst and Anthony Eng

SUBJECT: Evaluation of pretreatment/UNICOAT finishing system

DATE OF REPORT: 6 December 1989

BACKGROUND: In February 1989, the commanding officer at NAS Whiting Field prohibited the disposal of chromate containing materials in their waste treatment plant. After learning of the good performance of low gloss UNICOAT on chemically deoxidized aluminum surfaces (using corrosion removing compound Mil-C-10578) at NADEP Pensacola, CNATRA decided to paint their T-34's with a similar non-chromated high gloss UNICOAT finishing system. In July and August 1989 at NAS Whiting Field, three T-34's (Buno 161841, 162631 & 162623) were painted with gloss white UNICOAT over a chemically deoxidized surface (Alumiprep 33 applied with a non-abrasive pad). Appendix A of this article contains the detailed preparation procedures for the T-34 and H-3 aircraft. In October 1989, NADC was informed of adhesive failures of UNICOAT on T-34 Buno 161841. In November 1989, NADC and NADEP Pensacola personnel investigated the condition of T-34 Buno 161841 stationed at NAS Corpus Christi. Ken Sanders of NADEP Pensacola also investigated the condition of the other two T-34's (Buno 162631 & 162623) at NAS Whiting Field. Due to a rigid flight test schedule, only a visual inspection could be performed on Buno 162631, which showed no adhesive failures. Buno 161623 was thoroughly inspected and the coating adhesion was evaluated based on crosshatch adhesion testing. This test indicated that the coating had poor adhesion to the substrate. However, Mr. Sanders attributed this lack of adequate adhesion to surface preparation rather than to the inherent adhesive strength of UNICOAT.

EVALUATION PROGRAM: In order to determine appropriate chrome and non-chrome treatments prior to UNICOAT application, NADC initiated a laboratory evaluation program. The following describes the evaluation program variables, test procedure, results, conclusions, and recommendations.

Variables

Pretreatments: All test panels were cleaned with Mil-C-85570 Type I (diluted 1/9 by volume with tap water) using a white non-abrasive pad (Mil-C-83957) and then allowed to air dry. All test panels consisted of 7075 bare aluminum except for the panels conversion coated by Q-panel which were 2024 T3 bare aluminum. The various pretreatments evaluated were:

- A. Chromate conversion coating Mil-C-81706 (prepared by Q-Panel Co)
- B. Chromate conversion coating Mil-C-81706 (prepared by NADC)
- C. Chemical deoxidizing using a corrosion removing compound Mil-C-38334 Type I, Class 1 (diluted 1/1 by volume with tap water) and applied with a white non-abrasive pad (Mil-C-83957) for about 5 minutes. Rinsed

thoroughly with tap water to a water break-free condition and allowed to air dry. Mil-C-38334 and Mil-C-10578 (used on H-3 at NADEP Pensacola) are both phosphoric acid based and produce similar effects on aluminum.

D. Physical deoxidizing using a red abrasive pad (Mil-A-9962) while cleaning with Mil-C-85570 Type I for about 5 minutes. Rinsed thoroughly with tap water to a water break-free condition and allowed to air dry.

E. Chemical deoxidizing using Alumiprep 33, a US Patent corrosion removing compound (diluted 1/4 by volume with tap water), applied with a white non-abrasive pad (Mil-C-83957) for about 5 minutes. Rinsed thoroughly with tap water to a water break-free condition and allowed to air dry.

F. Wash priming with Mil-C-8514 applied to a thickness of 0.5 to 0.7 mils using conventional air-atomizing siphon cup spray equipment. Allow to air dry.

Coatings: All coatings were applied within 4 to 4.5 hrs after the pretreatment to a thickness of 1.8 to 2.2 mils using conventional air-atomizing siphon cup spray equipment. All coatings were allowed to cure for 7 days at ambient laboratory conditions (75°F). The coatings evaluated in this program were:

1. Gloss white UNICOAT (retain sample from NAS Whiting Field)
2. Gloss white UNICOAT (manufactured in NADC lab)
3. Flat gray UNICOAT (manufactured by Coatings For Industry)

Test Procedure

Method: After allowing all of the coatings to reach full cure (7 days @ 75°F), the adhesion tests were performed by subjecting the test specimens to dry/ambient, wet/ambient, and wet/accelerated test conditions, applying a 1" wide 3M #250 masking tape over an X scribe within two parallel scribe lines (3/4" separation) and then lifting rapidly and smoothly. The following rating system (from ASTM D3359) was used to determine the coating adhesion by tape test:

- 5A - No peeling or removal
- 4A - Trace peeling or removal along incisions
- 3A - Jagged removal up to 1/16" on either side on incisions
- 2A - Jagged removal along most of incision up to 1/8" on either side
- 1A - Removal from most of the area of the X under the tape
- 0A - Removal beyond the area of the X

Evaluation Criterion: A rating of 5A or 4A is considered acceptable.

