

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

## **Joint Test Report J-99-OC-014-R1**

### **for Validation of Low/No VOC and Nonchromate Coating Systems for Support Equipment**

**Final**

**November 25, 2003**

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## ACRONYMS

|                   |   |
|-------------------|---|
| AF                | Air Force   |
| Alum/Al           | Aluminum  |
| ASTM              | American Society for Testing and Materials              |
| CaCl <sub>2</sub> | Calcium Chloride  |
| CRES              | Corrosion Resistant Steel                               |
| CTC               | Concurrent Technologies Corporation                     |
| CTIO              | Coatings Technology Integration Office                  |
| DoD               | Department of Defense                                   |
| ESTCP             | Environmental Security Technology Certification Program |
| FED STD           | Federal-Standard  |
| HAPs              | hazardous air pollutants                                |
| HazMats           | hazardous materials                                     |
| HVLP              | high volume low pressure                                |
| JG-PP             | Joint Group on Pollution Prevention                     |
| JLC               | Joint Logistics Commanders                              |
| JTP               | Joint Test Protocol                                     |
| JTR               | Joint Test Report                                       |
| KSC               | Kennedy Space Center                                    |
| Ksi               | thousand pounds per square inch                         |
| mil               | 0.001-inch  |
| Mil               | Military  |
| MEK               | Methyl Ethyl Ketone                                     |
| MWAS              | Metal Wire Arc Spray                                    |
| NaCl              | Sodium Chloride   |
| NASA              | National Aeronautics and Space Administration           |
| NAWCAD            | Naval Air Warfare Center Aircraft Division              |
| NDCEE             | National Defense Center for Environmental Excellence    |
| OEM               | original equipment manufacturer                         |
| PMB               | Plastic Media Blast                                     |
| RH                | Relative Humidity                                       |
| SAIC              | Science Applications International Corporation          |
| SE                | Support Equipment                                       |
| SO <sub>2</sub>   | Sulfur Dioxide  |
| TBD               | To Be Determined  |
| USMC              | United States Marine Corp                               |
| UV                | Ultra Violet  |
| VOC               | Volatile Organic Compound                               |
| Zn                | Zinc  |

## PREFACE

This report was prepared by Concurrent Technologies Corporation (*CTC*) through the National Defense Center for Environmental Excellence (NDCEE) under Contract Number DAAA21-93-C-0046. This report was prepared on behalf of, and under guidance provided by, the Joint Group on Pollution Prevention (JG-PP) through the JG-PP Working Group. The structure, format, and depth of technical content of the report were determined by the JG-PP Working Group, government contractors, and other government technical representatives in response to the specific needs of this project.

We wish to thank the participants involved in the creation of this document for their invaluable contributions.

This Joint Test Report (JTR) documents the results of testing performed in accordance with *Joint Test Protocol (J-99-OC-014-P) for Low/No VOC and Nonchromate Coating System for Support Equipment*, dated August 10, 2000. This JTR will be made available as a reference for future pollution prevention endeavors by other U.S. Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and industry organizations to minimize duplication of effort.

## EXECUTIVE SUMMARY

During the Joint Group on Pollution Prevention (JG-PP) Validation of Low/No Volatile Organic Compound (VOC) and Nonchromate Coating Systems for Support Equipment project, validation testing was performed on alternatives to organic coating systems that contain hexavalent chromium and VOCs, such as methyl ethyl ketone (MEK), toluene, and xylene. Alternatives tested included advanced film technology, high-solids coatings, metal wire arc spray, powder coatings, and waterborne coatings. These alternatives are described in *Potential Alternatives Report, J-99-OC-014-A, for Low/No VOC and Nonchromate Coating Systems*, dated June 20, 1996 (rev. May 11, 1998).

Prior to testing, stakeholders from the Air Force (AF), Army, Marine Corps, Navy, National Aeronautics and Space Administration (NASA), and industry reached consensus on the critical technical and performance requirements that alternative coating systems must satisfy to be used for support equipment applications. These requirements are documented in *Joint Test Protocol, J-99-OC-014-P, for Low/No VOC and Nonchromate Coating Systems for Support Equipment*, dated August 10, 2000. This Joint Test Report documents the validation testing results.

The project technical representatives met on June 12–13, 2001 to determine the alternatives that would continue testing in the field evaluations. It was decided that the following coating systems would be evaluated in field testing: Coating system 8, Morton 13-7004 Corvel Zinc Rich Primer with Morton 30-1007 Corvel Clean White U 1578-1; Coating system 9, DuPont ELH503S5 Gray Morning with DuPont PFW510S9 Sky White; Coating system 10, Deft 44-GY-16 Zinc Rich Primer with Deft 44-W-7 Intermediate Primer and Defthane Zero VOC Topcoat; and Coating system 11, Aqua-Poxy 912 with Defthane Zero VOC Topcoat.

These coating systems were applied to pieces of Support Equipment and placed in field environments at the following four locations.

- Cape Canaveral Air Force Station, Florida
- Patrick Air Force Base, Florida
- Naval Air Station Brunswick, Maine
- Naval Station Everett, Washington

The coating systems were evaluated every three months with final evaluations taking place in June 2003. The results of the field evaluations will be documented in a separate field evaluation report, which will be posted on the JG-PP Web site when final. Interim field evaluation reports are available on the JG-PP Web site.

## 1. INTRODUCTION

The Joint Logistics Commanders (JLC) and Headquarters National Aeronautics and Space Administration (NASA) co-chartered the Joint Group on Pollution Prevention (JG-PP) to coordinate joint service/agency activities affecting pollution prevention issues identified during system and component acquisition and sustainment processes. The primary objectives of the JG-PP are to:

- Reduce or eliminate the use of hazardous materials (HazMats) or hazardous processes at manufacturing, remanufacturing, and sustainment locations
- Avoid duplication of effort in actions required to reduce or eliminate HazMats through joint service cooperation and technology sharing.

JG-PP projects typically involve at least one original equipment manufacturer (OEM) producing multiple systems for more than one of the Services and NASA, as well as at least one facility, such as a Department of Defense (DoD) depot, maintaining one or more of the systems. JG-PP technical representatives for each project begin by selecting at least one target HazMat for reduction or elimination. This target HazMat(s) is a material used in production or sustainment processes that is known to create environmental and/or worker health concerns. Project participants then identify alternative technologies or materials for evaluation.

For each project, a Joint Test Protocol (JTP) is written, containing the critical requirements and tests necessary to qualify potential alternatives to selected target HazMats and processes for a particular application. The required tests for this project are documented in *Joint Test Protocol, J-99-OC-014-P, for Low/No VOC and Nonchromate Coating System for Support Equipment*, dated August 10, 2000, hereafter referred to as JTP. The tests are summarized in Section 3.

During each project, the participating technical representatives select candidate alternatives that will be tested in accordance with the JTP. The alternative selection process for this project is documented in *Potential Alternatives Report, J-99-OC-014-A, for Low/No VOC and Nonchromate Coating Systems*, dated June 20, 1996 (rev. May 11, 1998). The alternatives tested are listed in Section 2, Table 2-2.

After project participants define the tests to be performed and the alternatives to be tested, testing is executed. This Joint Test Report (JTR) documents the results of the testing, describes any test modifications made during the execution of testing, and identifies technically acceptable alternatives to the baseline process. The project technical stakeholders have agreed upon all test procedure modifications documented in this JTR.

Technical representatives from the affected DoD and NASA programs, Science Applications International Corporation (SAIC) in Warner Robins, Georgia, the sustainment community and other government organizations participated in this project. The project participants were led by the JG-PP Working Group, the working-level government managers tasked with executing JG-PP projects. The participants identified volatile organic compounds (VOCs)

such as methyl ethyl ketone (MEK) and toluene, and also hexavalent chromium and lead as found in existing polyurethane and epoxy coating systems as the target HazMats to be reduced or eliminated. The targeted process is wet-spray application of primers and topcoats by high volume low pressure (HVLP), airless, and electrostatic methods. Table 1 summarizes the target HazMats, current material and process, current specifications, affected programs, and substrates.

**Table 1. Target HazMat Summary**

| <b>Target HazMats</b>  | <b>Current Process</b>  | <b>Applications</b>  | <b>Current Specifications</b>  | <b>Affected Agencies</b>  | <b>Substrates</b>               |
|--|---|--|--|---|---------------------------------|
| Hexavalent Chromium<br>Lead<br>HAPs (e.g., methyl ethyl ketone Toluene Xylene) | Wet-Spray application of primers and topcoats by HVLP, airless, and electrostatic methods | Exteriors and interiors of powered and non-powered Support Equipment | MIL-P-53022B, MIL-P-53030A, MIL-PRF-23377G, MIL-PRF-26915D, MIL-PRF-85582C, MIL-PRF-85285C, MIL-PRF-22750F, MIL-C-46168D, MIL-C53039A, NASA System (CATHACOAT 304K inorganic zinc-rich primer, DEVRAN 201 epoxy primer, DEVTHANE 369 Aliphatic Urethane) | All participants in the Air Force, Army, Marine Corps, Navy, and NASA | Aluminum, Steel, and composites |

This JTR will be made available as a reference for future pollution prevention efforts by other DoD, NASA, and commercial users to minimize duplication of effort.

## 2. PROCESSING PROCEDURES

The objective of this project is to compare candidate-coating performance to the standard coating system, not to qualify the candidates under the specifications for the standard system. This project compared coating performance of the alternative coating systems to existing coating systems or standards.

Test coupons were prepared in accordance with ASTM D 5139-90 (1996) (*Standard Specification for Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants*, approved 1990, reaffirmed 1996). Coupon surfaces were cleaned to a “water-break-free” condition prior to coating. The surface conditioning for steel test coupons was in accordance with the Society of Protective Coating Standards SSPC-SP-1 (*Solvent Cleaning*), –10 (*Near-White blast Cleaning*), and –11 (*Power Tool Cleaning to Bare Metal*). Table 2 summarizes the test coupons used during processing.

**Table 2. Coupon (Test Specimen) Codes and Substrate Descriptions**

| Test Coupon Code | Substrate Description   |
|------------------|---|
| Al-1a            | Aluminum Alloy: 2024-T3 (Alclad)<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; chromate conversion coated, conforming to MIL-C-5541E ( <i>Chemical Conversion Coatings on Aluminum and Aluminum Alloys</i> , issued November 30, 1990), Class 1A. |
| Al-1b            | Aluminum Alloy: 2024-T3 (Alclad)<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; anodized per MIL-A-8625F-93, <i>Anodic Coatings for Aluminum and Aluminum Alloys, Type II Sulfuric Acid Anodize</i> .  |
| Al-1c            | Aluminum Alloy: 2024-T3 (Alclad)<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; no conversion coating or other pretreatment.   |
| Al-1d            | Aluminum Alloy: 2024-T3 (Alclad)<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; Henkel 5700 nonchromate conversion coating applied according to the manufacturer’s specifications.   |
| Al-2             | Aluminum Alloy: 2024-T0<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; anodized per MIL-A-8625F-93.  |
| Al-3a            | Aluminum Alloy: 6061-T6<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; chromate conversion coating applied to the coupon.  |
| Al-3b            | Aluminum Alloy: 6061-T6<br>Cleaned according to ASTM F 22-65 to provide a water-break-free surface; anodized per MIL-A-8625F-93.  |

(Table 2. continued on next page)

**Table 2. Coupon (Test Specimen) Codes and Substrate Descriptions (continued)**

|       |  |
|-------|--|
| St-1a | Steel Alloy: 4340<br>Cleaned and prepared according to SSPC SP-10 (Blast clean to a near white metal cleanliness, until 95% of the surface area is free of all visible residues); no pretreatment. |
| St-1b | Steel Alloy: 4340<br>Cleaned and prepared according to SSPC SP-11 (Complete removal of all rust, scale, and paint by power tools with resultant profile with no pretreatment).                     |
| St-2a | Steel Alloy: 1020<br>Cleaned and prepared according to SSPC SP-10 (Blast clean to a near white metal cleanliness, until 95% of the surface area is free of all visible residues); no pretreatment. |
| St-2b | Steel Alloy: 1020<br>Cleaned and prepared according to SSPC SP-11 (Complete removal of all rust, scale, and paint by power tools with resultant profile with no pretreatment).                     |
| St-3  | Steel Alloy: 304 Corrosion Resistant Steel (CRES)<br>Cleaned and scuffed with either 280 grit sandpaper or stainless steel brush to a SSPC-SP1 finish.   |
| St-6  | Steel Alloy: 4340<br>Cleaned and prepared according to SSPC SP-10 (Blast clean to a near white metal cleanliness, until 95% of the surface area is free of all visible residues); no pretreatment. |

Each coating system was prepared and applied according to instructions provided by the manufacturer. Coating systems were applied by spraying or in the case of advanced film technology by hand. Coating technicians followed all manufacturer application instructions and documented all relevant conditions at the time of application. Table 3 lists the coating systems that were applied to test coupons.

**Table 3. Coating System Alternatives**

| Technology                  | Coating System | Primer/Topcoat System Selected for Screening |   |
|-----------------------------|----------------|--|---|
|                             |                | Primer                                       | Topcoat   |
| Film Technology             | 1              | Primer (MIL-P-53022B, Type I)                | 3M Fluoropolymer Paint Replacement Product (Applique) (Color 17925 (white)) |
|                             | 2              | Primer (MIL-P-53022B, Type I)                | Fluorogrip, Grade E (Color 17925 (white))                                   |
| Metal Wire Arc Spray (MWAS) | 3              | Platt Bros. 100% Zinc Wire                   | Defthane Zero VOC Topcoat (Color 17925 (white))                             |
|                             | 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire   | Defthane Zero VOC Topcoat (Color 17925 (white))                             |

*(Table 3. continued on next page)*

**Table 3. Coating System Alternatives (continued)**

| Technology                     | Coating System | Primer/Topcoat System Selected for Screening   |  |
|--------------------------------|----------------|--|--|
|                                |                | Primer   | Topcoat  |
| High Solids Coatings           | 5              | No primer  | Ameron PSX 700 Siloxane Self Priming Topcoat (Color 17925 (white)) |
|                                | 6              | Dimetcote 9HS Zinc Rich Primer   | Ameron PSX 700 Siloxane Self Priming Topcoat (Color 17925 (white)) |
|                                | 7              | Devoe 304H   | Ameron PSX 700 Siloxane Self Priming Topcoat (Color 17925 (white)) |
| Powder Coatings                | 8              | Morton 13-7004 Corvel Zinc Rich Primer   | Morton 30-1007 Corvel Clean White U 1578-1 (Color 17925 (white))   |
|                                | 9              | DuPont ELH503S5 Gray Morning   | DuPont PFW510S9 Sky White (Color 17925 (white))                    |
| Waterborne Coatings            | 10             | Deft 44-GY-16 Zinc Rich Primer (MIL-P-26915)/Deft 44-W-7 Intermediate Primer (on QPL of MIL-P-53030) | Defthane Zero VOC Topcoat (Color 17925 (white))                    |
|                                | 11             | Aqua-Poxy 912  | Defthane Zero VOC Topcoat (Color 17925 (white))                    |
| Control: Army                  | C1             | Mil-P-53022B, Type II  | MIL-C-46168D (Color 34094 (green 383))                             |
| Control: NASA                  | C2             | Devoe Inorganic base primer, Zn CATHACOAT 304K with Devoe Intermediate Epoxy Primer, DEVRAN 201      | Devoe Aliphatic Urethane, DEVTHANE 369 (Color 17925 (white))       |
| Control: Air Force, Navy, USMC | C3             | MIL-P-53022B, Type II  | MIL-P-85285C, Type II (Color 17925 (white))                        |

**2.1. Deviations from JTP**

Modifications to the JTP that were necessary during coating execution are described below. The technical representatives approved these modifications.

**Coating application after pretreatment** – Section 3 of the JTP states that “test coupons must be painted within one week of the application of pretreatment...” Due to the number of panels and vendor lead times, test coupons were painted as soon as possible upon receipt from the vendor.

**3M Fluoropolymer Paint Replacement Product** – This coating was ordered to match FED STD color white 17925, however at the time of order this color was

unavailable. The applique was supplied in a similar white color that differs from the FED STD 17925 by an  $\Delta E$  of 3.

**Fluorogrip, Grade E** – This coating was ordered to match FED STD color white 17925, however, this product has not yet been formulated to match this color. Instead the vendor supplied Fluorogrip, Grade E in clear, because the primer was supplied to match FED STD 17925.

**Platt Bros. 100% Zinc Metallizing Wire** – This coating was unavailable for use; therefore, Metallisation 100% Zinc Rich Coating was substituted.

## 2.2. Film Technology

### 2.2.1. MIL-P-53022B, Type I with 3M Fluoropolymer Paint Replacement Product (Applique) (CS1)

Primer MIL-P-53022B, Type I was applied on November 27, 2000. It was applied with a Devilbiss JGA spray gun with a 0.070-inch nozzle and a No. 30 air cap. This primer was applied at 21.9°C and 27% relative humidity (RH) with 60 psi of air pressure.

The test coupons were placed in a gas convection oven at 140°F for 40 minutes to facilitate cure. MIL-P-53022B, Type I was applied to a wet film thickness of 4.0 mils and to an average dry film thickness of 1.7 mils.

The topcoat for this coating system, 3M Fluoropolymer Paint Replacement Product (Applique), was also applied on November 27, 2000. It was applied using a 4.5-lb. roller and squeegees to smooth out the film and reduce the presence of air bubbles between the primer and topcoat. At the time of application the temperature was 19.7°C and the RH was 18.3%.

This coating was ordered to match FED STD color white 17925, however at the time of order this color was unavailable. The applique was supplied in a similar white color that differs from the FED STD 17925 by an  $\Delta E$  of 3.

### 2.2.2. MIL-P-53022B, Type I with Fluorogrip, Grade E (CS2)

Primer MIL-P-53022B, Type I was applied on November 27, 2000. It was applied with a Devilbiss JGA spray gun with a 0.070-inch nozzle and a No. 30 air cap. This primer was applied at 21.9°C and 27% RH with 60 psi of air pressure.

The test coupons were placed in a gas convection oven at 140°F for 40 minutes to cure. MIL-P-53022B, Type I was applied to a wet film thickness of 4.0 mils and to an average dry film thickness of 1.7 mils.

The topcoat for this coating system, Fluorogrip, Grade E, was applied on November 28–29, 2000. It was applied using a 4.5 lb. roller and squeegees to smooth out the film and to reduce the presence of air bubbles between the primer and the topcoat. The temperature and RH on the days that this topcoat was applied was 20.3°C and 21.2% and 19.5°C and 19.7%, respectively.

This coating was ordered to match FED STD color white 17925, however this product has not yet been formulated to match this color. Instead the vendor supplied Fluorogrip, Grade E in clear, because the primer was supplied to match FED STD 17925.

### **2.3. Metal Wire Arc Spray (MWAS)**

#### **2.3.1. Platt Bros. 100% Zinc Metallizing Wire with Defthane Zero VOC Topcoat (CS3)**

Test coupons were sent to CSI Coating Systems Inc., in Nisku, Alberta, Canada to be coated with Platt Bros. 100% Zinc Wire. This coating was unavailable for use at this time, however Metallisation 100% Zinc Rich Coating was substituted. The project technical leaders approved this substitution.

Upon receipt of the test coupons from CSI Coating Systems, Inc., Defthane Zero VOC Topcoat was applied. This occurred on December 12, 2000. The topcoat was applied by using a pressure pot with a mechanical agitator and 60 psi of pressure and at 20.3°C. Defthane Zero VOC Topcoat was applied in two coats, as recommended by the manufacturer; each coat was applied to a wet film thickness of 1.0 mils. The average dry film thickness of the topcoat was 1.8 mils.

#### **2.3.2. Platt Bros. Zn/Alum 85/15 Metallizing Wire with Defthane Zero VOC Topcoat (CS4)**

Test coupons were sent to CSI Coating Systems Inc., in Nisku, Alberta, Canada to be coated with Platt Bros. Zn/Alum 85/15 Metallizing Wire.

Upon receipt of test coupons from CSI Coating Systems, Defthane Zero VOC Topcoat was applied. The application took place on December 12, 2000. The topcoat was applied by using a pressure pot with a mechanical agitator at 60 psi of pressure and at 20.3°C. The topcoat was applied in two coats, as

recommended by the manufacturer, each coat was applied to a wet film thickness of 1.0 mils. The average dry film thickness of the topcoat was 1.8 mils.

## **2.4. High Solids Coatings**

### **2.4.1. Ameron PSX 700 Siloxane Self Priming Topcoat (CS5)**

Test coupons were coated with Ameron PSX 700 Siloxane Self-Priming Topcoat on November 21, 2000. This coating system was applied at 20.3°C and 16.7% RH, using a pressure pot with a mechanical agitator at 60-psi air pressure. It was applied to a wet film thickness of approximately 6 mils. Test coupons were then transferred into a humidity chamber maintained at 40% RH to cure. The average dry film thickness of this coating was 3.2 mils.

### **2.4.2. Dimetcote 9HS Zinc Rich Primer with Ameron PSX 700 Self Priming Topcoat (CS6)**

Test coupons were coated with Dimetcote 9HS Zinc Rich Primer on December 8, 2000. The primer was applied using a pressure pot with a mechanical agitator and a pressure of 60 psi. Test coupons were coated at 19.7°C and to a wet film thickness of 4.0 mils. The test coupons were then placed in a humidity chamber maintained at 73°F and 60% RH to cure. The average dry film thickness of this primer was 5.4 mils.

Upon removal of test coupons from the humidity chamber, Ameron PSX 700 was applied. Application occurred on December 11, 2000. The topcoat was applied by using a pressure pot with a mechanical agitator and a pressure of 60 psi and at 20.2°C. The topcoat was applied by first spraying two thin mist coats and allowing each to flash off, and then a full coat was applied to the test coupons. This procedure was followed to reduce or eliminate bubbling from occurring in the topcoat due to the zinc primer. Test coupons were then placed in a humidity chamber maintained at 73° F and 60% RH to cure.

### **2.4.3. Devoe 304H with Ameron PSX 700 Self Priming Topcoat (CS7)**

Test coupons were coated with Devoe CATHACOAT 304H on November 30, 2000. This primer was applied by using a pressure pot with a mechanical agitator and a pressure of 60 psi. CATHACOAT 304H was applied to a wet film thickness of 4.0 mils at 21.9°C and 23.5% RH. The test coupons were then placed in a humidity chamber maintained at 60% RH and 77°C for 18 hours to cure. The average dry film thickness of this primer was 3.0 mils.

The test coupons were then coated with Ameron PSX Self-Priming Topcoat on December 7, 2000. The topcoat was applied by using a pressure pot with a mechanical agitator and first spraying two mist coats and allowing each to flash off. After applying the mist coats, a full coat was applied. This procedure was followed to reduce or eliminate bubbling from occurring in the topcoat due to the zinc primer. The topcoat was applied at 19.4°C. Test coupons were then placed in a humidity chamber maintained at 77°F and 60% RH to cure. The average dry film thickness of the topcoat was 3.1 mils.

## **2.5. Powder Coatings**

### **2.5.1. Morton 13-7004 Corvel Zinc Rich Primer with Morton 30-1007 Corvel Clean White U 1578-1 (CS8)**

Morton 13-7004 Corvel Zinc Rich Primer was applied on November 14, 2000. Test panels were coated with powder booth settings of 25 psi of fluidizing air, and 18 psi of atomizing air with the powder guns at 100 kV. The powder guns operated at 28 strokes per minute. The test coupons were then placed in a powder cure oven at 375°F. The test coupons were allowed to rise in temperature for 8 minutes and then allowed to partially cure for 2 minutes.

The test coupons were then topcoated with Morton 30-1007 Corvel Clean White U 1578-1 on November 14, 2000. Test panels were coated with powder booth settings of 25 psi of fluidizing air, 18 psi of atomizing air and powder guns at 100 kV. The powder guns operated at 28 strokes per minute. The test coupons were then placed in a powder cure oven at 375°F. The test coupons were allowed to rise in temperature for 8 minutes and then allowed to cure for 15 minutes.

### **2.5.2. DuPont ELH503S5 Gray Morning with DuPont PFW510S9 Sky White (CS9)**

DuPont ELH503S5 Gray Morning Primer was applied on November 15, 2000. Test panels were coated with powder booth settings of 23 psi of fluidizing air, 18 psi of atomizing air and powder guns at 100 kV. The powder guns operated at 28 strokes per minute. The test coupons were then placed in a powder cure oven at 400°F. The test coupons were allowed to rise in temperature for 8 minutes and then allowed to partially cure for 5 minutes.

The test coupons were then topcoated with DuPont PFW510S9 Sky White on November 15, 2000. Test panels were coated with powder booth settings of 23 psi of fluidizing air, 18 psi of atomizing air and powder guns at 100 kV. The powder guns operated at 28 strokes per minute. The test coupons were

then placed in a powder cure oven at 400°F. The test coupons were allowed to rise in temperature for 8 minutes and then allowed to cure for 10 minutes.

## **2.6. Waterborne Coatings**

### **2.6.1. Deft 44-GY-16 Zinc Rich Primer with Deft 44-W-7 Intermediate Primer and Defthane Zero VOC Topcoat (CS10)**

Deft 44-GY-16 Zinc Rich Primer was applied to test coupons on December 4, 2000. It was applied using a pressure pot with an agitator at 60-psi air pressure and at 20.7°C and 15.7% RH. The primer was applied to 4.0 mils wet film thickness.

The test coupons were allowed to flash off for 31 minutes before being coated with Deft 44-W-7 Intermediate Primer. This primer was also applied using a pressure pot with an agitator and an air pressure of 60 psi and at 20.7°C and 15.7% RH. This primer was applied to a wet film thickness of 1.0 mils.

The test coupons were coated with Defthane Zero VOC topcoat on December 5, 2000. The topcoat was applied using a pressure pot with a mechanical agitator and 60 psi air pressure. The application was performed at 20.6°C and 18.5% RH. This coating was applied in two coats, as recommended by the manufacturer; each coat was applied to a 1.0 mil wet film thickness. The average total dry film thickness of this coating system was 3.9 mils.

### **2.6.2. Aqua-Poxy 912 with Defthane Zero VOC Topcoat (CS11)**

Aqua-Poxy 912 was applied to test coupons on December 5, 2000. This primer was applied using a Devilbiss JGA spray gun with a 0.070 inch fluidizing nozzle and a No. 30 air cap. It was applied with 60-psi air pressure at 20.6°C and 18.5% RH. The test panels were allowed to dry for 25 minutes until becoming dry-to-touch. They were then topcoated with Defthane Zero VOC topcoat.

Defthane Zero VOC Topcoat was applied on December 5, 2000 using a pressure pot with a mechanical agitator and 60-psi air pressure. The application was performed at 20.6°C and 18.5% RH. This coating was applied in two coats, as recommended by the manufacturer; each coat was applied to a 1.0 mil wet film thickness. The average total dry film thickness of this coating system was 3.9 mils.

## **2.7. Control Coatings**

### **2.7.1. Army: MIL-P-53022B, Type II with MIL-C-46168D**

MIL-P-53022B, Type II was applied on December 6, 2000. This primer was applied using a Devilbiss JGA spray gun with a 0.070 inch fluidizing nozzle and a No. 30 cap. The primer was applied with 60-psi air pressure and at 19.7°C and 12.7% RH. The primer was applied to a wet film thickness of 3.0 mils. The average dry film thickness of the primer was 0.8 mils.

The test coupons were allowed to flash off for one hour before being topcoated with MIL-C-46168D. This topcoat was applied with a Devilbiss JGA spray gun with a 0.070 inch fluidizing nozzle and a No. 30 cap. The topcoat was applied with 60-psi air pressure and at 21.3°C and 11.9% RH. The topcoat was applied to a wet film thickness of 6.0 mils and the average dry film thickness was 3.4 mils.

### **2.7.2 NASA: Devoe CATHACOAT 304K with DEVRAN 201 And DEVTHANE 369**

Devoe CATHACOAT 304K was applied on November 15, 2000. This primer was applied using a pressure pot with a mechanical agitator and a #66 nozzle and was used with 60 psi air pressure. This primer was applied at 23.6°C and 16.1% RH to 4.0 mils wet film thickness. The test coupons had an average dry film thickness of 3.4 mils. The test coupons were allowed to dry for 18 hours before being coated with DEVRAN 201.

DEVRAN 201 was applied using a pressure pot with a mechanical agitator and #66 nozzle. DEVRAN 201 was applied with 50-psi atomizing air pressure and 26-psi fluidizing air pressure. This intermediate primer was applied at 21.7°C and 17.6% RH to a wet film thickness of 5.0 mils.

The test coupons were allowed to flash off for one hour before being topcoated with DEVTHANE 369. This topcoat was applied with a Devilbiss JGA spray gun with a #66 nozzle and 65-psi air pressure. It was applied at 22.0°C and 17.0% RH. DEVTHANE 369 was applied to a wet film thickness of 5.0 mils.

### **2.7.3. Air Force, Navy, USMC: MIL-P-53022B, Type II with MIL-PRF-85285C, Type II**

MIL-P-53022B, Type II was applied on December 6, 2000. This primer was applied using a Devilbiss JGA spray gun with a 0.070 inch fluidizing nozzle and a No. 30 cap at 60 psi. The primer was applied at 19.7°C and 12.7% RH

to a wet film thickness of 3.0 mils. The average dry film thickness of the primer was 0.8 mils.

The test coupons were allowed to dry overnight before being topcoated with MIL-PRF-85285C, Type II. This topcoat was applied using a Devilbiss JGA spray gun with a 0.070 inch fluidizing nozzle and a No. 30 cap. It was applied with 60-psi air pressure and at 20.4°C and 16.0% RH to a wet film thickness of 3.0 mils. The average dry film thickness of the test coupons was 1.5 mils.

### 3. PERFORMANCE AND TESTING REQUIREMENTS

The DoD and NASA technical representatives developed a consensus regarding the proposed coating test criteria to quantify and qualify potential technical and performance test requirements required by DoD and NASA. These requirements include procedures, methodologies, and acceptance criteria, which will provide the minimum requirements for a candidate technology to meet the stakeholders' needs.

Testing was performed in a manner that optimized the use of each test panel. For example, where practical, more than one test was performed on the coated test coupons. The number and types of tests performed on a given panel was determined by the destructive nature of the tests in question. Each test was performed on identical test coupons prepared with the candidate alternative coating system and the DoD and NASA standard control coatings as the test controls, where applicable.

The tests described in this JTR are in the following main categories: screening tests, common tests, field evaluations, and extended tests. Table 4 through Table 7 summarize the test requirements for validating alternative coating candidates against existing approved SE coating systems.

Table 4 lists screening tests. Screening tests are preliminary tests performed on the candidate alternative coating systems.

Table 5 lists the common tests required by participating services/agencies, such as adhesion, flexibility, corrosion resistance, fluid resistance, removability, and reparability.

Table 6 lists field evaluations that are intended to compare the performance of candidate test coatings with current coatings when applied to powered and non-powered Support Equipment (SE) in an operational environment. The field evaluations will be performed after the laboratory tests have been completed, using only those candidate-coating systems that have met acceptance criteria in the screening and common tests, unless directed by the testing authority. Coating evaluators will complete a written evaluation and documentation checklist to organize and quantify the observations of coating system performance under actual operating conditions.

Table 7 lists service/agency-specific extended tests that are required by one or more, but not all, of the services/agencies. These tests may be unique to that particular service or agency mission profile rather than the entire DoD or NASA.

These tables include acceptance criteria and the reference specifications, if any, used to conduct the tests. Where "none" appears under the *Test Method References*, the proposed test and evaluation are based on the aggregate knowledge and experience of the assigned technical project personnel and prior testing.

**Table 4. Screening Test Requirements**

| <b>Test</b>                 | <b>JTP Section</b> | <b>Test Specimen</b> | <b>Acceptance Criteria</b>  | <b>Test Method References</b>          |
|-----------------------------|--------------------|----------------------|---|--|
| Ease of Application         | 3.1.1              | Coupon               | Smooth coat, with acceptable appearance, no runs, bubbles, or sags. Ability to cover the properly prepared/primed substrate with a single coat (one-coat hiding ability).   | None                                   |
| Surface Appearance          | 3.1.2              | Coupon               | No streaks, blistering, voids, air bubbles, cratering, lifting, blushing, or other surface defects/irregularities. No microcracks observable at 10x magnification. Gloss and color should match FED-STD-595B color chips (either color 34094 or color 17925 is required to be tested).  | ASTM D 523-89 (1999)<br>ASTM D 2244-93 |
| Pot Life (Viscosity)        | 3.1.3              | Mixed Coating System | <p>Procedure A: <u>High Solids Coatings</u> – Viscosity of both test batches shall not exceed 60 seconds after 4 hours of continuous mixing in a closed container maintained at 75±5°F (Batch 1) and 95±5°F (Batch 2). The admixed materials must still be sprayable 4 hours after mixing.</p> <p>Procedure B: <u>Waterborne Coatings</u>-Coating viscosity shall not exceed admixed viscosity by more than 15 seconds after 4 hours, with no gelling of the admixed coating after 6 hours.</p> | ASTM D 1200-94 (1999)                  |
| Dry-To-Touch (Sanding)      | 3.1.4              | Coupon               | No rolling or scribing during sanding, and “easy” sanding (as evaluated by the technician).   | None                                   |
| Cure Time (MEK Solvent Rub) | 3.1.5              | Coupon               | No effect on surface or coating on the cloth (Resistance Rating 5).   | ASTM D 4752-98                         |

**Table 5. Common Test Requirements**

| <b>Test</b>                   | <b>JTP Section</b> | <b>Test Specimen</b> | <b>Acceptance Criteria</b>   | <b>Test Method References</b>   |
|-------------------------------|--------------------|----------------------|--|---|
| Removability                  | 3.2.1              | Coupon               | Less than one minute to penetrate to substrate.  | ASTM D 532-89 (1999)<br>ASTM D 2244-93<br>ASTM G 26-96, Test Method 1 |
| Accelerated Weathering        | 3.2.3              | Coupon               | Color change performance < one unit ( $\Delta E$ ) @ 500 hrs.  | ASTM G 26-96, Test Method 1<br>ASTM D 523-89 (1999)<br>ASTM D 2244-93 |
| Filiform Corrosion Resistance | 3.2.4              | Coupon               | No filiform corrosion extending beyond ¼ -inch from the scribe lines with the majority of filaments less than 1/8 -inch long.                      | ASTM 2803-93, Procedure C   |
| X-Cut Adhesion Test           | 3.2.5              | Coupon               | Candidate coating performs as well or better than control coatings and greater than or equal to 4a as specified in ASTM D 3359-97.                 | ASTM D 3359-97, Test Method A<br>FED-STD-141C, Method 6301.2          |
| Mandrel Bend Flexibility      | 3.2.6              | Coupon               | No peeling or delamination from the substrate and no cracking greater than ¼ -inch from the edges.   | ASTM D 522-93a, Test Method B   |
| Accelerated Storage Stability | 3.2.7              | Coupon               | No skinning, grains, or lumps of the coating; no pressure buildup, corrosion on the container, odor of spoilage, or cloudy appearance of catalyst. | ASTM D 1849-95  |

**Table 6. Field Evaluation Requirements**

| <b>Test</b>                   | <b>JTP Section</b> | <b>Test Specimen</b> | <b>Acceptance Criteria</b>   | <b>Test Method Reference</b> |
|-------------------------------|--------------------|----------------------|--|------------------------------|
| Full Unit Operational Testing | 3.3.1              | SE-Type<br>TBD       | Performance equal to or better than DOD and NASA control coating system. | TBD                          |

**Table 7. Extended Test Requirements**

| <b>Test</b>                              | <b>JTP Section</b> | <b>Service/ Agency</b> | <b>Test Specimen</b> | <b>Acceptance Criteria</b>  | <b>Test Method References</b>   |
|--|--------------------|------------------------|----------------------|---|---|
| 18-Month Marine Environment Test         | 3.4.3              | NASA                   | Coupon               | Panel condition rated 9 or better as per ASTM D 610-95  | ASTM D 610-95   |
| Cyclic Corrosion Test                    | 3.4.4              | Air Force, NASA, Army  | Coupon               | Candidate coating performs as well or better than the control coatings.<br><br>No significant blistering, softening, or lifting of coating. | GM 9540P  |
| SO <sub>2</sub> Corrosion Resistance     | 3.4.5              | Navy                   | Coupon               | No blistering or lifting after 500 hours. Slight substrate corrosion only. Slight substrate corrosion acceptable.                           | ASTM G 85-98, Annex A4<br>ASTM D 1654-02, Procedure A, Method 1       |
| B 117 Salt Fog Corrosion Resistance Test | 3.4.6              | Navy                   | Coupon               | No blistering or lifting after 2,000 hours. Slight substrate corrosion only.  | ASTM B 117-97<br>ASTM D 1654-92, Procedure A, Method 1                |
| Accelerated Weathering                   | 3.4.7              | Navy                   | Coupon               | Color change performance <2 units ( $\Delta E$ ) @ 1,000 hours and 1,500 hours.   | ASTM G 26-96, Test Method 1<br>ASTM D 2244-93<br>ASTM D 523-89 (1999) |

*(Table 7. continued on next page)*

**Table 7. Extended Test Requirements (continued)**

| <b>Test</b>                 | <b>JTP Section</b> | <b>Service/ Agency</b> | <b>Test Specimen</b> | <b>Acceptance Criteria</b>   | <b>Test Method References</b>      |
|-----------------------------|--------------------|------------------------|----------------------|--|------------------------------------|
| Fluid Resistance            | 3.4.8              | Air Force, Army, Navy  | Coupon               | No objectionable discoloration, change in gloss, blistering or swelling.<br><br>Scratch hardness $\leq 2$ pencil hardness units from the control finishes. | ASTM D 3363-00                     |
| High-Temperature Resistance | 3.4.16             | NASA                   | Coupon               | No change in film integrity and adhesion.  | ASTM D 2197-98<br>ASTM D 4541-95e1 |

**3.1. Testing Facilities**

All testing was performed in accordance with the JTP unless otherwise stated in this JTR. The testing facilities are summarized in Table 8.

**Table 8. Testing Facilities**

| <b>Testing</b>   | <b>Facility</b>   |
|--|---|
| NASA extended testing, including High-Temperature Resistance and 18-Month Marine Environment | Kennedy Space Center, Florida   |
| Accelerated Weathering, B117 Salt Fog Corrosion Resistance, and Cyclic Corrosion Resistance  | Coatings Technology Integration Office (CTIO), Wright-Patterson Air Force Base, Ohio                              |
| SO <sub>2</sub> Corrosion Resistance and Fluid Resistance                                    | Naval Air Warfare Center, Patuxent River, Maryland  |
| All other screening and common testing   | National Defense Center for Environmental Excellence/Concurrent Technologies Corporation, Johnstown, Pennsylvania |

**3.2. Deviations from JTP**

Modifications to the JTP that were necessary during test execution are described below. The technical representatives approved these modifications.