Test Conditions:

- I. Dry, 75°F
- II. Distilled Water Immersion, 24 hr, 75°F
- III. Distilled Water Immersion, 72 hr, 120°F
- IV. Distilled Water Immersion, 120 hr, 150°F

Test Results

TAPE TEST ADHESION RATING

Pretreatment	Condition	Gloss White UNICOAT (Whiting)	Gloss White UNICOAT (NADC)	Flat Gray UNICOAT (CFI)
A	Dry, 75°F	5	5	5
A	H ₂ O, 24 hr, 75°F	5	5	5
A	H ₂ O, 72 hr, 120°F	5	5	5
A	H ₂ O, 120 hr, 150°F	5	5	3
A	AVERAGE RATING	5.00	5.00	4.50
B	Dry, 75°F	5	5	5
B	H ₂ O, 24 hr, 75°F	5	5	5
B	H ₂ O, 72 hr, 120°F	2	5	5
B	H ₂ O, 120 hr, 150°F	4	5	5
B	AVERAGE RATING	4.00	5.00	5.00
C	Dry, 75°F	5	5	5
C	H ₂ O, 24 hr, 75°F	5	5	5
C	H ₂ O, 72 hr, 120°F	5	5	5
C	H ₂ O, 120 hr, 150°F	5	5	4
C	AVERAGE RATING	5.00	5.00	4.75
D	Dry, 75°F	5	2	5
D	H ₂ O, 24 hr, 75°F	0	0	0
D	H ₂ O, 72 hr, 120°F	0	0	0
D	H ₂ O, 120 hr, 150°F	0	0	0
D	AVERAGE RATING	1.25	0.50	1.25
E	Dry, 75°F	5	5	5
E	H ₂ O, 24 hr, 75°F	1	0	0
E	H ₂ O, 72 hr, 120°F	4	5	0
E	H ₂ O, 120 hr, 150°F	5	5	0
E	AVERAGE RATING	3.75	3.75	1.25
F	Dry, 75°F	5	5	5
F	H ₂ O, 24 hr, 75°F	2	4	4
F	H ₂ O, 72 hr, 120°F	3	4	4
F	H ₂ O, 120 hr, 150°F	5	5	5
F	AVERAGE RATING	3.75	4.50	4.50

Pretreatments: A - Chromate Conversion Coating (Q-Panel)
 B - Chromate Conversion Coating (NADC)
 C - Chemical Deoxidize (Mil-C-38334)
 D - Physical Deoxidize (Mil-A-9962)
 E - Chemical Deoxidize (Alumiprep 33)
 F - Wash Primer (Mil-C-8514)

Conclusions

The conclusions made from these test results with regard to adhesion are:

1. The batch of gloss white UNICOAT used to paint the three T-34's at NAS Whiting Field was good.
2. Aluminum surfaces pretreated with a chromate conversion coating conforming to Mil-C-81706 or a chemical deoxidizer conforming to Mil-C-38334 using a non-abrasive pad conforming to Mil-C-83957 performed well when coated with gloss or flat UNICOAT.
3. Chemical deoxidizing using US Paints' Alumiprep 33 as the sole pretreatment process did not prove to be adequate for gloss or flat UNICOAT.
4. Physical deoxidizing using a red abrasive pad (Mil-A-9962) while cleaning with Mil-C-85570 Type I as the sole pretreatment process did not prove to be adequate for gloss or flat UNICOAT. Note: NADEP Jacksonville successfully applied flat gray UNICOAT over a physically deoxidized surface (port side only) of a P-3 in August 1989. See Appendix A for the detailed surface preparation procedure for this aircraft.
7. Wash priming using Mil-C-8514 (contains chromates) in conjunction with UNICOAT, although promising in terms of adhesion, does not appear to be a viable alternative to either Mil-C-81706 or Mil-C-38334 with UNICOAT.