**Pot Life (Viscosity) Test** – Viscosity measurements were taken with # 5 Zahn viscosity cups instead of with #4 Ford viscosity cups. This was done to reduce the amount of paint used during testing and also because a number of the alternative coatings had high initial viscosities.

**X-Cut Adhesion by Tape Test** – ASTM D 3359-97 states that for coatings of 1.0-mil dry film thickness, one pass should be used to scribe through the coating. The alternative coatings applied had greater dry film thicknesses. In this case the number of passes taken to scribe through the coating is noted.

**Removability** – This test calls for the use of Type V Plastic Media Blast (PMB) at 100 psi and 8 inches from the coupon surface. Upon the advice of the PMB manufacturer, these parameters were re-evaluated and adjusted to 25 psi and a standoff distance of 9.5 inches.

**Reparability** – This test calls for the use of a 4.5-lb. roller in the dry tape adhesion evaluation of the test coupons. Due to cratering in the repaired area of the test coupon, finger pressure was found to give more accurate results.

**High Temperature Resistance Test** – In Section 3.4.16 of the JTP it is stated, “This procedure is used to determine the heat resistance of a coating system.” NASA technical leaders clarified that this procedure is used to evaluate test coupons with primer only. Therefore test coupons for this test were coated with primer only.

## 4. SUMMARY OF TESTS PERFORMED

### 4.1. Screening Tests

#### 4.1.1. Ease of Application

##### Rationale

This screening test was conducted to identify and eliminate those candidate-coating systems that are difficult to properly apply under normal maintenance operation conditions. All participants have agreed that ease of application is a performance requirement. The ease of application test results are listed in Table 9.

##### Test Description

Test coupons were prepared according to manufacturer's recommendations. All coating application processes and equipment were noted.

##### Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | Coating manufacturer's preparation instructions  |
| <b>Coupons per Coating System</b>           | Three St-2a, Three St-2b   |
| <b>Trials per Coupon</b>                    | One per coating per test coupon  |
| <b>Control Coupons Required for Testing</b> | None   |
| <b>Acceptance Criteria</b>                  | Smooth coat, with acceptable appearance, no runs, bubbles, or sags. Ability to cover the properly prepared/primed substrate with a single coat (one-coat hiding ability) |

**Table 9. Ease of Application Results**

| Coating System | Date used               | Coating                                      | Manufacturer     | Coating Application | Equipment                  | Appearance (Note: smooth coat, runs, bubbles, sags, one-coat hiding ability)   | Application Notes   |
|----------------|-------------------------|--|------------------|---------------------|----------------------------|--|---|
| 1, 2           | 11/27/2000              | Mil-P-53022B, Type I                         | Sherwin Williams | Spray               | DeVilbiss JGA              | Smooth coat, very easy to apply  |   |
| 1              | 11/28/2000              | 3M Paint Replacement Product                 | 3M               | Roll                | 4.5 lb Roller              | Slight orange peel, Few air bubbles  | Protective Top Layer requires practice  |
| 2              | 11/29/2000              | Fluorogrip, Grade E                          | Integument       | Roll                | 4.5 lb Roller              | Smooth coat, Slight contamination due to adhesive, Very few air bubbles  | Film easily damaged by squeegee   |
| 3, 4, 10, 11   | 12-06-00,<br>12/12/2000 | Defthane Zero VOC Topcoat                    | Deft Inc.        | Spray               | Pressure Pot with Agitator | CS 3-Rough appearance, Poor hiding ability<br>CS 4-Rough appearance, Poor hiding ability<br>CS 10-Orange peel, Moderate hiding ability<br>CS 11- Slight orange peel, Good hiding ability |   |
| 6              | 12/8/2000               | Dimetcote 9HS Zinc Rich Primer               | Ameron           | Spray               | Pressure Pot with Agitator | Smooth, powdery coat, Adhesion best on blasted surfaces  | Humidity Restrictions, Zinc Flashoff-Mist coats required                      |
| 7              | 12/8/2000               | Devoe 304H                                   | Devoe/ICI-Dulux  | Spray               | Pressure Pot with Agitator | Grainy appearance,   | Humidity Restrictions, Zinc Flashoff-Mist coats required, Even coat difficult |
| 5, 6, 7        | 11/21/00,<br>12/11/00   | Ameron PSX 700 Siloxane Self Priming Topcoat | Ameron           | Spray               | Pressure Pot with Agitator | CS 5- Orange peel, Very few pinholes , Moderate-Poor hiding ability,<br>CS 6- Pinholes, Orange peel, Poor hiding ability,<br>CS 7-Absorbed by primer, Poor hiding ability, Orange peel   |   |
| 8              | 11/9/2000               | Morton 13-7004 Corvel Zinc Rich Primer       | Morton           | Spray               | Powder Booth Guns          | Orange peel  |   |
| 8              | 11/9/2000               | Morton 30-1007 Corvel Clean White U1578-1    | Morton           | Spray               | Powder Booth Guns          | Orange peel, Very few pinholes, Good hiding ability  |   |
| 9              | 11/15/2000              | DuPont ELH503S5 Gray Morning                 | DuPont           | Spray               | Powder Booth Guns          | Orange peel  |   |
| 9              | 11/15/2000              | DuPont PFW510S9 Sky White                    | DuPont           | Spray               | Powder Booth Guns          | Orange peel, Absorbed by primer in spots   |   |
| 10             | 12/4/2000               | Deft 44-GY-16 Zinc Rich Primer (Mil-P-26915) | Deft Inc.        | Spray               | DeVilbiss JGA              | Orange peel  |   |
| 10             | 12/4/2000               | Deft 44-W-7 Intermediate Primer              | Deft Inc.        | Spray               | DeVilbiss JGA              | Orange peel  |   |
| 11             | 12/5/2000               | Aqua-Poxy 912                                | Sandstrom, Inc.  | Spray               | DeVilbiss JGA              | Smooth coat  |   |

### Test Summary

Overall Fluorogrip, Grade E and Aqua-Poxy 912 with Defthane Zero VOC Topcoat performed best in this test. Fluorogrip, Grade E required no mixing and was easy to apply; however the surface was easily damaged during the smoothing process. Defthane Zero VOC Topcoat had slight orange peel however was very easy to prepare and apply.

## **4.1.2. Surface Appearance**

### Rationale

This test was conducted to provide a critical, detailed evaluation of coating appearance and integrity. All participants have agreed that surface appearance is a performance requirement. The surface appearance results are listed in Table 10.

### Test Description

Alternative coatings were applied according to manufacturer instructions. After curing, test coupons were examined with the unaided eye and with 10x magnification. Color and gloss measurements were taken on each test coupon per ASTM D 2244-93, (*Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates*, approved September 15, 1993) and ASTM D 523-89 (1999), (*Standard Test Method for Specular Gloss*, approved March 31, 1989, reaffirmed 1999), respectively. This was done to document the original finish of the test coupons.

### Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | 10x Magnification   |
| <b>Coupons per Coating System</b>           | Three St-2a, Three St-2b (Recycled coupons from paragraph 4.1.1)  |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | None  |
| <b>Acceptance Criteria</b>                  | No streaks, blistering, voids, air bubbles, cratering, lifting, blushing, or other surface defects/irregularities. No micro-cracks observable at 10x magnification. Gloss and color should match FED-STD-595B color chips (either color 34094 or color 17925 is required to be tested). |

**Table 10. Surface Appearance Results**

| Coating System | Primer               | Topcoat             | Substrate                                    | Color         |                   |                | Gloss      |               | Visual Inspection (streaks, blisters, voids, air bubbles, cratering, lifting, blushing, micro-cracks at 10x) |  | Pass/Fail   |
|----------------|----------------------|---------------------|--|---------------|-------------------|----------------|------------|---------------|--|--|-------------|
|                |                      |                     |  | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle      | Average       | Unaided Eye  | 10x Magnification  |             |
| 1              | Mil-P-53022B, Type I | 3M Applique         | Steel 1020-Blast clean, No pretreatment      | 1.836         | 2.439             | 2.123          | 20°        | 37.1          | Slight orange peel, Few (9) bubbles  | No microcracks Blistering on edges, Few scratches  |             |
| 1              | Mil-P-53022B, Type I | 3M Applique         | Steel 1020-Blast clean, No pretreatment      | 2.008         | 2.375             | 2.254          | 20°        | 25.0          | Few (5) bubbles, Slight orange peel  | No microcracks   |             |
| 1              | Mil-P-53022B, Type I | 3M Applique         | Steel 1020-Blast clean, No pretreatment      | 1.490         | 2.222             | 1.879          | 20°        | 16.9          | Slight orange peel   | No microcracks   |             |
| <b>Average</b> |                      |                     |  | <b>1.778</b>  | <b>2.345</b>      | <b>2.085</b>   | <b>20°</b> | <b>26.353</b> | <b>Slight orange peel, Few bubbles</b>   | <b>No microcracks</b>  | <b>Pass</b> |
| 1              | Mil-P-53022B, Type I | 3M Applique         | Steel 1020-Power tool clean, No pretreatment | 1.595         | 2.285             | 1.962          | 20°        | 40.5          | Slight orange peel   | No microcracks, Slight blisters  |             |
| 1              | Mil-P-53022B, Type I | 3M Applique         | Steel 1020-Power tool clean, No pretreatment | 1.806         | 2.456             | 2.117          | 20°        | 44.0          | Few (2) bubbles, Slight orange peel  | No microcracks   |             |
| 1              | Mil-P-53022B, Type I | 3M Applique         | Steel 1020-Power tool clean, No pretreatment | 1.665         | 2.318             | 1.984          | 20°        | 42.2          | Slight orange peel   | No microcracks, Small blisters on edges and top  |             |
| <b>Average</b> |                      |                     |  | <b>1.740</b>  | <b>2.349</b>      | <b>2.058</b>   | <b>20°</b> | <b>33.2</b>   | <b>Slight orange peel, Few bubbles</b>   | <b>No microcracks, Few blisters</b>  | <b>Pass</b> |
| 2              | Mil-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020-Blast clean, No pretreatment      | 4.495         | 4.449             | 4.508          | 20°        | 48.8          | Minor surface scratches covering 100% of panel   | No microcracking, Few scratches, Blisters near bottom of panel, dirt between applique and coating    |             |
| 2              | Mil-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020-Blast clean, No pretreatment      | 4.424         | 4.371             | 4.445          | 20°        | 49.4          | Minor surface scratches covering 100% of panel   | Blisters - heavy on edges, scratches, Dirt between applique and coating, No microcracking            |             |
| 2              | Mil-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020-Blast clean, No pretreatment      | 3.745         | 3.684             | 3.771          | 20°        | 3.7           | Minor surface scratches covering 100% of panel creases   | No microcracking, Blisters - heavy on edges and bottom, Dirt between applique and coating            |             |
| <b>Average</b> |                      |                     |  | <b>4.221</b>  | <b>4.168</b>      | <b>4.241</b>   | <b>20°</b> | <b>33.957</b> | <b>Minor surface scratches</b>   | <b>No microcracking, Blisters, Dirt between applique and primer</b>                                  | <b>Fail</b> |
| 2              | Mil-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020-Power tool clean, No pretreatment | 3.944         | 3.909             | 3.974          | 20°        | 52.3          | Minor surface scratches covering 100% of panel crease in applique  | Blisters - heavy on edges and bottom, scratches, Dirt between applique and coating, No microcracking |             |
| 2              | Mil-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020-Power tool clean, No pretreatment | 3.716         | 3.680             | 3.763          | 20°        | 48.0          | Minor surface scratches covering 100% of panel Dark line under surface of applique                           | No microcracking, Few scratches, Blisters near bottom of panel, dirt between applique and coating    |             |
| 2              | Mil-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020-Power tool clean, No pretreatment | 3.588         | 3.549             | 3.633          | 20°        | 42.9          | Minor surface scratches covering 100% of panel One dark spot, stains present                                 | No microcracking, Few scratches, Blisters near bottom of panel, dirt between applique and coating    |             |
| <b>Average</b> |                      |                     |  | <b>4.019</b>  | <b>3.973</b>      | <b>4.048</b>   | <b>20°</b> | <b>39.9</b>   | <b>Minor surface scratches</b>   | <b>No microcracking, Blisters, Dirt between applique and primer</b>                                  | <b>Fail</b> |

(Table 10. continued on next page)

**Table 10. Surface Appearance Results (continued)**

| Coating System | Primer                                     | Topcoat                   | Substrate                                    | Color         |                   |                | Gloss      |               | Visual Inspection (streaks, blisters, voids, air bubbles, cratering, lifting, blushing, micro-cracks at 10x) |   | Pass/Fail |
|----------------|--|---------------------------|--|---------------|-------------------|----------------|------------|---------------|--|---|-----------|
|                |  |                           |  | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle      | Average       | Unaided Eye  | 10x Magnification                                     |           |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 3.351         | 2.566             | 3.023          | 20°        | 16.4          | Poor hiding ability, Small blisters covering 100% of panel   | Pinholes, Blistering, Surface imperfections           | Fail      |
| 4              | Platt Bros. Zn/Zlum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 3.331         | 2.552             | 3.024          | 20°        | 18.0          | Poor hiding ability, Small blisters covering 100% of panel   | Pinholes, Blistering, Surface imperfections           | Fail      |
| 5              | None                                       | Ameron PSX 700            | Steel 1020-Blast clean, No pretreatment      | 2.757         | 2.683             | 2.707          | 20°        | 40.9          | Slight orange peel, Few blisters (3), small pinholes covering 100% of panel                                  | No microcracking, Few blisters                        |           |
| 5              | None                                       | Ameron PSX 700            | Steel 1020-Blast clean, No pretreatment      | 3.022         | 2.942             | 2.931          | 20°        | 43.4          | Slight orange peel, Small blisters covering 100% of panel  | No microcracking, Sag in coating near bottom of panel |           |
| 5              | None                                       | Ameron PSX 700            | Steel 1020-Blast clean, No pretreatment      | 4.209         | 4.123             | 4.092          | 20°        | 45.5          | Poor hiding ability, Slight orange peel, Small pinholes covering 100% of panel                               | No microcracking, Few blisters                        |           |
| <b>Average</b> |  |                           |  | <b>3.329</b>  | <b>3.249</b>      | <b>3.243</b>   | <b>20°</b> | <b>43.287</b> | <b>Slight orange peel, Small pinholes</b>  | <b>No microcracking, Few blisters</b>                 | Fail      |
| 5              | None                                       | Ameron PSX 700            | Steel 1020-Power tool clean, No pretreatment | 3.735         | 3.645             | 3.622          | 20°        | 51.8          | Slight orange peel   | No microcracking                                      |           |
| 5              | None                                       | Ameron PSX 700            | Steel 1020-Power tool clean, No pretreatment | 3.920         | 3.827             | 3.816          | 20°        | 48.3          | Poor hiding ability, Slight orange peel  | No microcracking, Few blisters                        |           |
| 5              | None                                       | Ameron PSX 700            | Steel 1020-Power tool clean, No pretreatment | 4.392         | 4.314             | 4.271          | 20°        | 47.9          | Poor hiding ability, Slight orange peel  | No microcracking, Few blisters                        |           |
| <b>Average</b> |  |                           |  | <b>3.623</b>  | <b>3.540</b>      | <b>3.526</b>   | <b>20°</b> | <b>45.9</b>   | <b>Poor hiding ability, Slight orange peel</b>   | <b>No microcracking, Few blisters</b>                 | Fail      |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | Steel 1020-Blast clean, No pretreatment      | 5.704         | 5.643             | 5.526          | 20°        | 10.8          | Poor hiding ability, Small pinholes covering 100% of panel   | No microcracking, many pinholes, some blistering      |           |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | Steel 1020-Blast clean, No pretreatment      | 4.590         | 4.517             | 4.451          | 20°        | 13.9          | Poor hiding ability, Small pinholes covering 100% of panel   | No microcracking, many pinholes                       |           |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | Steel 1020-Blast clean, No pretreatment      | 5.217         | 5.153             | 5.056          | 20°        | 11.6          | Poor hiding ability, Small pinholes covering 100% of panel   | No microcracking, pinholes present, blisters present  |           |
| <b>Average</b> |  |                           |  | <b>5.170</b>  | <b>5.104</b>      | <b>5.011</b>   | <b>20°</b> | <b>12.120</b> | <b>Poor hiding ability, Small pinholes covering 100% of panel</b>  | <b>No microcracking, Many pinholes, blistering</b>    | Fail      |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | Steel 1020-Power tool clean, No pretreatment | 4.007         | 3.931             | 3.886          | 20°        | 12.7          | Poor hiding ability, Small pinholes covering 100% of panel   | No microcracking, many pinholes                       |           |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | Steel 1020-Power tool clean, No pretreatment | 3.994         | 3.910             | 3.875          | 20°        | 14.0          | Poor hiding ability, Small pinholes covering 100% of panel   | No microcracking, Many pinholes, blistering           |           |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | Steel 1020-Power tool clean, No pretreatment | 1.697         | 2.318             | 2.057          | 20°        | 28.4          | Slight orange peel   | No microcracking, some scratches                      |           |
| <b>Average</b> |  |                           |  | <b>4.340</b>  | <b>4.368</b>      | <b>4.266</b>   | <b>20°</b> | <b>14.8</b>   | <b>Poor hiding ability, Small pinholes covering 100% of panel</b>  | <b>No microcracking, Many pinholes, blistering</b>    | Fail      |

(Table 10. continued on next page)

**Table 10. Surface Appearance Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate                                    | Color         |                   |                | Gloss      |               | Visual Inspection (streaks, blisters, voids, air bubbles, cratering, lifting, blushing, micro-cracks at 10x) |  | Pass/Fail   |
|----------------|--|--|--|---------------|-------------------|----------------|------------|---------------|--|--|-------------|
|                |  |  |  | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle      | Average       | Unaided Eye  | 10x Magnification  |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020-Blast clean, No pretreatment      | 1.408         | 1.373             | 1.415          | 20°        | 39.7          | Slight orange peel, small blisters covering 5% of panel - evenly distributed                                 | No microcracking, some blistering                        |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020-Blast clean, No pretreatment      | 4.398         | 4.486             | 4.266          | 20°        | 36.4          | Poor hiding Ability, Orange Peel   | No microcracking, Scratches, pinholes, Slight blistering |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020-Blast clean, No pretreatment      | 5.584         | 5.669             | 5.422          | 20°        | 24.2          | Pock marks over 80% of the Panel, Orange Peel<br>Poor hiding ability   | No microcracking, blisters, few pinholes                 |             |
| <b>Average</b> |  |  |  | <b>3.797</b>  | <b>3.843</b>      | <b>3.701</b>   | <b>20°</b> | <b>33.433</b> | <b>Poor hiding Ability, Orange Peel</b>  | <b>No microcracking, minor pinholes, blistering</b>      | <b>Fail</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020-Power tool clean, No pretreatment | 4.252         | 4.325             | 4.128          | 20°        | 45.7          | Poor hiding ability, Small pinholes covering 100% of panel   | No microcracking, minor pinholes, blistering             |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020-Power tool clean, No pretreatment | 6.548         | 6.704             | 6.318          | 20°        | 25.6          | Poor hiding Ability, Orange Peel   | No microcracking, Pinholes at edges, blistering          |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020-Power tool clean, No pretreatment | 4.474         | 4.555             | 4.354          | 20°        | 39.3          | Poor hiding Ability, Orange Peel   | No microcracking, few pinholes                           |             |
| <b>Average</b> |  |  |  | <b>4.352</b>  | <b>4.422</b>      | <b>4.229</b>   | <b>20°</b> | <b>34.9</b>   | <b>Poor hiding Ability, Orange Peel</b>  | <b>No microcracking, minor pinholes, blistering</b>      | <b>Fail</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020-Blast clean, No pretreatment      | 4.409         | 3.507             | 3.824          | 20°        | 74.5          | Small blisters over 80% of panel, orange peel over entire panel  | No microcracking, no pinholes                            |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020-Blast clean, No pretreatment      | 4.455         | 3.520             | 3.805          | 20°        | 43.0          | Small Blisters over 80% of panel, Slight orange peel   | No microcracking, few pinholes                           |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020-Blast clean, No pretreatment      | 4.416         | 3.498             | 3.784          | 20°        | 52.2          | Few (4) blisters present, Orange peel over entire panel  | No microcracking, few pinholes                           |             |
| <b>Average</b> |  |  |  | <b>4.427</b>  | <b>3.508</b>      | <b>3.804</b>   | <b>20°</b> | <b>56.577</b> | <b>Orange peel, blistering</b>   | <b>No microcracking, few pinholes</b>                    | <b>Fail</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020-Power tool clean, No pretreatment | 4.583         | 3.623             | 3.954          | 20°        | 86.7          | Slight orange peel over entire panel   | No microcracking, few pinholes                           |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020-Power tool clean, No pretreatment | 4.501         | 3.574             | 3.914          | 20°        | 83.7          | Slight orange peel over entire panel, Few (1) blisters   | No microcracking, few pinholes                           |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020-Power tool clean, No pretreatment | 4.401         | 3.475             | 3.785          | 20°        | 77.7          | Orange Peel over entire panel, Few (2) blisters  | No microcracking, few pinholes                           |             |
| <b>Average</b> |  |  |  | <b>4.456</b>  | <b>3.529</b>      | <b>3.839</b>   | <b>20°</b> | <b>67.8</b>   | <b>Slight orange peel, Slight blistering</b>   | <b>No microcracking, few pinholes</b>                    | <b>Fail</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Steel 1020-Blast clean, No pretreatment      | 4.214         | 3.639             | 3.914          | 20°        | 28.7          | Small Blisters over 60% of panel, Heavy blisters on edges, Heavy orange peel                                 | No microcracking, Pinholes at edges                      |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Steel 1020-Blast clean, No pretreatment      | 3.886         | 3.272             | 3.627          | 20°        | 43.2          | Poor hiding ability, Blisters over 50% of Panel, Orange Peel over entire panel                               | No microcracking, few pinholes                           |             |

(Table 10. continued on next page)

**Table 10. Surface Appearance Results (continued)**

| Coating System | Primer                       | Topcoat                   | Substrate                                    | Color         |                   |                | Gloss      |               | Visual Inspection (streaks, blisters, voids, air bubbles, cratering, lifting, blushing, micro-cracks at 10x) |   | Pass/Fail |
|----------------|------------------------------|---------------------------|--|---------------|-------------------|----------------|------------|---------------|--|---|-----------|
|                |                              |                           |  | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle      | Average       | Unaided Eye  | 10x Magnification                         |           |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020-Blast clean, No pretreatment      | 5.774         | 5.370             | 5.433          | 20°        | 28.2          | Heavy Blistering Poor hiding Ability over entire panel   | No microcracking, few pinholes            |           |
| <b>Average</b> |                              |                           |  | <b>4.625</b>  | <b>4.094</b>      | <b>4.325</b>   | <b>20°</b> | <b>33.367</b> | <b>Poor hiding ability, Heavy orange peel and blistering</b>   | <b>No microcracking, few pinholes</b>     | Fail      |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020-Power tool clean, No pretreatment | 6.325         | 5.944             | 5.937          | 20°        | 24.7          | Heavy Blistering Poor hiding Ability over entire panel   | No microcracking, Pinholes visible        |           |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020-Power tool clean, No pretreatment | 4.662         | 4.133             | 4.353          | 20°        | 26.7          | Heavy Blistering Poor hiding Ability over entire panel   | No microcracking, few pinholes            |           |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020-Power tool clean, No pretreatment | 3.486         | 2.815             | 3.256          | 20°        | 46.3          | Poor hiding ability, Heavy orange peel and blistering  | No microcracking, Pinholes at edges       |           |
| <b>Average</b> |                              |                           |  | <b>4.710</b>  | <b>4.181</b>      | <b>4.406</b>   | <b>20°</b> | <b>33.0</b>   | <b>Poor hiding ability, Heavy orange peel and blistering</b>   | <b>No microcracking, few pinholes</b>     | Fail      |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 3.980         | 3.169             | 3.613          | 20°        | 26.6          | Poor Hiding Ability, Blistering, Orange Peel over entire panel   | No microcracking, pinholes visible        |           |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 3.593         | 2.764             | 3.255          | 20°        | 47.5          | Poor Hiding Ability, Blistering, Orange Peel over entire panel   | No microcracking, pinholes visible        |           |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 3.856         | 3.028             | 3.477          | 20°        | 38.7          | Poor Hiding Ability, Blistering, Orange Peel over entire panel   | No microcracking, pinholes visible        |           |
| <b>Average</b> |                              |                           |  | <b>3.810</b>  | <b>2.987</b>      | <b>3.448</b>   | <b>20°</b> | <b>37.590</b> | <b>Poor Hiding Ability, Blistering, Orange Peel over entire panel</b>  | <b>No microcracking, Pinholes Visible</b> | Fail      |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat | Steel 1020-Power tool clean, No pretreatment | 3.464         | 2.578             | 3.129          | 20°        | 40.0          | Poor Hiding Ability, Blisters over 30%, Orange Peel  | No microcracking, Pinholes Visible        |           |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat | Steel 1020-Power tool clean, No pretreatment | 3.816         | 2.967             | 3.432          | 20°        | 53.6          | Poor Hiding Ability, Blisters over 30%, Orange Peel  | No microcracking, Pinholes Visible        |           |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat | Steel 1020-Power tool clean, No pretreatment | 3.740         | 2.859             | 3.365          | 20°        | 61.0          | Poor Hiding Ability, Blistering, Orange Peel   | No microcracking, Pinholes Visible        |           |
| <b>Average</b> |                              |                           |  | <b>3.751</b>  | <b>2.907</b>      | <b>3.388</b>   | <b>20°</b> | <b>43.6</b>   | <b>Poor Hiding Ability, Blistering, Orange Peel over entire panel</b>  | <b>No microcracking, Pinholes Visible</b> | Fail      |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 2.410         | 1.886             | 2.376          | 20°        | 65.8          | Blisters over 90% of panel, Sagging bottom left corner   | No microcracking                          |           |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 2.428         | 2.024             | 2.436          | 20°        | 69.7          | Blisters over 90% of panel   | No microcracking                          |           |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | Steel 1020-Blast clean, No pretreatment      | 2.153         | 1.628             | 2.154          | 20°        | 63.5          | Blisters over 80% of panel, Slight orange peel   | No microcracking                          |           |
| <b>Average</b> |                              |                           |  | <b>2.330</b>  | <b>1.846</b>      | <b>2.322</b>   | <b>20°</b> | <b>66.323</b> | <b>Blistering</b>  | <b>No microcracking</b>                   | Fail      |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | Steel 1020-Power tool clean, No pretreatment | 2.186         | 1.707             | 2.201          | 20°        | 79.8          | Slight edge buildup, slight orange peel  | No microcracking                          |           |

(Table 10. continued on the next page)

**Table 10. Surface Appearance Results (continued)**

| Coating System | Primer        | Topcoat                   | Substrate                                    | Color         |                   |                | Gloss      |             | Visual Inspection (streaks, blisters, voids, air bubbles, cratering, lifting, blushing, micro-cracks at 10x) |                         | Pass/Fail   |
|----------------|---------------|---------------------------|--|---------------|-------------------|----------------|------------|-------------|--|-------------------------|-------------|
|                |               |                           |  | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle      | Average     | Unaided Eye  | 10x Magnification       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020-Power tool clean, No pretreatment | 2.084         | 1.589             | 2.105          | 20°        | 74.8        | Slight edge buildup, slight orange peel  | No microcracking        |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020-Power tool clean, No pretreatment | 2.288         | 1.826             | 2.291          | 20°        | 78.3        | Slight edge buildup, slight orange peel  | No microcracking        |             |
| <b>Average</b> |               |                           |  | <b>2.268</b>  | <b>1.787</b>      | <b>2.269</b>   | <b>20°</b> | <b>71.2</b> | <b>Slight edge buildup, slight orange peel</b>   | <b>No microcracking</b> | <b>Fail</b> |

### Test Summary

Most of the test coupons exhibited coating defects, including poor hiding ability, pinholes, blisters, and/or surface scratches. Overall coating systems 1 and 2, film technology coatings, and coating system 11, a waterborne coating, exhibited the best surface appearance. Coating system 1 is the 3M Fluoropolymer Paint Replacement Product. Coating system 2 is the Fluorogrip, Grade E. Coating system 11 is Aqua-Poxy 912 with Defthane Zero VOC Topcoat.

### **4.1.3. Pot Life (Viscosity) Test**

#### Rationale

This test provides data to characterize the pot life envelope of an admixed coating. Knowledge of initial viscosity and viscosity change, in relation to time and temperature, is important for determining the effective time frame for coating application. All participants have agreed that the agitation history and temperature at which coating mixtures have been maintained are important parameters in determining the pot life of the mixture. The pot live (viscosity) test results are listed in Table 11.

#### Test Description

This test was separated into two procedures. Procedure A is for solvent borne coatings and Procedure B is for waterborne coatings. All non-liquid coatings such as metal wire arc spray, powder coatings, and dry film technology were exempt from this requirement.

#### Procedure A

Coatings were mixed according to the manufacturer's instructions. A freshly mixed sample was maintained in a closed container at  $75\pm 5^{\circ}\text{F}$  for four hours. The mixture's viscosity was measured and recorded every 30 minutes in accordance with ASTM D 1200-94 (1999) (*Test Method for Viscosity by Ford Viscosity Cup*, approved August 15, 1994, reaffirmed 1999). Viscosity measurements were made with a #5 Zahn viscosity cup. This was done to reduce the amount of paint used during testing and also because a number of the alternative coatings had high initial viscosities.

A second sample of the freshly mixed coating was maintained in a closed container at  $95\pm 5^{\circ}\text{F}$  for four hours with continuous stirring. The viscosity of this sample was measured and recorded every 15 minutes with a #5 Zahn viscosity cup.

### Procedure B

Coatings were mixed and thinned according to the manufacturer's instructions. Coatings were maintained at  $75\pm 5^{\circ}\text{F}$  for six hours. The viscosity of the admixed coating was recorded every 30 minutes in accordance with ASTM D 1200-94 (1999). Viscosity measurements were made with a #5 Zahn viscosity cup. This was done to reduce the amount of paint used during testing and also because a number of the alternative coatings had high initial viscosities.

### Test Methodology

| <b>Parameters</b>                           | <b>Temperature, Viscosity</b>   |
|---|---|
| <b>Amount of Coating per Test</b>           | One gallon of mixed coating per temperature condition.  |
| <b>Control Coupons Required for Testing</b> | None  |
| <b>Acceptance Criteria</b>                  | <p>Procedure A- Solvent borne Coatings – Viscosity of both batches shall not exceed 60 seconds after 4 hours of continuous mixing in a closed container maintained at <math>75\pm 5^{\circ}\text{F}</math> (Batch 1) and <math>95\pm 5^{\circ}\text{F}</math> (Batch 2). The admixed materials must still be sprayable 4 hours after mixing.</p> <p>Procedure B- Waterborne Coatings – Coating viscosity shall not exceed admix viscosity by more than 15 seconds after 4 hours with no gelling of the admixed coating after 6 hours.</p> |

Table 11. Pot Life (Viscosity) Results

| Coating<br>Type of Coating<br>Procedure<br>Time/Temp | Deffthane Zero VOC                      |                               | Ameron PSX 700                          |                               |   |                               | Dimetcote 9HS                           |                               |   |      |
|--|---|-------------------------------|---|-------------------------------|---|-------------------------------|---|-------------------------------|---|------|
|  | Waterborne                              |                               | Solvent-borne                           |                               |   |                               | Solvent-borne                           |                               |   |      |
|  | Procedure B                             |                               | Procedure A                             |                               |   |                               | Procedure A                             |                               |   |      |
|  | 75 F                                    |                               | 75 F                                    |                               | 95 F                                    |                               | 75 F                                    |                               | 95 F                                    |      |
| Viscosity,<br>s, (#5<br>Zahn)                        | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford |      |
| 00:00  | 5.50                                    | <58s                          | 25.85                                   | >74s                          | 25.85                                   | >74s                          | 38.56                                   | >74s                          | 38.56                                   | >74s |
| 00:15  | --                                      | --                            | --                                      | --                            | 17.78                                   | >74s                          | --                                      | --                            | 42.78                                   | >74s |
| 00:30  | 5.97                                    | <58s                          | 26.81                                   | >74s                          | 19.65                                   | >74s                          | 31.19                                   | >74s                          | 34.50                                   | >74s |
| 00:45  | --                                      | --                            | --                                      | --                            | 22.28                                   | >74s                          | --                                      | --                            | 30.12                                   | >74s |
| 01:00  | 6.03                                    | <58s                          | 22.25                                   | >74s                          | 28.47                                   | >74s                          | 28.06                                   | >74s                          | 24.75                                   | >74s |
| 01:15  | --                                      | --                            | --                                      | --                            | 1:24.03                                 | >74s                          | --                                      | --                            | 33.38                                   | >74s |
| 01:30  | 6.25                                    | <58s                          | 37.90                                   | >74s                          | 2:35.06                                 | >74s                          | 42.80                                   | >74s                          | 22.82                                   | >74s |
| 01:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | 27.97***                                | >74s |
| 02:00  | 6.78                                    | <58s                          | 45.56                                   | >74s                          | --                                      | --                            | 26.66                                   | >74s                          | 31.56                                   | >74s |
| 02:15  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | 34.28                                   | >74s |
| 02:30  | 12.35                                   | ~65s                          | 1:01.00                                 | >74s                          | --                                      | --                            | 28.85                                   | >74s                          | 37.72                                   | >74s |
| 02:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | 28.44                                   | >74s |
| 03:00  | 31.75                                   | >74s                          | 1:11.59                                 | >74s                          | --                                      | --                            | 27.41                                   | >74s                          | 26.69                                   | >74s |
| 03:15  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | 28.18**                                 | >74s |
| 03:30  | 16.13*                                  | >74s                          | 1:32.34                                 | >74s                          | --                                      | --                            | 26.22**                                 | >74s                          | 34.75                                   | >74s |
| 03:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | 43.22                                   | >74s |
| 04:00  | 10.38                                   | ~58s                          | 1:26.68                                 | >74s                          | --                                      | --                            | 27.72                                   | >74s                          | 55.66                                   | >74s |
| 04:15  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 04:30  | 7.34                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 04:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 05:00  | 7.15                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 05:15  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 05:30  | 7.05                                    |                               | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 05:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| 06:00  | 5.63                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --                            |   |      |
| <b>Final Conclusion</b>                              | <b>Pass</b>                             |                               | <b>Fail</b>                             |                               | <b>Fail</b>                             |                               | <b>Fail</b>                             |                               | <b>Fail</b>                             |      |

\*Can felt warm  
 \*\*Skinning  
 \*\*\*Admixed coating very thick  
 \*\*\*\*Gelling

(Table 11. continued on next page)

Table 11. Pot Life (Viscosity) Results (continued)

| Coating<br>Type of Coating<br>Procedure<br>Time/Temp | Devoe 304 H                             |                               |   |                               | Deft 44-GY-16                           |                               | Deft 44-W-7                             |                               | Aqua-Poxy 912                           |      |
|--|---|-------------------------------|---|-------------------------------|---|-------------------------------|---|-------------------------------|---|------|
|  | Solvent-borne                           |                               |   |                               | Waterborne                              |                               | Waterborne                              |                               | Waterborne                              |      |
|  | Procedure A                             |                               |   |                               | Procedure B                             |                               | Procedure B                             |                               | Procedure B                             |      |
|  | 75 F                                    |                               | 95 F                                    |                               | 75 F                                    |                               | 75 F                                    |                               | 75 F                                    |      |
| Viscosity,<br>s, (#5<br>Zahn)                        | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford | Viscosity,<br>s, (#5<br>Zahn) | Approximate<br>Conversion to #4<br>Ford |      |
| 00:00  | 8.44                                    | <58s                          | 8.44                                    | <58s                          | 9.94                                    | ~58s                          | 7.16                                    | <58s                          | 4.72                                    | <58s |
| 00:15  | --                                      | --                            | 5.69                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 00:30  | 7.81                                    | <58s                          | 5.47                                    | <58s                          | 14.62                                   | ~74s                          | 7.44                                    | <58s                          | 6.12                                    | <58s |
| 00:45  | --                                      | --                            | 5.69                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 01:00  | 7.97                                    | <58s                          | 7.09                                    | <58s                          | 18.47                                   | >74s                          | 8.19                                    | <58s                          | 5.91                                    | <58s |
| 01:15  | --                                      | --                            | 6.47                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 01:30  | 6.15                                    | <58s                          | 5.81                                    | <58s                          | 27.44                                   | >74s                          | 6.69                                    | <58s                          | 5.44                                    | <58s |
| 01:45  | --                                      | --                            | 6.13                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 02:00  | 7.16                                    | <58s                          | 7.35                                    | <58s                          | 45.44                                   | >74s                          | 6.12                                    | <58s                          | 5.19                                    | <58s |
| 02:15  | --                                      | --                            | 5.85                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 02:30  | 7.31                                    | <58s                          | 6.87                                    | <58s                          | 32.88                                   | >74s                          | 6.00                                    | <58s                          | 5.03                                    | <58s |
| 02:45  | --                                      | --                            | 6.69                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 03:00  | 7.40                                    | <58s                          | 6.93                                    | <58s                          | 1:05.38****                             | >74s                          | 6.22                                    | <58s                          | 5.22                                    | <58s |
| 03:15  | --                                      | --                            | 7.97                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 03:30  | 6.72                                    | <58s                          | 6.28                                    | <58s                          | > 2 m                                   | >74s                          | 6.41                                    | <58s                          | 5.07                                    | <58s |
| 03:45  | --                                      | --                            | 6.85                                    | <58s                          | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 04:00  | 6.53                                    | <58s                          | 7.66                                    | <58s                          | --                                      | --                            | 5.75                                    | <58s                          | 5.35                                    | <58s |
| 04:15  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 04:30  | --                                      | --                            | --                                      | --                            | --                                      | --                            | 5.75                                    | <58s                          | 5.16                                    | <58s |
| 04:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 05:00  | --                                      | --                            | --                                      | --                            | --                                      | --                            | 5.25                                    | <58s                          | 4.75                                    | <58s |
| 05:15  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 05:30  | --                                      | --                            | --                                      | --                            | --                                      | --                            | 5.25                                    | <58s                          | 4.97                                    | <58s |
| 05:45  | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --                            | --                                      | --   |
| 06:00  | --                                      | --                            | --                                      | --                            | --                                      | --                            | 5.54                                    | <58s                          | 5.00                                    | <58s |
| <b>Final Conclusion</b>                              | <b>Pass</b>                             |                               | <b>Pass</b>                             |                               | <b>Fail</b>                             |                               | <b>Pass</b>                             |                               | <b>Pass</b>                             |      |

\*Can felt warm

\*\*Skinning

\*\*\*Admixed coating very thick

\*\*\*\*Gelling

### Test Summary

The primers for the waterborne coating systems, Deft 44-W-7 Intermediate Primer and Aqua-Poxy 912, performed best in this test. Devoe 304H Zinc Rich Primer also yielded acceptable results. Failure of some coatings may be due to the high initial viscosities of the coatings.