Recommendations

The following recommendations are made with respect to the application of UNICOAT (flat and gloss):

1. A chemical deoxidizer (or corrosion removing compound) conforming to Mil-C-38334 can be used as the single pretreatment to activate the aluminum surface prior to the application of UNICOAT. This pretreatment can be used where environmental regulations restrict the use of chromates. A chromate conversion coating conforming to Mil-C-81706 can be used as the pretreatment for UNICOAT.
2. Painting should be performed within 4 hrs of pretreatment step.
3. All other substrate preparation and paint application procedures shall conform to NAVAIR 01-1A-509.
4. See Appendix B for the recommended surface pretreatment, materials handling, and application procedures for the UNICOAT finishing system.

Donald F. Heiser
Anthony T. Egan

APPENDIX A - Surface Preparation Procedures Used For The UNICOAT Finishing System At Several Navy Activities

T-34 Buno 161841 (7/89 NAS Whiting Field - Chemical Deoxidizing)

- strip paint from aircraft
- alkali detergent wash
- chemical deoxidizing (US Paints Alumiprep 33) applied with non-abrasive pad Mil-C-83957 for 3 minutes
- water rinse (to break-free condition) and allow to air dry
- next day mask and tape
- MEK wipe
- tack cloth
- apply gloss white UNICOAT (30 hr after deoxidizing) (manuf. by Coatings For Industry)

T-34 Buno 162631 (8/89 NAS Whiting Field - Chemical Deoxidizing)

- strip paint from aircraft
- alkali detergent wash
- next day chemical deoxidizing (US Paints Alumiprep 33) applied with non-abrasive pad Mil-C-83957 for 3 minutes
- water rinse (to break-free condition) and dry with air hose
- mask and tape
- solvent (US Paints Alumiprep T0008) wipe
- tack cloth
- apply gloss white UNICOAT (4 hr after deoxidizing) (manuf. by CFI)

T-34 Buno 162623 (8/89 NAS Whiting Field - Chemical Deoxidizing)

- strip paint from aircraft
- alkali detergent wash
- next day chemical deoxidizing (US Paints Alumiprep 33) applied with non-abrasive pad Mil-C-83957 for 3 minutes
- water rinse (to break-free condition) and dry with air hose
- mask and tape
- solvent (US Paints Alumiprep T0008) wipe
- tack cloth
- apply gloss white UNICOAT (4 hr after deoxidizing) (manuf. by CFI)

H-3 Buno 148049 (6/88 NADEP Pensacola - Chemical Deoxidizing)

- strip paint from aircraft
- wash with Mil-C-85570 Type I
- water rinse (to break-free condition)
- chemical deoxidize with corrosion removing compound Mil-C-10578 applied with a non-abrasive pad conforming to Mil-C-83957 for 5 to 7 minutes
- water rinse (to break-free condition)
- mask and tape
- tack cloth
- paint with flat gray UNICOAT (manuf. by CFI)

P-3 Buno 148889 (8/89 NADEP Jacksonville - Physical Deoxidizing)

- paint stripped from aircraft
- scrub with Mil-T-6096A and Mil-C-87936 Type I using 3M Co #7447 abrasive pads
- water rinse
- steam clean
- wash with Mil-C-87936 Type I using 3M #7447 abrasive pads
- conversion coat (Mil-C-81706) on starboard side only
- wash with Mil-C-87936 Type I using 3M #7447 abrasive pads (port side) and 3M non-abrasive pads (starboard side)
- mask and tape
- paint with flat gray UNICOAT (manuf. by CFI)

APPENDIX B - The Recommended Surface Preparation, Materials Handling, and Application Procedures For The UNICOAT Finishing System.

Aircraft Preparation

- strip paint from aircraft
- wash with Mil-C-85570 Type I (diluted 1/9 by volume with water)
- water rinse (to break-free condition)
- chemical deoxidize with corrosion removing compound Mil-C-38834 Type I Class 1 (diluted 1/1 by volume with water) applied with a non-abrasive pad conforming to Mil-C-83957 for 12 but not more than 20 minutes
- apply chromate conversion coating conforming to Mil-C-81706; this step can be omitted if chromate-free finishing system is desired
- water rinse (to break-free condition) and allow to air dry
- mask and tape
- tack cloth
- prepare and apply UNICOAT
- UNICOAT application should be performed within 4 hr of the last chemical surface treatment process (deoxidizing or chromate conversion)