#### **4.1.4. Dry-To-Touch (Sanding)**

### Rationale

This test documents the time that a coating requires to become dry-to-touch, so that the item may be handled without damage to the coating. All participants have agreed that it is important to know the drying time required by a coating. The dry-to-the-touch (sanding) results are listed in Table 12.

### Test Description

Both liquid primers and liquid primer/topcoat coating systems were tested against this requirement. Metal wire arc spray was exempt from this requirement.

Coatings were applied to test coupons in accordance with the manufacturer's instructions. The test coupons were allowed to air dry at  $75\pm 5^{\circ}\text{F}$  and  $50\pm 10\%$  RH for 12-16 hours. After 12–16 hours the coating was lightly abraded with 3M Co. Scotch Brite Type A very fine grit nylon web abrasive pads to evaluate the ease of sanding.

### Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | Coating Cure Time   |
| <b>Coupons per Coating System</b>           | Two St-2a   |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | None  |
| <b>Acceptance Criteria</b>                  | No rolling or scribing during sanding, and “easy” sanding (as evaluated by the technician). |

**Table 12. Dry-to-Touch Results**

| Coating System | Coating                                   | Lab ID    | Sample ID             | Effects of Sanding |
|----------------|---|-----------|-----------------------|--------------------|
| 5              | Ameron PSX 700                            | 00-2955-P | TOF-293-00-05-S-2A-04 | None               |
|                |   | 00-2956-P | TOF-293-00-05-S-2A-05 | None               |
| 6              | Dimetcote 9HS                             | 00-4144-P | TOF-292-00-06-S-2A-04 | Scribing           |
|                |   | 00-4145-P | TOF-292-00-06-S-2A-05 | Scribing           |
| 6              | Dimetcote 9HS + Ameron PSX 700            | 00-4146-P | TOF-292-00-06-S-2A-06 | None               |
|                |   | 00-4147-P | TOF-292-00-06-S-2A-07 | None               |
| 7              | Devoe 304 H                               | 00-3973-P | TOF-291-00-07-S-2A-04 | Scribing           |
|                |   | 00-3974-P | TOF-291-00-07-S-2A-05 | Scribing           |
| 7              | Devoe 304 H + Ameron PSX 700              | 00-3975-P | TOF-291-00-07-S-2A-06 | None               |
|                |   | 00-3976-P | TOF-291-00-07-S-2A-07 | None               |
| 10             | Deft 44-GY-16                             | 00-3472-P | TOF-298-00-10-S-2A-04 | Slight Scribing    |
|                |   | 00-3473-P | TOF-298-00-10-S-2A-05 | Slight Scribing    |
| 10             | Deft 44-GY-16 + Deft 44-W-7 + Deft 55-W-2 | 00-3474-P | TOF-298-00-10-S-2A-06 | None               |
|                |   | 00-3475-P | TOF-298-00-10-S-2A-07 | None               |
| 11             | Aqua-Poxy 912                             | 00-3643-P | TOF-299-00-11-S-2A-04 | None               |
|                |   | 00-3644-P | TOF-299-00-11-S-2A-05 | None               |
| 11             | Aqua-poxy 912 + Deft 55-W-2               | 00-3645-P | TOF-299-00-11-S-2A-06 | None               |
|                |   | 00-3646-P | TOF-299-00-11-S-2A-07 | None               |

Test Summary

Overall most of the coatings passed this requirement. The primers for the high solids coating systems did not pass this requirement due to the powdery nature of the coating. Also Deft 44-GY-16, one of the primers from the waterborne coating systems, did not pass this requirement due to slight scribing with light abrasion.

**4.1.5. Cure Time (MEK Solvent Rub)**

Rationale

This test was performed to determine the solvent resistance of a cured coating. Participants deemed the MEK solvent rub test as more stringent

than an acetone rub test. Participants required that this test be performed at two-day intervals to determine the actual cure time of a coating. All participants have agreed that the MEK rub test is a performance requirement. The cure time (MEK solvent rub) test results are listed in Table 13.

Test Description

The MEK solvent rub test determines the amount of time a coating requires to fully cure at 75±5°F and 50±10% relative humidity. Both liquid primers and liquid primer/topcoat systems were tested against this requirement. Film technology and powder coatings were also tested against this requirement. Metal wire arc spray coatings were exempt from this requirement.

Every two days for a period of 14 days, fifty double rubs were performed on the test coupons with clean cheesecloth wetted with MEK. This test was performed in accordance with ASTM D 4752-98, (*Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub*, approved June 15, 1995). Each test was performed on a previously untested area of the coating. The coating was visually examined for substrate metal exposure.

Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | MEK saturated cheesecloth, 50 double rubs   |
| <b>Coupons per Coating System</b>           | Two St-2a   |
| <b>Trials per Coupon</b>                    | Seven (maximum)   |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"> <li>• One coupon coated with MIL-P-53022B and MIL-C-46168D</li> <li>• One coupon coated with MIL-P-53022B, Type II and MIL-C-85285, Type II</li> <li>• One coupon coated with NASA coating system</li> </ul> |
| <b>Acceptance Criteria</b>                  | No effect on surface or coating on the cloth (Resistance Rating 5).   |

**Table 13. Cure Time Results**

| Coating System | Coating  | Lab ID    | Panel ID              | Dry Film Thickness (mils) | Day 2  | Day 4  | Day 6  | Day 8  | Day 10 | Day 12 | Day 14 | Pass/Fail |
|----------------|--|-----------|-----------------------|---------------------------|--------|--------|--------|--------|--------|--------|--------|-----------|
|                |  |           |                       |                           | Rating |           |
| 1              | 3M Fluoropolymer                               | 00-3310-P | TOF-296-00-01-S-2A-04 | 7.18                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 1              | 3M Fluoropolymer                               | 00-3311-P | TOF-296-00-01-S-2A-05 | 7.21                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 2              | Fluorogrip, Grade E                            | 00-3811-P | TOF-297-00-02-S-2A-04 | 9.09                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 2              | Fluorogrip, Grade E                            | 00-3812-P | TOF-297-00-02-S-2A-05 | 9.28                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 5              | Ameron PSX 700                                 | 00-2957-P | TOF-293-00-05-S-2A-06 | 4.41                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 5              | Ameron PSX 700                                 | 00-2958-P | TOF-293-00-05-S-2A-07 | 4.50                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 6              | Dimetcote 9HS                                  | 00-4148-P | TOF-292-00-06-S-2A-08 | <0.48                     | 0      | 0      | 0      | 0      | 0      | 0      | 0      | Fail      |
| 6              | Dimetcote 9HS                                  | 00-4149-P | TOF-292-00-06-S-2A-09 | 1.05                      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | Fail      |
| 6              | Dimetcote 9HS, with Ameron PSX 700             | 00-4150-P | TOF-292-00-06-S-2A-10 | 4.96                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 6              | Dimetcote 9HS, with Ameron PSX 700             | 00-4151-P | TOF-292-00-06-S-2A-11 | 4.44                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 7              | Devoe 304 H                                    | 00-3977-P | TOF-291-00-07-S-2A-08 | 2.36                      | 3      | 3      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 7              | Devoe 304 H                                    | 00-3978-P | TOF-291-00-07-S-2A-09 | 1.35                      | 3      | 0      | 0      | 0      | 0      | 3      | 3      | Fail      |
| 7              | Devoe 304 H with Ameron PSX 700                | 00-3979-P | TOF-291-00-07-S-2A-10 | 5.55                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 7              | Devoe 304 H with Ameron PSX 700                | 00-3980-P | TOF-291-00-07-S-2A-11 | 4.34                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 8              | Morton Primer                                  | 00-2791-P | TOF-290-00-08-S-2A-04 | 4.22                      | 4      | 5      | -      | -      | -      | -      | -      | Pass      |
| 8              | Morton Primer                                  | 00-2792-P | TOF-290-00-08-S-2A-05 | 3.64                      | 4      | 5      | -      | -      | -      | -      | -      | Pass      |
| 8              | Morton Powders                                 | 00-2793-P | TOF-290-00-08-S-2A-06 | 5.50                      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 8              | Morton Powders                                 | 00-2794-P | TOF-290-00-08-S-2A-07 | 5.10                      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 9              | DuPont Primer                                  | 00-3138-P | TOF-295-00-09-S-2A-04 | 4.30                      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 9              | DuPont Primer                                  | 00-3139-P | TOF-295-00-09-S-2A-05 | 6.40                      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 9              | DuPont Powders                                 | 00-3140-P | TOF-295-00-09-S-2A-06 | 7.00                      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 9              | DuPont Powders                                 | 00-3141-P | TOF-295-00-09-S-2A-07 | 6.00                      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | Fail      |
| 10             | Deft 44-GY-16                                  | 00-3476-P | TOF-298-00-10-S-2A-08 | 2.06                      | 4      | 4      | 4      | 4      | 5      | -      | -      | Pass      |
| 10             | Deft 44-GY-16                                  | 00-3477-P | TOF-298-00-10-S-2A-09 | 1.88                      | 4      | 4      | 4      | 4      | 5      | -      | -      | Pass      |
| 10             | Deft 44-GY-16 with Deft 44-W-7 and Deft 55-W-2 | 00-3478-P | TOF-298-00-10-S-2A-10 | 4.98                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |

(Table 13 continued on next page)

**Table 13. Cure Time Results (continued)**

| Coating System | Coating  | Lab ID    | Panel ID              | Dry Film Thickness (mils) | Day 2  | Day 4  | Day 6  | Day 8  | Day 10 | Day 12 | Day 14 | Pass/Fail |
|----------------|--|-----------|-----------------------|---------------------------|--------|--------|--------|--------|--------|--------|--------|-----------|
|                |  |           |                       |                           | Rating |           |
| 10             | Deft 44-GY-16 with Deft 44-W-7 and Deft 55-W-2     | 00-3479-P | TOF-298-00-10-S-2A-11 | 13.91                     | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 11             | Aqua-Poxy 912                                      | 00-3647-P | TOF-299-00-11-S-2A-08 | 1.58                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 11             | Aqua-Poxy 912                                      | 00-3648-P | TOF-299-00-11-S-2A-09 | 1.59                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 11             | Aqua-Poxy 912 with Deft 55-W-2                     | 00-3649-P | TOF-299-00-11-S-2A-10 | 4.64                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| 11             | Aqua-Poxy 912 with Deft 55-W-2                     | 00-3650-P | TOF-299-00-11-S-2A-11 | 4.65                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| C1             | Mil-P-53022B, Type II                              | 00-4398-P | TOF-302-00-C1-S-2A-01 | 1.37                      | 0      | 0      | 4      | 5      | -      | -      | -      | Pass      |
| C1             | Mil-P-53022B, Type II with Mil-C-46168D            | 00-4399-P | TOF-302-00-C1-S-2A-02 | 5.89                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |
| C3             | Mil-P-53022B, Type II                              | 00-4460-P | TOF-303-00-C3-S-2A-01 | 1.42                      | 0      | 0      | 4      | 5      | -      | -      | -      | Pass      |
| C3             | Mil-P-53022B, Type II with Mil-PRF-85285C, Type II | 00-4461-P | TOF-303-00-C3-S-2A-02 | 3.25                      | 5      | -      | -      | -      | -      | -      | -      | Pass      |

Test Summary

All coating systems passed this requirement except the high solids coatings primers and most of the powder coatings. This is not believed to be a function of cure, but of coating components.

**4.2. Common Tests**

**4.2.1. Removability**

Rationale

Coating systems applied to Support Equipment must typically be removed after prescribed periods of use. To predict the effectiveness of field maintenance operations, it is necessary to evaluate the relative ease of removal of alternative coating systems. All participants agreed that plastic media blast; Type V is representative of the media found at the depot and organizational maintenance levels. The removability test results are listed in Table 14.

### Test Description

This test evaluates the ease of removing a 2-inch diameter area of coating on a test coupon using a Type V plastic media blast (PMB) process after artificial weathering.

Coated test coupons were weathered for 504 hours (21 days) in accordance with ASTM G 26-96 (*Standard Practice for Operating Light – Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials*), Test Method 1 (*Continuous Exposure to Light and Intermittent Exposure to Water Spray*, approved 1996), prior to testing for removability. Before and after exposure, color and gloss measurements were taken on each coated coupon per ASTM D 2244-93 and ASTM D 523-89 (1999), respectively, to document the aged finish prior to removability testing. Also, the dry film thickness of each test coupon was recorded prior to removability testing.

The aged test coupons were placed on a rack at a 60° angle to the horizontal. The PMB system pressure was adjusted to 25 psi and the test coupon was placed 9.5 inches away from a ½ - inch ventury nozzle. The abrasive blast was directed at the same area for 1 minute or until penetration to the substrate was achieved. The amount of time taken to penetrate to the substrate was recorded as well as the dry film thickness of the coating (if present) in the abrasive blast area.

### Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | Plastic Media, type V;<br>Blast pressure of 25–40 psi;<br>Standoff distance of 6–12 inches;<br>½ inch ventury nozzle;<br>Dwell time of 1 minute or until penetration to substrate   |
| <b>Coupons per Coating System</b>           | Three St-6  |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"><li>• One coupon coated with MIL-P-53022B and MIL-C-46168D</li><li>• One coupon coated with MIL-P-53022B, Type II and MIL-C-85285, Type II</li><li>• One coupon coated with NASA coating system</li></ul> |
| <b>Acceptance Criteria</b>                  | Less than one minute to penetrate to the substrate.   |

**Table 14. Removability Results**

| Coating System | Primer                                     | Topcoat                   | Color         |                   |                | Gloss |                 |               | Thickness (mils) |       | Exposed Substrate (Y/N) | Pass/Fail   |
|----------------|--|---------------------------|---------------|-------------------|----------------|-------|-----------------|---------------|------------------|-------|-------------------------|-------------|
|                |  |                           | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle | Initial Average | Final Average | Initial          | Final |                         |             |
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | 2.408         | 2.706             | 2.164          | 20°   | 42.03           | 39.03         | 6.96             | 0     | Y                       |             |
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | 2.416         | 2.749             | 2.200          | 20°   | 39.67           | 39.10         | 6.96             | 0     | Y                       |             |
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | 2.412         | 2.8               | 2.196          | 20°   | 42.20           | 36.83         | 7.14             | 0     | Y                       |             |
|                | <b>Average</b>                             |                           | <b>2.412</b>  | <b>2.752</b>      | <b>2.187</b>   |       | <b>41.30</b>    | <b>38.32</b>  | <b>7.02</b>      |       |                         | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | 9.293         | 7.634             | 8.458          | 20°   | 48.93           | 49.97         | 10.57            | 0     | Y                       |             |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | 8.159         | 6.664             | 7.450          | 20°   | 49.27           | 45.30         | 10.22            | 0     | Y                       |             |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | 9.118         | 7.564             | 8.360          | 20°   | 44.50           | 8.17          | 10.84            | 0     | Y                       |             |
| 2              | <b>Average</b>                             |                           | <b>8.857</b>  | <b>7.287</b>      | <b>8.089</b>   |       | <b>47.57</b>    | <b>34.48</b>  | <b>10.54</b>     |       |                         | <b>Pass</b> |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | 1.670         | 1.629             | 1.715          | 20°   | 24.33           | 20.07         | 6.84             | 0     | Y                       |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | 1.767         | 1.599             | 1.763          | 20°   | 18.90           | 15.50         | 6.82             | 0     | Y                       |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | 1.604         | 1.559             | 1.647          | 20°   | 17.63           | 12.90         | 8.54             | 0     | Y                       |             |
| 3              | <b>Average</b>                             |                           | <b>1.680</b>  | <b>1.596</b>      | <b>1.708</b>   |       | <b>20.29</b>    | <b>16.16</b>  | <b>7.40</b>      |       |                         | <b>Pass</b> |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | 1.354         | 1.244             | 1.385          | 20°   | 20.53           | 15.37         | 6.32             | 0     | Y                       |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | 1.419         | 1.403             | 1.476          | 20°   | 19.13           | 13.10         | 6.75             | 0     | Y                       |             |

(Table 14. continued on next page)

**Table 14. Removability Results (continued)**

| Coating System | Primer                                     | Topcoat                                    | Color         |                   |                | Gloss |                 |               | Thickness (mils) |       | Exposed Substrate (Y/N) | Pass/Fail   |
|----------------|--|--|---------------|-------------------|----------------|-------|-----------------|---------------|------------------|-------|-------------------------|-------------|
|                |  |  | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle | Initial Average | Final Average | Initial          | Final |                         |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat                  | 1.943         | 1.894             | 1.968          | 20°   | 18.67           | 14.83         | 6.34             | 0     | Y                       |             |
| <b>4</b>       | <b>Average</b>                             |  | <b>1.572</b>  | <b>1.514</b>      | <b>1.610</b>   |       | <b>19.44</b>    | <b>14.43</b>  | <b>6.47</b>      |       |                         | <b>Pass</b> |
| 5              | None                                       | Ameron PSX 700                             | 1.536         | 1.661             | 1.455          | 20°   | 53.23           | 46.00         | 3.54             | 0     | Y                       |             |
| 5              | None                                       | Ameron PSX 700                             | 1.163         | 1.324             | 1.119          | 20°   | 57.27           | 42.20         | 4.00             | 0     | Y                       |             |
| 5              | None                                       | Ameron PSX 700                             | 1.477         | 1.638             | 1.473          | 20°   | 52.60           | 44.40         | 3.64             | 0     | Y                       |             |
| <b>5</b>       | <b>Average</b>                             |  | <b>1.392</b>  | <b>1.541</b>      | <b>1.349</b>   |       | <b>54.37</b>    | <b>44.20</b>  | <b>3.73</b>      |       |                         | <b>Pass</b> |
| 6              | Dimetcote 9HS                              | Ameron PSX 700                             | 0.719         | 0.72              | 0.704          | 20°   | 11.53           | 9.97          | 8.06             | 0     | Y                       |             |
| 6              | Dimetcote 9HS                              | Ameron PSX 700                             | 1.078         | 1.261             | 1.113          | 20°   | 13.80           | 10.63         | 8.04             | 0     | Y                       |             |
| 6              | Dimetcote 9HS                              | Ameron PSX 700                             | 1.217         | 1.486             | 1.213          | 20°   | 10.97           | 9.60          | 7.98             | 0     | Y                       |             |
| <b>6</b>       | <b>Average</b>                             |  | <b>1.005</b>  | <b>1.156</b>      | <b>1.010</b>   |       | <b>12.10</b>    | <b>10.07</b>  | <b>8.03</b>      |       |                         | <b>Pass</b> |
| 7              | Devoe 304H                                 | Ameron PSX 700                             | 1.636         | 1.752             | 1.643          | 20°   | 48.93           | 36.23         | 8.05             | 0     | Y                       |             |
| 7              | Devoe 304H                                 | Ameron PSX 700                             | 1.793         | 1.925             | 1.789          | 20°   | 48.07           | 35.00         | 7.63             | 0     | Y                       |             |
| 7              | Devoe 304H                                 | Ameron PSX 700                             | 1.637         | 1.721             | 1.566          | 20°   | 32.77           | 25.07         | 5.38             | 0     | Y                       |             |
| <b>7</b>       | <b>Average</b>                             |  | <b>1.689</b>  | <b>1.799</b>      | <b>1.666</b>   |       | <b>43.26</b>    | <b>32.10</b>  | <b>7.02</b>      |       |                         | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer     | Morton 30-1007 Corvel Clean White U 1578-1 | 1.193         | 1.605             | 1.385          | 20°   | 79.77           | 81.00         | 5.08             | 0     | Y                       |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer     | Morton 30-1007 Corvel Clean White U 1578-1 | 1.276         | 1.591             | 1.447          | 20°   | 75.60           | 81.70         | 5.09             | 0     | Y                       |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer     | Morton 30-1007 Corvel Clean White U 1578-1 | 1.576         | 1.641             | 1.639          | 20°   | 71.37           | 81.03         | 5.13             | 0     | Y                       |             |
| <b>8</b>       | <b>Average</b>                             |  | <b>1.348</b>  | <b>1.612</b>      | <b>1.490</b>   |       | <b>75.58</b>    | <b>81.24</b>  | <b>5.10</b>      |       |                         | <b>Pass</b> |

(Table 14. continued on next page)

**Table 14. Removability Results (continued)**

| Coating System | Primer                       | Topcoat                   | Color         |                   |                | Gloss |                 |               | Thickness (mils) |       | Exposed Substrate (Y/N) | Pass/Fail   |
|----------------|------------------------------|---------------------------|---------------|-------------------|----------------|-------|-----------------|---------------|------------------|-------|-------------------------|-------------|
|                |                              |                           | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Angle | Initial Average | Final Average | Initial          | Final |                         |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | 0.991         | 1.009             | 1.093          | 20°   | 41.20           | 36.40         | 4.85             | 0     | Y                       |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | 1.082         | 1.206             | 1.189          | 20°   | 43.20           | 36.47         | 4.80             | 0     | Y                       |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | 0.963         | 1.134             | 1.075          | 20°   | 40.67           | 36.90         | 4.80             | 0     | Y                       |             |
| <b>9</b>       | <b>Average</b>               |                           | <b>1.012</b>  | <b>1.116</b>      | <b>1.119</b>   |       | <b>41.69</b>    | <b>36.59</b>  | <b>4.82</b>      |       |                         | <b>Pass</b> |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | 1.678         | 1.425             | 1.667          | 20°   | 54.33           | 37.60         | 3.04             | 0     | Y                       |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | 1.817         | 1.658             | 1.823          | 20°   | 55.60           | 43.17         | 3.35             | 0     | Y                       |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | 1.860         | 1.725             | 1.878          | 20°   | 50.53           | 46.80         | 3.08             | 0     | Y                       |             |
| <b>10</b>      | <b>Average</b>               |                           | <b>1.785</b>  | <b>1.603</b>      | <b>1.789</b>   |       | <b>53.49</b>    | <b>42.52</b>  | <b>3.16</b>      |       |                         | <b>Pass</b> |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | 1.945         | 1.822             | 1.944          | 20°   | 75.07           | 67.87         | 6.18             | 0     | Y                       |             |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | 1.842         | 1.707             | 1.838          | 20°   | 69.57           | 66.97         | 6.16             | 0     | Y                       |             |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | 1.837         | 1.697             | 1.836          | 20°   | 74.17           | 71.47         | 6.04             | 0     | Y                       |             |
| <b>11</b>      | <b>Average</b>               |                           | <b>1.875</b>  | <b>1.742</b>      | <b>1.873</b>   |       | <b>72.94</b>    | <b>68.77</b>  | <b>6.13</b>      |       |                         | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II        | MIL-C-46168D              | 2.818         | 2.775             | 2.775          | 20°   | 1.10            | 1.20          | 4.12             | 0     | Y                       |             |
| Control 1      | MIL-P-53022B, Type II        | MIL-C-46168D              | 2.657         | 2.612             | 2.596          | 20°   | 1.23            | 1.20          | 4.23             | 0     | Y                       |             |
| Control 1      | <b>Average</b>               |                           | <b>2.738</b>  | <b>2.694</b>      | <b>2.686</b>   |       | <b>1.17</b>     | <b>1.20</b>   | <b>4.18</b>      |       |                         | <b>Pass</b> |
| Control 2      | CATHACOAT 304K, DEVRAN 201   | DEVTHANE 369              | 2.309         | 2.306             | 2.343          | 20°   | 52.00           | 45.00         | 9.33             | 0     | Y                       |             |
| Control 2      | CATHACOAT 304K, DEVRAN 201   | DEVTHANE 369              | 1.175         | 1.359             | 1.268          | 20°   | 44.73           | 39.17         | 8.77             | 0     | Y                       |             |

(Table 14. continued on next page)

**Table 14. Removability Results (continued)**

| Coating System | Primer                     | Topcoat               | Color         |                   |                | Angle | Gloss           |               | Thickness (mils) |       | Exposed Substrate (Y/N) | Pass/Fail   |
|----------------|----------------------------|-----------------------|---------------|-------------------|----------------|-------|-----------------|---------------|------------------|-------|-------------------------|-------------|
|                |                            |                       | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) |       | Initial Average | Final Average | Initial          | Final |                         |             |
| Control 2      | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369          | 1.345         | 1.549             | 1.431          | 20°   | 51.90           | 42.23         | 10.22            | 0     | Y                       |             |
| Control 2      | <b>Average</b>             |                       | <b>1.610</b>  | <b>1.738</b>      | <b>1.681</b>   |       | <b>49.54</b>    | <b>42.13</b>  | <b>9.44</b>      |       |                         | <b>Pass</b> |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II | 1.272         | 1.287             | 1.364          | 20°   | 84.70           | 78.53         | 2.86             | 0     | Y                       |             |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II | 1.327         | 1.368             | 1.406          | 20°   | 89.23           | 80.03         | 2.93             | 0     | Y                       |             |
| Control 3      | <b>Average</b>             |                       | <b>1.300</b>  | <b>1.328</b>      | <b>1.385</b>   |       | <b>86.97</b>    | <b>79.28</b>  | <b>2.90</b>      |       |                         | <b>Pass</b> |

### Test Summary

All coating systems were removed in less than one minute. All coating systems passed the acceptance criteria. See Appendix A for photographs of the removability process.

## **4.2.2. Reparability**

### Rationale

This test provides data to evaluate how effectively coatings can be replaced/repared in field maintenance environments. All participants have agreed that coating reparability is a performance requirement. The reparability test results are listed in Table 15.

### Test Description

This test determined the relative ease of replacing and blending in coatings that have been removed or damaged otherwise. The dry tape adhesion test provided a procedure for establishing acceptability of intercoat and surface adhesion of an organic coating by applying pressure-sensitive adhesive tape over a scribed area of the coating, then removing that tape.

This test was divided into three procedures.

- (A) The baseline control was repaired with the baseline coating.
- (B) The baseline control was repaired with each of the alternative coatings.
- (C) The alternative coating was repaired with the alternative coating.

Test coupons that completed removability testing were used to evaluate reparability. The first step in this process was to replace the removed coating in accordance with the coating manufacturer's repair instructions. Then the repaired area was inspected to evaluate the appearance and match to the aged finish. Color and gloss measurements were taken to compare the repaired area to the aged area. After color and gloss tests were complete, a dry tape adhesion test was performed to ensure coating adherence. The dry tape adhesion test was performed in accordance with Method A of ASTM D 3359-97 (*Standard Test Methods for Measuring Adhesion by Tape Test*, approved December 10, 1995, re-approved 1997).

The test was performed by scribing two "X" incisions through the coating so that the smaller angle of each "X" is 30–45 degrees, making sure that the coating has been scribed all the way to the substrate. The scribe had a 45-degree bevel, and each line of the "X" was approximately 1.5 inches long. After scribing the test coupon, a piece of tape was immediately placed over the intersection of the "X" and smoothed down with finger

pressure. The tape was then removed quickly at a 180-degree angle. The incision area was then inspected for peel away.

Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | Manufacturer’s instructions for coating repair   |
| <b>Coupons per Coating System</b>           | Three St-6 (Recycled coupons from Paragraph 4.2.1)   |
| <b>Trials per Coupon</b>                    | One  |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"> <li>• One coupon coated with MIL-P-53022B and MIL-C-46168D</li> <li>• One coupon coated with MIL-P-53022B, Type II and MIL-C-85285, Type II</li> <li>• One coupon coated with NASA coating system</li> <li>• No controls for procedures B and C</li> </ul>                            |
| <b>Acceptance Criteria</b>                  | Ease of removal and replacement of damaged areas of the test coatings, color matching of aged versus new material. No streaks, blistering, voids, air bubbles, over-spray “halo”, cratering, lifting, blushing, or other surface irregularities. No peel away of the repaired coating during the dry tape adhesion test. |

**Table 15. Reparability Results**

| Coating System  | Primer                            | Topcoat                  | CFW (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with                       | Pass/Fail   |
|---|-----------------------------------|--------------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-------------|
| <b>Procedure A:<br/>Baseline repaired<br/>with Baseline</b> |                                   |                          |               |                   |                |               |                 |                        |   |             |
| Control 1   | MIL-P-53022B,<br>Type II          | MIL-C-46168D             | 3.147         | 2.949             | 3.093          | -             | 4               | Intersection           | MIL-P-53022B,<br>Type II, MIL-C-<br>46168D          |             |
| Control 1   | MIL-P-53022B,<br>Type II          | MIL-C-46168D             | 3.331         | 3.056             | 3.236          | -             | 4               | Intersection           | MIL-P-53022B,<br>Type II, MIL-C-<br>46168D          |             |
| <b>Average</b>  |                                   |                          | <b>3.239</b>  | <b>3.003</b>      | <b>3.165</b>   | <b>3.135</b>  | <b>4</b>        |                        |   | <b>Fail</b> |
| Control 2   | CATHACOAT<br>304K,<br>DEVTRAN 201 | DEVTHANE<br>369          | 2.159         | 1.475             | 1.990          | -             | 5               | No Failure             | CATHACOAT<br>304K, DEVTRAN<br>201, DEVTHANE<br>369  |             |
| Control 2   | CATHACOAT<br>304K,<br>DEVTRAN 201 | DEVTHANE<br>369          | 2.135         | 1.445             | 1.961          | -             | 5               | No Failure             | CATHACOAT<br>304K, DEVTRAN<br>201, DEVTHANE<br>369  |             |
| Control 2   | CATHACOAT<br>304K,<br>DEVTRAN 201 | DEVTHANE<br>369          | 2.328         | 1.628             | 2.132          | -             | 5               | No Failure             | CATHACOAT<br>304K, DEVTRAN<br>201, DEVTHANE<br>369  |             |
| <b>Average</b>  |                                   |                          | <b>2.207</b>  | <b>1.516</b>      | <b>2.028</b>   | <b>1.917</b>  | <b>5</b>        |                        |   | <b>Pass</b> |
| Control 3   | MIL-P-53022B,<br>Type II          | MIL-P-85285C,<br>Type II | 1.405         | 1.316             | 1.281          | -             | 5               | No Failure             | MIL-P-53022B,<br>Type II, MIL-P-<br>85285C, Type II |             |
| Control 3   | MIL-P-53022B,<br>Type II          | MIL-P-85285C,<br>Type II | 1.650         | 1.591             | 1.577          | -             | 5               | No Failure             | MIL-P-53022B,<br>Type II, MIL-P-<br>85285C, Type II |             |
| <b>Average</b>  |                                   |                          | <b>1.528</b>  | <b>1.454</b>      | <b>1.429</b>   | <b>1.470</b>  | <b>5</b>        |                        |   | <b>Pass</b> |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System   | Primer                   | Topcoat      | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred    | Coating System/ Repaired with   | Pass/Fail   |
|--|--------------------------|--------------|---------------|-------------------|----------------|---------------|-----------------|---------------------------|---|-------------|
| <b>Procedure B:<br/>Baseline repaired<br/>with alternative</b> |                          |              |               |                   |                |               |                 |                           | <b>Control 1<br/>Repaired with:</b>                                       |             |
| Control 1  | MIL-P-53022B,<br>Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection              | MIL-P-53022B,<br>Type I, 3M<br>Applique                                   |             |
| Control 1  | MIL-P-53022B,<br>Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure                | MIL-P-53022B,<br>Type I; 3M<br>Applique                                   |             |
| <b>Average</b>   |                          |              | -             | -                 | -              | -             | <b>5</b>        |                           |   | <b>Pass</b> |
| Control 1  | MIL-P-53022B,<br>Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection,<br>Incision | MIL-P-53022B,<br>Type I; Fluorogrip,<br>Grade E                           |             |
| Control 1  | MIL-P-53022B,<br>Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure                | MIL-P-53022B,<br>Type I; Fluorogrip,<br>Grade E                           |             |
| <b>Average</b>   |                          |              | -             | -                 | -              | -             | <b>5</b>        |                           |   | <b>Pass</b> |
| Control 1  | MIL-P-53022B,<br>Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure                | Platt Bros. 100%<br>Zinc Metallizing<br>Wire, Dethane<br>Zero VOC Topcoat |             |
| Control 1  | MIL-P-53022B,<br>Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure                | Platt Bros. 100%<br>Zinc Metallizing<br>Wire, Dethane<br>Zero VOC Topcoat |             |
| <b>Average</b>   |                          |              | -             | -                 | -              | -             | <b>5</b>        |                           |   | <b>Pass</b> |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                | Topcoat      | CFW (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with   | Pass/Fail   |
|----------------|-----------------------|--------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-------------|
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>5</b>        |                        |   | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection, Incision | Ameron PSX 700  |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection           | Ameron PSX 700  |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>4</b>        |                        |   | <b>Pass</b> |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                | Topcoat      | CFW (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with  | Pass/Fail   |
|----------------|-----------------------|--------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|--|-------------|
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700  |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Dimetcote 9HS, Ameron PSX 700  |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>5</b>        |                        |  | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>4</b>        |                        |  | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>5</b>        |                        |  | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW 510S9 Sky White                           |             |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                | Topcoat      | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with                            | Pass/Fail   |
|----------------|-----------------------|--------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|--|-------------|
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW 510S9 Sky White |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>5</b>        |                        |  | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection           | Defth 44-GY-16, Defth 44-W-7, Defthane Zero VOC Topcoat  |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 4               | Intersection           | Defth 44-GY-16, Defth 44-W-7, Defthane Zero VOC Topcoat  |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>4</b>        |                        |  | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat                 |             |
| Control 1      | MIL-P-53022B, Type II | MIL-C-46168D | NA            | NA                | NA             | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat                 |             |
| <b>Average</b> |                       |              | -             | -                 | -              | -             | <b>5</b>        |                        |  | <b>Pass</b> |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                     | Topcoat               | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with             | Pass/Fail |
|----------------|----------------------------|-----------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-----------|
|                |                            |                       |               |                   |                |               |                 |                        | <b>Control 2 Repaired with:</b>           |           |
| Control 2      | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369          | 5.349         | 5.645             | 5.248          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700             |           |
| Control 2      | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369          | 2.901         | 3.072             | 2.876          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700             |           |
| <b>Average</b> |                            |                       | <b>4.125</b>  | <b>4.359</b>      | <b>4.062</b>   | <b>4.182</b>  | <b>4</b>        |                        |   | Fail      |
| Control 2      | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369          | 4.269         | 4.545             | 4.227          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700                |           |
|                | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369          | 5.127         | 5.470             | 5.045          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700                |           |
| <b>Average</b> |                            |                       | <b>4.698</b>  | <b>5.008</b>      | <b>4.636</b>   | <b>4.781</b>  | <b>4</b>        |                        |   | Fail      |
|                |                            |                       |               |                   |                |               |                 |                        | <b>Control 3 Repaired with</b>            |           |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II | 2.471         | 2.745             | 2.172          | -             | 4               | Intersection, Incision | MIL-P-53022B, Type I; 3M Applique         |           |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II | 2.717         | 3.017             | 2.408          | -             | 4               | Intersection, Incision | MIL-P-53022B, Type I; 3M Applique         |           |
| <b>Average</b> |                            |                       | <b>2.594</b>  | <b>2.881</b>      | <b>2.290</b>   | <b>2.588</b>  | <b>4</b>        |                        |   | Fail      |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II | 3.713         | 3.562             | 3.642          | -             | 4               | Intersection, Incision | MIL-P-53022B, Type I; Fluorogrip, Grade E |           |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II | 3.782         | 3.588             | 3.654          | -             | 4               | Intersection, Incision | MIL-P-53022B, Type I; Fluorogrip, Grade E |           |
| <b>Average</b> |                            |                       | <b>3.748</b>  | <b>3.575</b>      | <b>3.648</b>   | <b>3.657</b>  | <b>4</b>        |                        |   | Fail      |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                | Topcoat               | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with   | Pass/Fail |
|----------------|-----------------------|-----------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-----------|
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 1.794         | 1.192             | 1.659          | -             | 5               | No Failure             | Platt Bros. 100% Zinc Metallizing Wire, Defthane Zero VOC Topcoat     |           |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 2.796         | 2.292             | 2.572          | -             | 5               | No Failure             | Platt Bros. 100% Zinc Metallizing Wire, Defthane Zero VOC Topcoat     |           |
| <b>Average</b> |                       |                       | <b>2.295</b>  | <b>1.742</b>      | <b>2.116</b>   | <b>2.051</b>  | <b>5</b>        |                        |   | Fail      |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 5.572         | 5.292             | 5.240          | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |           |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 5.182         | 4.878             | 4.875          | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |           |