UNICOAT Storage

- promptly store UNICOAT in a refrigerated area (but not less than 35°F) whenever possible; this will significantly increase shelf-life and maintain the current pot life property

Mixing Individual Components

- mix part A (pigmented) by mechanical or manual techniques in 5 - 10 minute intervals until uniform or homogeneous
- check for caking or settling at the bottom
- Caution: do not excessively shake, mix, or stir such that significant air bubbles are produced; excessive dispersing will generate heat which will decrease pot life
- part B (resin only) does not need to be mixed

Mixing Catalyzed Paint

- mechanically or manually stir the appropriate amount (per paint manufacturer's instructions) of part B into part A for 1 - 3 minutes or until thoroughly dispersed.

Thinning

- to obtain the self-priming topcoat compliant VOC of 420 g/l for all types/colors of UNICOAT, thin the admixed paint with MIL-T-81772 Type I at the prescribed volume or weight (per manufacturer's instructions)
- or
- to obtain non-VOC compliant flat or low gloss UNICOAT, thin the admixed paint to a Zahn #2 spray viscosity of 20 - 25 seconds depending on the spray application atomization technique (conventional, airless, air-assisted airless, or HVLP) and delivery system (siphon feed or pressurized feed)

or

- to obtain non-VOC compliant high gloss UNICOAT, thin the admixed paint to a Zahn #2 spray viscosity of 25 - 30 seconds

Application

- apply two full cross-coats for flat UNICOAT and three full cross-coats for gloss UNICOAT to a dry film thickness of 2.0 - 3.0 mils
- check the viscosity of the feed material after 30 minutes and at 15 minute intervals thereafter for paint thickening
- if the Zahn#2 viscosity exceeds 60 seconds, purge the system and dispose of the material

NAVAL AIR DEVELOPMENT CENTER
AEROSPACE MATERIALS DIVISION (CODE 606)
WARMINSTER, PA 18974-5000

TRIP REPORT

From: William J. Green, Code 6062, A/V 441-1644, (215)441-1644

Subj: Evaluation Of UNICOAT On T-34's At NAS Corpus Christi

Date Of Report: 29 March 1990

At the end of January 1990, two T-34's (Buno 160271 & 160960) were pretreated with a phosphoric acid-based deoxidizer Mil-C-38334 and painted with gloss white UNICOAT at NAS Whiting Field, FL. The surface preparation and paint application procedures were performed as per NADC recommended instructions for a totally non-chromated UNICOAT finishing system. These two aircraft have been in service at CNATRA/NAS Corpus Christi, TX since the beginning of February 1990.

On 27 - 28 March 1990, I visited Harry Sprinkle (CNATRA) at NAS Corpus Christi and began my analysis of the condition of UNICOAT on the above T-34's. From a visual inspection, these two aircraft were in excellent condition. UNICOAT was intact even in the high flex areas (i.e. around fastener patterns). The thickness of the UNICOAT film on Buno 160271 was approximately 2 mils over most of the aircraft which is exactly at the recommended thickness. Scattered readings as high as 2.8 mils were also recorded. The average film thickness on Buno 160960 was about 4 mils but were found to be as high as 7 mils. The average 60 degree gloss on both aircraft was about 70. Four dry tape adhesion tests and one wet tape adhesion test (24 hrs water immersion @ RT) were performed on both aircraft. The tape adhesion test method consists of scribing through the coating to the substrate in single, smooth strokes. The scribe pattern consists of an X within two parallel lines separated by 3/4 inch. One inch wide (3M Corp #250) masking tape is applied over the scribe pattern and then lifted rapidly and smoothly. The scribe pattern used was specifically designed to produce sharp intersecting angles that tend to be more readily removed by the masking tape than the scribe pattern used in the standard paint adhesion tests ASTM D 3359 and FTMS No 141C Method 6301.2. The dry tape adhesion test is an indicator of only dry adhesion strength whereas the wet tape adhesion test is a relative indicator of both water permeability resistance and wet adhesion strength. On both aircraft, three out of four dry tape adhesion tests performed on the wing and tail sections passed with only trace peeling along the scribe marks. The failed dry tape tests produced about 50% removal of the coating from the substrate in the scribed area. On both aircraft, the wet tape adhesion tests produced coating failures. The wet tape failure on Buno 160271, produced 40% coating removal in the scribed area. The wet tape failure on Buno 160960 produced 100% coating removal in the scribed area with delamination extending into the unscribed area. In general, a thicker coating film will have lower adhesion strength than a thinner film of the same composition. This is the case for the 4 mil coating on Buno 160960 with 100%

delamination versus 40% delamination for the 2 mil coating on Buno 160271. The coating, on both of the T-34's, displayed good resistance to 1 day water immersion or in other words showed no signs of coating defects such as blistering or softening. The only complaint from maintenance personnel was that the coating tended to peel away from the sharp edges around the external fuel intake areas on the wings.