*(Table 15. continued on next page)*

**Table 15. Reparability Results (continued)**

| Coating System | Primer                | Topcoat               | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with  | Pass/Fail   |
|----------------|-----------------------|-----------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|--|-------------|
| <b>Average</b> |                       |                       | <b>5.377</b>  | <b>5.085</b>      | <b>5.058</b>   | <b>5.173</b>  | <b>5</b>        |                        |  | Fail        |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 1.991         | 1.889             | 1.962          | -             | 4               | Intersection           | Ameron PSX 700   |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 1.736         | 1.696             | 1.723          | -             | 4               | Intersection           | Ameron PSX 700   |             |
| <b>Average</b> |                       |                       | <b>1.864</b>  | <b>1.793</b>      | <b>1.843</b>   | <b>1.833</b>  | <b>4</b>        |                        |  | <b>Pass</b> |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 2.798         | 2.804             | 2.785          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700  |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 3.359         | 3.442             | 3.345          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700  |             |
| <b>Average</b> |                       |                       | <b>3.079</b>  | <b>3.123</b>      | <b>3.065</b>   | <b>3.089</b>  | <b>4</b>        |                        |  | Fail        |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 3.763         | 3.907             | 3.757          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 3.649         | 3.724             | 3.642          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| <b>Average</b> |                       |                       | <b>3.706</b>  | <b>3.816</b>      | <b>3.700</b>   | <b>3.740</b>  | <b>4</b>        |                        |  | Fail        |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 2.940         | 2.622             | 2.370          | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 3.425         | 2.955             | 2.795          | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                | Topcoat               | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with                            | Pass/Fail   |
|----------------|-----------------------|-----------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|--|-------------|
| <b>Average</b> |                       |                       | <b>3.183</b>  | <b>2.789</b>      | <b>2.583</b>   | <b>2.851</b>  | <b>5</b>        |                        |  | <b>Fail</b> |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 1.743         | 1.695             | 1.675          | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW 510S9 Sky White |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 1.902         | 1.868             | 1.869          | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW 510S9 Sky White |             |
| <b>Average</b> |                       |                       | <b>1.823</b>  | <b>1.782</b>      | <b>1.772</b>   | <b>1.792</b>  | <b>5</b>        |                        |  | <b>Pass</b> |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 1.380         | 1.331             | 1.228          | -             | 4               | Intersection           | Defth 44-GY-16, Defth 44-W-7, Defthane Zero VOC Topcoat  |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 0.962         | 0.873             | 0.818          | -             | 4               | Intersection           | Defth 44-GY-16, Defth 44-W-7, Defthane Zero VOC Topcoat  |             |
| <b>Average</b> |                       |                       | <b>1.171</b>  | <b>1.102</b>      | <b>1.023</b>   | <b>1.099</b>  | <b>4</b>        |                        |  | <b>Pass</b> |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 0.483         | 0.511             | 0.483          | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat                 |             |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | 0.503         | 0.529             | 0.505          | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat                 |             |
| <b>Average</b> |                       |                       | <b>0.493</b>  | <b>0.52</b>       | <b>0.494</b>   | <b>0.502</b>  | <b>5</b>        |                        |  | <b>Pass</b> |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System  | Primer                                 | Topcoat                   | CFW (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with                                     | Pass/Fail |
|---|--|---------------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-----------|
| <b>Procedure C: Alternative repaired with Alternative</b> |  |                           |               |                   |                |               |                 |                        | <b>Coating System</b>   |           |
| 1   | MIL-P-53022B, Type I                   | 3M Applique               | 2.220         | 2.125             | 2.003          | -             | 5               | No Failure             | MIL-P-53022B, Type I; 3M Applique                                 |           |
| 1   | MIL-P-53022B, Type I                   | 3M Applique               | 2.181         | 2.117             | 1.991          | -             | 5               | No Failure             | MIL-P-53022B, Type I; 3M Applique                                 |           |
| 1   | MIL-P-53022B, Type I                   | 3M Applique               | 2.018         | 1.991             | 1.838          | -             | 4               | Intersection           | MIL-P-53022B, Type I; 3M Applique                                 |           |
| <b>Average</b>  |  |                           | <b>2.140</b>  | <b>2.078</b>      | <b>1.944</b>   | <b>2.054</b>  | <b>5</b>        |                        |   | Fail      |
| 2   | MIL-P-53022B, Type I                   | Fluorogrip, Grade E       | 8.898         | 7.209             | 7.975          | -             | 4               | Intersection, Incision | MIL-P-53022B, Type I; Fluorogrip, Grade E                         |           |
| 2   | MIL-P-53022B, Type I                   | Fluorogrip, Grade E       | 6.877         | 5.253             | 6.173          | -             | 3               | Intersection, Incision | MIL-P-53022B, Type I; Fluorogrip, Grade E                         |           |
| 2   | MIL-P-53022B, Type I                   | Fluorogrip, Grade E       | 9.145         | 7.566             | 8.334          | -             | 3               | Intersection, Incision | MIL-P-53022B, Type I; Fluorogrip, Grade E                         |           |
| <b>Average</b>  |  |                           | <b>8.307</b>  | <b>6.676</b>      | <b>7.494</b>   | <b>7.492</b>  | <b>3</b>        |                        |   | Fail      |
| 3   | Platt Bros. 100% Zinc Metallizing Wire | Defthane Zero VOC Topcoat | 3.054         | 2.597             | 2.842          | -             | 5               | No Failure             | Platt Bros. 100% Zinc Metallizing Wire, Defthane Zero VOC Topcoat |           |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                                     | Topcoat                   | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with   | Pass/Fail |
|----------------|--|---------------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-----------|
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | 5.990         | 5.765             | 5.695          | -             | 5               | No Failure             | Platt Bros. 100% Zinc Metallizing Wire, Defthane Zero VOC Topcoat     |           |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | 3.515         | 3.086             | 3.251          | -             | 5               | No Failure             | Platt Bros. 100% Zinc Metallizing Wire, Defthane Zero VOC Topcoat     |           |
| <b>Average</b> |  |                           | <b>4.186</b>  | <b>3.816</b>      | <b>3.929</b>   | <b>3.977</b>  | <b>5</b>        |                        |   | Fail      |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | 3.601         | 3.204             | 3.372          | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |           |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | 4.815         | 4.497             | 4.552          | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |           |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | 4.943         | 4.635             | 4.680          | -             | 5               | No Failure             | Platt Bros. Zn/Alum 85/15 Metallizing Wire, Defthane Zero VOC Topcoat |           |
| <b>Average</b> |  |                           | <b>4.453</b>  | <b>4.112</b>      | <b>4.201</b>   | <b>4.255</b>  | <b>5</b>        |                        |   | Fail      |
| 5              | None                                       | Ameron PSX 700            | 0.558         | 0.527             | 0.529          | -             | 4               | Intersection           | Ameron PSX 700  |           |
| 5              | None                                       | Ameron PSX 700            | 0.819         | 0.854             | 0.777          | -             | 4               | Intersection           | Ameron PSX 700  |           |
| 5              | None                                       | Ameron PSX 700            | 0.589         | 0.591             | 0.597          | -             | 2               | Intersection           | Ameron PSX 700  |           |
| <b>Average</b> |  |                           | <b>0.655</b>  | <b>0.657</b>      | <b>0.634</b>   | <b>0.649</b>  | <b>3</b>        |                        |   | Fail      |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with  | Pass/Fail   |
|----------------|--|--|---------------|-------------------|----------------|---------------|-----------------|------------------------|--|-------------|
| 6              | Dimetcote 9HS                          | Ameron PSX 700                             | 0.084         | 0.114             | 0.083          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700  |             |
| 6              | Dimetcote 9HS                          | Ameron PSX 700                             | 1.651         | 1.666             | 1.656          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700  |             |
| 6              | Dimetcote 9HS                          | Ameron PSX 700                             | 0.885         | 0.906             | 0.888          | -             | 4               | Intersection           | Dimetcote 9HS, Ameron PSX 700  |             |
| <b>Average</b> |  |  | <b>0.873</b>  | <b>0.895</b>      | <b>0.876</b>   | <b>0.881</b>  | <b>4</b>        |                        |  | <b>Pass</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | 4.034         | 4.230             | 3.827          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | 2.731         | 2.850             | 2.579          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | 0.581         | 0.634             | 0.544          | -             | 4               | Intersection           | Devoe 304H, Ameron PSX 700   |             |
| <b>Average</b> |  |  | <b>2.449</b>  | <b>2.571</b>      | <b>2.317</b>   | <b>2.446</b>  | <b>4</b>        |                        |  | <b>Fail</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | 2.258         | 1.913             | 2.043          | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | 2.297         | 2.065             | 2.134          | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | 2.521         | 2.115             | 2.263          | -             | 5               | No Failure             | Morton 13-7004 Corvel Zinc Rich Primer, Morton 30-1007 Corvel Clean White U 1578-1 |             |
| <b>Average</b> |  |  | <b>2.359</b>  | <b>2.031</b>      | <b>2.147</b>   | <b>2.179</b>  | <b>5</b>        |                        |  | <b>Fail</b> |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer                       | Topcoat                   | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with                           | Pass/Fail   |
|----------------|------------------------------|---------------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|---|-------------|
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | 1.235         | 1.473             | 1.252          | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW510S9 Sky White |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | 0.966         | 1.183             | 1.010          | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW510S9 Sky White |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | 1.271         | 1.539             | 1.280          | -             | 5               | No Failure             | DuPont ELH503S5 Gray Morning, DuPont PFW510S9 Sky White |             |
| <b>Average</b> |                              |                           | <b>1.157</b>  | <b>1.398</b>      | <b>1.181</b>   | <b>1.245</b>  | <b>5</b>        |                        |   | <b>Pass</b> |
| 10             | Deft 44-GY-16, Deft 44-W-7   | Defthane Zero VOC Topcoat | 1.162         | 1.048             | 1.124          | -             | 4               | Intersection           | Deft 44-GY-16, Deft 44-W-7, Defthane Zero VOC Topcoat   |             |
| 10             | Deft 44-GY-16, Deft 44-W-7   | Defthane Zero VOC Topcoat | 1.113         | 0.906             | 0.998          | -             | 5               | No Failure             | Deft 44-GY-16, Deft 44-W-7, Defthane Zero VOC Topcoat   |             |
| 10             | Deft 44-GY-16, Deft 44-W-7   | Defthane Zero VOC Topcoat | 1.009         | 0.880             | 0.957          | -             | 4               | Intersection           | Deft 44-GY-16, Deft 44-W-7, Defthane Zero VOC Topcoat   |             |
| <b>Average</b> |                              |                           | <b>1.095</b>  | <b>0.945</b>      | <b>1.026</b>   | <b>1.022</b>  | <b>4</b>        |                        |   | <b>Pass</b> |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat | 1.869         | 1.801             | 1.624          | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat                |             |

(Table 15. continued on next page)

**Table 15. Reparability Results (continued)**

| Coating System | Primer        | Topcoat                   | CWF (Delta-E) | SPL-Hor (Delta-E) | D-65 (Delta-E) | Color Average | Adhesion Rating | Where Failure Occurred | Coating System/ Repaired with            | Pass/Fail   |
|----------------|---------------|---------------------------|---------------|-------------------|----------------|---------------|-----------------|------------------------|--|-------------|
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | 1.763         | 1.674             | 1.561          | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | 1.639         | 1.570             | 1.462          | -             | 5               | No Failure             | Aqua-Poxy 912, Defthane Zero VOC Topcoat |             |
| <b>Average</b> |               |                           | <b>1.757</b>  | <b>1.682</b>      | <b>1.549</b>   | <b>1.663</b>  | <b>5</b>        |                        |  | <b>Pass</b> |

### Test Summary

The NASA control coating performed best in Procedure A. It exhibited both color matching and adhesive qualities.

When testing the reparability of control coating 1, MIL-P-53022B, Type II with MIL-C-46168D, only the dry tape adhesion was evaluated. This was due to the control coating being green and the alternatives being white.

Only coating systems 5, 7, and 10 failed this evaluation. Coating system 5 is Ameron PSX 700 without a primer, coating system 7 is Devoe 304H with Ameron PSX 700, and coating system 10 is Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat.

The NASA control coating could not be repaired with either coating system 6 or coating system 7. Note: these coating systems were the only systems to be evaluated against the NASA control coating.

Coating systems 1 and 11 were the only coating systems to exhibit the required repair criteria when used to repair control coating 3, MIL-P-53022, Type II with MIL-PRF-85285C, Type II.

Only the waterborne coatings passed Procedure C, alternative coating repaired with alternative coating. These coatings are Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat, coating system 10, and Aqua-Poxy 912 with Defthane Zero VOC Topcoat, coating system 11.

See Appendix B for photographs of the reparability test coupons.

### **4.2.3. Accelerated Weathering**

#### Rationale

Support Equipment coating systems must withstand outdoor exposure to sunlight and wet/dry conditions daily. This procedure documented the coating resistance to accelerated outdoor weather exposure conditions. All of the participants agreed that accelerated weathering is a performance requirement. The accelerated weathering test results are listed in Table 16.

#### Test Description

This accelerated weathering test evaluated the degree of coating color and gloss degradation when exposed to simulated outdoor weathering.

Color and gloss measurements were taken on each test coupon prior to testing per ASTM D 2244-93 and ASTM D 523-89 (1999), respectively. Test coupons were then exposed to UV light, through a borosilicate inner and outer filter to simulate sunlight, and intermittent moisture for 500 hours in accordance with ASTM G 26-96, Test Method 1. After exposing test coupons to the accelerated weathering, color and gloss measurements were again recorded to measure any changes. This test was continued as a Navy extended test to 1,500 hours. Results for the extended test are reported in Paragraph 4.3.5.

Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | <ul style="list-style-type: none"> <li>• 140 ± 5°F (60±3°C)</li> <li>• 50±5% RH</li> <li>• Borosilicate glass inner and outer filter</li> <li>• One cycle: 102 minutes of light only, and 18 minutes of light and water spray</li> <li>• Spectral irradiance levels 0.35W/m<sup>2</sup> incident at 340 nm</li> <li>• Operate for 500 hours (250 cycles)</li> </ul> |
| <b>Coupons per Coating System</b>           | Three Al-1a, Al-1b, Al-1c, Al-1d, St-2a, St-2b  |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"> <li>• One coupon coated with MIL-P-53022B and MIL-C-46168D</li> <li>• One coupon coated with MIL-P-53022B, Type II and MIL-C-85285, Type II</li> <li>• One coupon coated with NASA coating system (steel panels only)</li> </ul>   |
| <b>Acceptance Criteria</b>                  | Color change performance <1 unit (ΔE) @ 500 hours.  |

Results, as reported by CTIO, are as follows:

**Table 16. Accelerated Weathering Results**

| Coating System | Primer               | Topcoat     | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail |
|----------------|----------------------|-------------|---|-----------------------|-------------|-----------|
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 39.76                 | 1.872812    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 38.28                 | 2.06317     |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 40.88                 | 1.960306    |           |
| <b>Average</b> |                      |             |   | <b>39.64</b>          | <b>1.97</b> | Fail      |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 43.14                 | 1.992942    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 39.16                 | 1.996441    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 37.98                 | 2.010565    |           |
| <b>Average</b> |                      |             |   | <b>40.09</b>          | <b>2.00</b> | Fail      |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 38.06                 | 1.967177    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 39.62                 | 1.840133    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 44.04                 | 2.044308    |           |
| <b>Average</b> |                      |             |   | <b>40.57</b>          | <b>1.95</b> | Fail      |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 39.54                 | 1.931294    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 41.92                 | 2.047717    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 42.90                 | 1.884376    |           |
| <b>Average</b> |                      |             |   | <b>41.45</b>          | <b>1.95</b> | Fail      |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 1020- Blast clean, No Pretreatment  | 23.40                 | 2.031064    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 1020- Blast clean, No Pretreatment  | 32.03                 | 2.031042    |           |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 1020- Blast clean, No Pretreatment  | 33.60                 | 2.170081    |           |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer               | Topcoat             | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail |
|----------------|----------------------|---------------------|---|-----------------------|-------------|-----------|
| <b>Average</b> |                      |                     |   | <b>29.68</b>          | <b>2.08</b> | Fail      |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 39.90                 | 5.056402    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 47.18                 | 4.789932    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 41.46                 | 4.499904    |           |
| <b>Average</b> |                      |                     |   | <b>42.85</b>          | <b>4.78</b> | Fail      |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 46.06                 | 5.021484    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 40.94                 | 4.698181    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 46.48                 | 4.402462    |           |
| <b>Average</b> |                      |                     |   | <b>44.49</b>          | <b>4.71</b> | Fail      |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 36.54                 | 5.010521    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 43.90                 | 4.662401    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 39.02                 | 4.497067    |           |
| <b>Average</b> |                      |                     |   | <b>39.82</b>          | <b>4.72</b> | Fail      |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 48.10                 | 4.453747    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 28.42                 | 4.221688    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 39.44                 | 4.25344     |           |
| <b>Average</b> |                      |                     |   | <b>38.65</b>          | <b>4.31</b> | Fail      |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Blast clean, No Pretreatment  | 48.53                 | 5.359363    |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Blast clean, No Pretreatment  | 31.40                 | 5.342194    |           |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                                     | Topcoat                   | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|--|---------------------------|---|-----------------------|-------------|-------------|
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Steel 1020- Blast clean, No Pretreatment  | 47.50                 | 4.99242     |             |
| <b>Average</b> |  |                           |   | <b>42.48</b>          | <b>5.23</b> | <b>Fail</b> |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 16.03                 | 0.423677    |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 14.83                 | 0.519066    |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 8.07                  | 0.507157    |             |
| <b>Average</b> |  |                           |   | <b>12.98</b>          | <b>0.48</b> | <b>Pass</b> |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 17.17                 | 0.992315    |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 16.77                 | 0.462129    |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 19.03                 | 1.073071    |             |
| <b>Average</b> |  |                           |   | <b>17.66</b>          | <b>0.84</b> | <b>Pass</b> |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 34.88                 | 1.156528    |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 33.22                 | 1.124513    |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 28.78                 | 1.126247    |             |
| <b>Average</b> |  |                           |   | <b>32.29</b>          | <b>1.14</b> | <b>Fail</b> |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 39.56                 | 1.04189     |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 42.64                 | 1.041631    |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 42.64                 | 1.001618    |             |
| <b>Average</b> |  |                           |   | <b>41.61</b>          | <b>1.03</b> | <b>Fail</b> |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer        | Topcoat        | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|---------------|----------------|---|-----------------------|-------------|-------------|
| 5              | None          | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 43.06                 | 1.157761    |             |
| 5              | None          | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 48.42                 | 1.203157    |             |
| 5              | None          | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 35.74                 | 1.17796     |             |
| <b>Average</b> |               |                |   | <b>42.41</b>          | <b>1.18</b> | <b>Fail</b> |
| 5              | None          | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 46.54                 | 1.10823     |             |
| 5              | None          | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 47.46                 | 1.141196    |             |
| 5              | None          | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 49.18                 | 1.133653    |             |
| <b>Average</b> |               |                |   | <b>47.73</b>          | <b>1.13</b> | <b>Fail</b> |
| 5              | None          | Ameron PSX 700 | Steel 1020- Blast clean, No Pretreatment  | 24.63                 | 0.971148    |             |
| 5              | None          | Ameron PSX 700 | Steel 1020- Blast clean, No Pretreatment  | 29.57                 | 1.15628     |             |
| 5              | None          | Ameron PSX 700 | Steel 1020- Blast clean, No Pretreatment  | 13.50                 | 1.190033    |             |
| <b>Average</b> |               |                |   | <b>22.57</b>          | <b>1.11</b> | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 9.10                  | 0.88316     |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 12.24                 | 0.918556    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 10.96                 | 0.94375     |             |
| <b>Average</b> |               |                |   | <b>10.77</b>          | <b>0.92</b> | <b>Pass</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 9.86                  | 1.007006    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 9.32                  | 0.92243     |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 11.38                 | 1.111789    |             |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer        | Topcoat        | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|---------------|----------------|---|-----------------------|-------------|-------------|
| <b>Average</b> |               |                |   | <b>10.19</b>          | <b>1.01</b> | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 12.86                 | 0.845311    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 9.46                  | 0.931447    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 7.54                  | 0.906937    |             |
| <b>Average</b> |               |                |   | <b>9.95</b>           | <b>0.89</b> | <b>Pass</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 6.82                  | 0.879359    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 12.62                 | 0.856662    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 8.28                  | 0.638029    |             |
| <b>Average</b> |               |                |   | <b>9.24</b>           | <b>0.79</b> | <b>Pass</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Blast clean, No Pretreatment  | 8.43                  | 0.808927    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Blast clean, No Pretreatment  | 5.93                  | 0.722867    |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Blast clean, No Pretreatment  | 8.57                  | 0.833885    |             |
| <b>Average</b> |               |                |   | <b>7.64</b>           | <b>0.79</b> | <b>Pass</b> |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 29.00                 | 1.303541    |             |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 21.00                 | 1.286148    |             |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 23.74                 | 1.276582    |             |
| <b>Average</b> |               |                |   | <b>24.58</b>          | <b>1.29</b> | <b>Fail</b> |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 24.40                 | 1.362801    |             |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 24.54                 | 1.404487    |             |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|--|--|---|-----------------------|-------------|-------------|
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 30.34                 | 1.402083    |             |
| <b>Average</b> |  |  |   | <b>26.43</b>          | <b>1.39</b> | <b>Fail</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 28.04                 | 1.414005    |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 30.54                 | 1.667045    |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 36.06                 | 1.449644    |             |
| <b>Average</b> |  |  |   | <b>31.55</b>          | <b>1.51</b> | <b>Fail</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 25.72                 | 1.314538    |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 27.76                 | 1.098113    |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 32.90                 | 0.976706    |             |
| <b>Average</b> |  |  |   | <b>28.79</b>          | <b>1.13</b> | <b>Fail</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Blast clean, No Pretreatment  | 23.43                 | 0.834931    |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Blast clean, No Pretreatment  | 8.97                  | 0.844461    |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Blast clean, No Pretreatment  | 38.17                 | 0.94083     |             |
| <b>Average</b> |  |  |   | <b>23.52</b>          | <b>0.87</b> | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 73.94                 | 0.326219    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 69.98                 | 0.329906    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 83.08                 | 0.334329    |             |
| <b>Average</b> |  |  |   | <b>75.67</b>          | <b>0.33</b> | <b>Pass</b> |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|--|--|---|-----------------------|-------------|-------------|
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93   | 83.86                 | 0.448963    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93   | 86.94                 | 0.414693    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93   | 78.48                 | 0.382535    |             |
| <b>Average</b> |  |  |   | <b>83.09</b>          | <b>0.42</b> | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment               | 83.92                 | 0.386654    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment               | 72.42                 | 0.364546    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment               | 66.98                 | 1.100942    |             |
| <b>Average</b> |  |  |   | <b>74.44</b>          | <b>0.62</b> | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated | 57.58                 | 0.397957    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated | 76.66                 | 0.433532    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated | 74.90                 | 0.406361    |             |
| <b>Average</b> |  |  |   | <b>69.71</b>          | <b>0.41</b> | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Blast clean, No Pretreatment                                | 75.20                 | 0.364874    |             |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|--|--|---|-----------------------|-------------|-------------|
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Blast clean, No Pretreatment  | 55.03                 | 0.324878    |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Blast clean, No Pretreatment  | 33.90                 | 0.652033    |             |
| <b>Average</b> |  |  |   | <b>54.71</b>          | <b>0.45</b> | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 31.28                 | 0.499355    |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 29.42                 | 0.408164    |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 29.68                 | 0.380299    |             |
| <b>Average</b> |  |  |   | <b>30.13</b>          | <b>0.43</b> | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 21.38                 | 0.290381    |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 28.80                 | 0.215019    |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 27.00                 | 0.4055      |             |
| <b>Average</b> |  |  |   | <b>25.73</b>          | <b>0.30</b> | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 34.02                 | 0.327358    |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 49.44                 | 0.369144    |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 34.20                 | 0.087344    |             |
| <b>Average</b> |  |  |   | <b>39.22</b>          | <b>0.26</b> | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 22.58                 | 0.661675    |             |