Since these aircraft have gone through nearly two months of standard flight service and to this date have encountered no serious problems, I recommend that the aircraft continue in service with the condition of the finishing system constantly monitored. Accurate recording of the condition and the maintenance performed on the coating system is extremely important for the effective use of this coating system as a self-priming topcoat for Naval aircraft. A solution to the peeling around the external fuel tank area, would be to prime that small area with Mil-P-53022 or Mil-P-53030 before applying UNICOAT.

William J. Green

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**PREPARATION AND APPLICATION
PROCEDURES**

NAVAL AIR DEVELOPMENT CENTER
AEROSPACE MATERIALS DIVISION
WARMINSTER, PA 18974-5000

30 March 1990

THE RECOMMENDED SURFACE PREPARATION, MATERIALS HANDLING, AND APPLICATION PROCEDURES FOR THE UNICOAT FINISHING SYSTEM.

Aircraft Preparation

- strip paint from aircraft
- wash with Mil-C-85570 Type II (diluted 1/9 by volume with water)
- rinse thoroughly with fresh water
- chemical deoxidize with corrosion removing compound Mil-C-38334 Type I Class 1 (diluted 1/1 by volume with water) applied with a non-abrasive pad conforming to Mil-C-83957 for 12 but not more than 20 minutes
- rinse thoroughly with fresh water
- wash with Mil-C-85570 Type II (diluted 1/9 by volume with water)

Note: Do not use MIL-C-85570 Type I, MIL-C-87936 Type II, or MIL-C-43616. These cleaners could leave hydrocarbon solvent residues which might interfere with coating adhesion.

- rinse thoroughly with fresh water
- apply chromate conversion coating conforming to Mil-C-81706 then rinse thoroughly with fresh water; THIS STEP CAN BE OMITTED IF A CHROMATE-FREE FINISHING SYSTEM IS DESIRED
- allow to air dry
- mask and tape
- tack cloth
- prepare and apply UNICOAT
- UNICOAT application should be performed within 4 hr of the last chemical surface treatment process (deoxidizing or chromate conversion)

UNICOAT Storage

- promptly store UNICOAT in a refrigerated area (but not less than 35°F) whenever possible; this will significantly increase shelf-life and maintain the current pot life property

Mixing Individual Components

- mix part A (pigmented) by mechanical or manual techniques in 5 - 10 minute intervals until uniform or homogeneous
- check for caking or settling at the bottom
- Caution: do not excessively shake, mix, or stir such that significant air bubbles are produced; excessive dispersing will

- generate heat which will decrease pot life
- part B (resin only) does not need to be mixed

Mixing Catalyzed Paint

- mechanically or manually stir the appropriate amount (per paint manufacturer's instructions) of part B into part A for 1 - 3 minutes or until thoroughly dispersed.

Thinning

- to obtain the self-priming topcoat compliant VOC of 420 g/l for all types/colors of UNICOAT, thin the admixed paint with MIL-T-81772 Type I at the prescribed volume or weight (per manufacturer's instructions)
- or
- to obtain non-VOC compliant flat or low gloss UNICOAT, thin the admixed paint to a Zahn #2 spray viscosity of 20 - 25 seconds depending on the spray application atomization technique (conventional, airless, air-assisted airless, or HVLP) and delivery system (siphon feed or pressurized feed)
- or
- to obtain non-VOC compliant high gloss UNICOAT, thin the admixed paint to a Zahn #2 spray viscosity of 25 - 30 seconds

Application

- apply two full cross-coats for flat UNICOAT and three full cross-coats for gloss UNICOAT to a dry film thickness of 2.0 - 3.0 mils
- check the viscosity of the feed material after 30 minutes and at 15 minute intervals thereafter for paint thickening
- if the Zahn#2 viscosity exceeds 60 seconds, purge the system and dispose of the material