*(Table 16. continued on next page)*

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                       | Topcoat                   | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|------------------------------|---------------------------|---|-----------------------|-------------|-------------|
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 29.14                 | 0.149997    |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 33.80                 | 0.239437    |             |
| <b>Average</b> |                              |                           |   | <b>28.51</b>          | <b>0.35</b> | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Blast clean, No Pretreatment  | 12.13                 | 0.08882     |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Blast clean, No Pretreatment  | 27.00                 | 0.31604     |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Blast clean, No Pretreatment  | 13.93                 | 0.259627    |             |
| <b>Average</b> |                              |                           |   | <b>17.69</b>          | <b>0.22</b> | <b>Pass</b> |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 42.84                 | 0.457288    |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 52.14                 | 0.441212    |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 41.84                 | 0.48131     |             |
| <b>Average</b> |                              |                           |   | <b>45.61</b>          | <b>0.46</b> | <b>Pass</b> |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 49.58                 | 0.485027    |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 34.48                 | 0.468558    |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 41.22                 | 0.450872    |             |
| <b>Average</b> |                              |                           |   | <b>41.76</b>          | <b>0.47</b> | <b>Pass</b> |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 31.20                 | 0.416906    |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 38.42                 | 0.441848    |             |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 45.58                 | 0.45435     |             |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                        | Topcoat                      | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|-------------------------------|------------------------------|---|-----------------------|-------------|-------------|
| <b>Average</b> |                               |                              |   | <b>38.40</b>          | <b>0.44</b> | <b>Pass</b> |
| 10             | Deft 44-GY-16,<br>Deft 44-W-7 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Nonchromate<br>conversion coated             | 54.36                 | 0.440028    |             |
| 10             | Deft 44-GY-16,<br>Deft 44-W-7 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Nonchromate<br>conversion coated             | 55.28                 | 0.476874    |             |
| 10             | Deft 44-GY-16,<br>Deft 44-W-7 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Nonchromate<br>conversion coated             | 57.62                 | 0.429359    |             |
| <b>Average</b> |                               |                              |   | <b>55.75</b>          | <b>0.45</b> | <b>Pass</b> |
| 10             | Deft 44-GY-16,<br>Deft 44-W-7 | Defthane Zero<br>VOC Topcoat | Steel 1020- Blast clean, No<br>Pretreatment   | 46.43                 | 0.50021     |             |
| 10             | Deft 44-GY-16,<br>Deft 44-W-7 | Defthane Zero<br>VOC Topcoat | Steel 1020- Blast clean, No<br>Pretreatment   | 32.33                 | 0.58326     |             |
| 10             | Deft 44-GY-16,<br>Deft 44-W-7 | Defthane Zero<br>VOC Topcoat | Steel 1020- Blast clean, No<br>Pretreatment   | 3.13                  | 0.575716    |             |
| <b>Average</b> |                               |                              |   | <b>27.30</b>          | <b>0.55</b> | <b>Pass</b> |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Chromate<br>conversion coated to MIL-C-5541E | 77.30                 | 0.515695    |             |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Chromate<br>conversion coated to MIL-C-5541E | 77.94                 | 0.467988    |             |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Chromate<br>conversion coated to MIL-C-5541E | 78.52                 | 0.521959    |             |
| <b>Average</b> |                               |                              |   | <b>77.92</b>          | <b>0.50</b> | <b>Pass</b> |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Anodized per MIL-<br>A-8625F-93              | 73.16                 | 0.521034    |             |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Anodized per MIL-<br>A-8625F-93              | 78.18                 | 0.435391    |             |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, Anodized per MIL-<br>A-8625F-93              | 75.42                 | 0.525662    |             |
| <b>Average</b> |                               |                              |   | <b>75.59</b>          | <b>0.49</b> | <b>Pass</b> |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, No Pretreatment                              | 74.40                 | 0.505939    |             |
| 11             | Aqua-Poxy 912                 | Defthane Zero<br>VOC Topcoat | Aluminum 2024-T3-Cleaned to<br>ASTM F 22-65, No Pretreatment                              | 76.50                 | 0.526411    |             |

*(Table 16. continued on next page)*

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                     | Topcoat                   | Substrate   | Avg. 20° (mils) n = 5 | delta E     | Pass/Fail   |
|----------------|----------------------------|---------------------------|---|-----------------------|-------------|-------------|
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 74.52                 | 0.505462    |             |
| <b>Average</b> |                            |                           |   | <b>75.14</b>          | <b>0.51</b> | <b>Pass</b> |
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 78.06                 | 0.49065     |             |
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 77.72                 | 0.500788    |             |
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 73.66                 | 0.537898    |             |
| <b>Average</b> |                            |                           |   | <b>76.48</b>          | <b>0.51</b> | <b>Pass</b> |
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 49.83                 | 0.646766    |             |
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 41.07                 | 0.972891    |             |
| 11             | Aqua-Poxy 912              | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No Pretreatment  | 53.40                 | 0.576484    |             |
| <b>Average</b> |                            |                           |   | <b>48.10</b>          | <b>0.73</b> | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II      | MIL-C-46168D              | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 0.46                  | 0.297691    | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II      | MIL-C-46168D              | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 0.50                  | 0.535351    | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II      | MIL-C-46168D              | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment                           | 60 = 0.5              | 0.402162    | <b>Pass</b> |
| Control 1      | MIL-P-53022B, Type II      | MIL-C-46168D              | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated             | 60 = 0.5              | 0.51482     | <b>Pass</b> |
| Control 2      | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369              | Steel 1020- Blast clean, No Pretreatment  | 41.27                 | 0.643625    | <b>Pass</b> |
| Control 2      | CATHACOAT 304K, DEVRAN 201 | DEVTHANE 369              | C2 S 2B 01 500HrsQ-Sun01-12-01  | 43.47                 | 0.345897    | <b>Pass</b> |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II     | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Chromate conversion coated to MIL-C-5541E | 61.64                 | 0.482623    | <b>Pass</b> |
| Control 3      | MIL-P-53022B, Type II      | MIL-P-85285C, Type II     | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Anodized per MIL-A-8625F-93               | 75.92                 | 0.170895    | <b>Pass</b> |

(Table 16. continued on next page)

**Table 16. Accelerated Weathering Results (continued)**

| Coating System | Primer                | Topcoat               | Substrate   | Avg. 20° (mils) n = 5 | delta E  | Pass/Fail |
|----------------|-----------------------|-----------------------|---|-----------------------|----------|-----------|
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | Aluminum 2024-T3-Cleaned to ASTM F 22-65, No Pretreatment               | 79.18                 | 0.166087 | Pass      |
| Control 3      | MIL-P-53022B, Type II | MIL-P-85285C, Type II | Aluminum 2024-T3-Cleaned to ASTM F 22-65, Nonchromate conversion coated | 70.30                 | 0.357041 | Pass      |

Test Summary

Most of the coating systems passed this requirement after 500 hours of testing. Only coating systems 1, 2, 5, and 7 failed this requirement. Coating systems 1 and 2 are the film technology coatings and coating systems 5 and 7 are from the high solids coatings group.

**4.2.4. Filiform Corrosion Resistance**

Rationale

This test demonstrates the ability of a coating system to resist filiform corrosion. Filiform corrosion resistance, which determines the resistance of coated metals to filiform-type corrosion, is distinctly different from the salt spray corrosion resistance test and is required to ensure the candidate coatings provide the necessary corrosion protection. Because some candidate coatings systems involve self-priming, single coating systems have been included in this test to ensure a full comparison of the coating system properties.

This test is not required by NASA, however it is a requirement of the other project participants. The Filiform corrosion resistance test results are listed in Table 17.

Test Description

The filiform corrosion resistance test was performed in accordance with ASTM D 2803-93 (*Standard Guide for Testing Filiform Corrosion Resistance of Organic Coatings on Metal*, approved May 15, 1993), Procedure C. Test coupons were scribed with an “X” incision so that the smaller angle of the “X” was 30 to 45 degrees. The scribe went through the coating to the substrate, and had a 45° bevel. Each line of the “X” was approximately 4 inches long. The scribed test coupons were then placed in a dessicator with 12 N hydrochloric acid for 1 hour at 75±5°F (24 ±3°C). The test coupons were immediately placed in a humidity cabinet maintained at 104±3°F (40±1.7°C) and 80±5% RH for 1,000 hours. At

the end of 1,000 hours, the test coupons were evaluated for the presence and length of any thread-like filaments.

Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | 12 N HCl for 1 hour/1,000 hours at 104±3°F (40±1.7°C) and 80±5% RH  |
| <b>Coupons per Coating System</b>           | Three Al-1a, Al-1d  |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"> <li>• One coupon coated with MIL-P-53022B and MIL-C-46168D</li> <li>• One coupon coated with MIL-P-53022B, Type II and MIL-C-85285, Type II</li> </ul> |
| <b>Acceptance Criteria</b>                  | No filiform corrosion extending beyond ¼ inch from the scribe lines with the majority of filaments less than 1/8 inch long.   |

**Table 17. Filiform Corrosion Results**

| Coating System | Primer               | Topcoat             | Substrate Description   | Number of Filaments | Length       | Pass/Fail   | Notes                     |
|----------------|----------------------|---------------------|---|---------------------|--------------|-------------|---------------------------|
| 1              | MIL-P-53022B, Type I | 3M Applique         | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5                   | 1/8-1/16"    |             | Edges of scribe feathered |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 8                   | 1/16-1/32"   |             | Edges of scribe feathered |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 12                  | 1/16-1/32"   |             | Edges of scribe feathered |
| <b>Average</b> |                      |                     |   | <b>8</b>            | <b>1/16"</b> | <b>Pass</b> |                           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 1                   | 1/16"        |             | Edges of scribe feathered |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 3                   | 1/16-1/32"   |             | Edges of scribe feathered |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             | Edges of scribe feathered |
| <b>Average</b> |                      |                     |   | <b>1</b>            | <b>1/16"</b> | <b>Pass</b> |                           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                           |
| <b>Average</b> |                      |                     |   | <b>0</b>            | <b>NA</b>    | <b>Pass</b> |                           |

(Table 17. continued on next page)

**Table 17. Filiform Corrosion Results (continued)**

| Coating System | Primer               | Topcoat             | Substrate Description   | Number of Filaments | Length      | Pass/Fail   | Notes  |
|----------------|----------------------|---------------------|---|---------------------|-------------|-------------|--|
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA          |             |  |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA          |             |  |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA          |             |  |
| <b>Average</b> |                      |                     |   | <b>0</b>            | <b>NA</b>   | <b>Pass</b> |  |
| 5              | None                 | Ameron PSX 700      | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA          |             |  |
| 5              | None                 | Ameron PSX 700      | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA          |             | Slight lifting at intersection of scribe lines |
| 5              | None                 | Ameron PSX 700      | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2                   | 1/4-1/8"    |             |  |
| <b>Average</b> |                      |                     |   | <b>1</b>            | <b>1/6"</b> | <b>Pass</b> |  |
| 5              | None                 | Ameron PSX 700      | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA          |             |  |
| 5              | None                 | Ameron PSX 700      | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA          |             |  |
| 5              | None                 | Ameron PSX 700      | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA          |             | Lifting on bottom of scribe                    |
| <b>Average</b> |                      |                     |   | <b>0</b>            | <b>NA</b>   | <b>Pass</b> |  |

(Table 17. continued on next page)

**Table 17. Filiform Corrosion Results (continued)**

| Coating System | Primer        | Topcoat        | Substrate Description   | Number of Filaments | Length    | Pass/Fail   | Notes                                   |
|----------------|---------------|----------------|---|---------------------|-----------|-------------|---|
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA        |             | Top of scribe lifting                   |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA        |             |   |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA        |             |   |
| <b>Average</b> |               |                |   | <b>0</b>            | <b>NA</b> | <b>Pass</b> |   |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA        |             |   |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA        |             |   |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA        |             |   |
| <b>Average</b> |               |                |   | <b>0</b>            | <b>NA</b> | <b>Pass</b> |   |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA        |             | Area around scribe lifting and cracking |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA        |             | Area around scribe lifting and cracking |
| 7              | Devoe 304H    | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA        |             | Area around scribe lifting and cracking |
| <b>Average</b> |               |                |   | <b>0</b>            | <b>NA</b> | <b>Pass</b> |   |

(Table 17. continued on next page)

**Table 17. Filiform Corrosion Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate Description   | Number of Filaments | Length       | Pass/Fail   | Notes                                   |
|----------------|--|--|---|---------------------|--------------|-------------|---|
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             | Area around scribe lifting and cracking |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             | Area around scribe lifting and cracking |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             | Area around scribe lifting and cracking |
| <b>Average</b> |  |  |   | <b>0</b>            | <b>NA</b>    | <b>Pass</b> |   |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 17                  | 1/4-1/16"    |             |   |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 6                   | 1/8-1/16"    |             |   |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 7                   | 1/8-1/16"    |             |   |
| <b>Average</b> |  |  |   | <b>10</b>           | <b>1/8"</b>  | <b>Pass</b> |   |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 8                   | 1/8-1/16"    |             |   |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 14                  | 1/8-1/16"    |             |   |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             |   |
| <b>Average</b> |  |  |   | <b>7</b>            | <b>1/12"</b> | <b>Pass</b> |   |

(Table 17. continued on next page)

**Table 17. Filiform Corrosion Results (continued)**

| Coating System | Primer                       | Topcoat                   | Substrate Description   | Number of Filaments | Length       | Pass/Fail   | Notes                              |
|----------------|------------------------------|---------------------------|---|---------------------|--------------|-------------|------------------------------------|
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                                    |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                                    |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                                    |
| <b>Average</b> |                              |                           |   | <b>0</b>            | <b>NA</b>    | <b>Pass</b> |                                    |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             |                                    |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             |                                    |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA           |             |                                    |
| <b>Average</b> |                              |                           |   | <b>0</b>            | <b>NA</b>    | <b>Pass</b> |                                    |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcaot | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             |                                    |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcaot | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2                   | 1/16"        |             |                                    |
| 10             | Defth 44-GY-16, Defth 44-W-7 | Defthane Zero VOC Topcaot | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA           |             | Slight lifting on bottom of scribe |
| <b>Average</b> |                              |                           |   | <b>1</b>            | <b>1/16"</b> | <b>Pass</b> |                                    |

(Table 17. continued on next page)

**Table 17. Filiform Corrosion Results (continued)**

| Coating System | Primer                          | Topcoat                      | Substrate Description   | Number of Filaments | Length       | Pass/Fail   | Notes |
|----------------|---------------------------------|------------------------------|---|---------------------|--------------|-------------|-------|
| 10             | Defth 44-GY-16,<br>Defth 44-W-7 | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3- Cleaned<br>per ASTM F 22-65,<br>Nonchromate conversion<br>coated              | 0                   | NA           |             |       |
| 10             | Defth 44-GY-16,<br>Defth 44-W-7 | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3- Cleaned<br>per ASTM F 22-65,<br>Nonchromate conversion<br>coated              | 0                   | NA           |             |       |
| 10             | Defth 44-GY-16,<br>Defth 44-W-7 | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3- Cleaned<br>per ASTM F 22-65,<br>Nonchromate conversion<br>coated              | 0                   | NA           |             |       |
| <b>Average</b> |                                 |                              |   | <b>0</b>            | <b>NA</b>    | <b>Pass</b> |       |
| 11             | Aqua-Poxy 912                   | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3-Cleaned<br>per ASTM F 22-65, Chromate<br>conversion coated per MIL-C-<br>5541E | 0                   | NA           |             |       |
| 11             | Aqua-Poxy 912                   | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3-Cleaned<br>per ASTM F 22-65, Chromate<br>conversion coated per MIL-C-<br>5541E | 1                   | 1/16"        |             |       |
| 11             | Aqua-Poxy 912                   | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3-Cleaned<br>per ASTM F 22-65, Chromate<br>conversion coated per MIL-C-<br>5541E | 0                   | NA           |             |       |
| <b>Average</b> |                                 |                              |   | <b>0</b>            | <b>1/16"</b> | <b>Pass</b> |       |
| 11             | Aqua-Poxy 912                   | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3- Cleaned<br>per ASTM F 22-65,<br>Nonchromate conversion<br>coated              | 2                   | 1/16"        |             |       |
| 11             | Aqua-Poxy 912                   | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3- Cleaned<br>per ASTM F 22-65,<br>Nonchromate conversion<br>coated              | 4                   | 1/16"        |             |       |
| 11             | Aqua-Poxy 912                   | Defthane Zero<br>VOC Topcaot | Aluminum 2024-T3- Cleaned<br>per ASTM F 22-65,<br>Nonchromate conversion<br>coated              | 3                   | 1/16-1/8"    |             |       |
| <b>Average</b> |                                 |                              |   | <b>3</b>            | <b>1/16"</b> | <b>Pass</b> |       |

(Table 17. continued on next page)

**Table 17. Filiform Corrosion Results (continued)**

| Coating System | Primer                   | Topcoat                  | Substrate Description   | Number of Filaments | Length | Pass/Fail | Notes |
|----------------|--------------------------|--------------------------|---|---------------------|--------|-----------|-------|
| Control 1      | MIL-P-53022B,<br>Type II | MIL-C-46168D             | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                   | NA     | Pass      |       |
| Control 1      | MIL-P-53022B,<br>Type II | MIL-C-46168D             | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 0                   | NA     | Pass      |       |
| Control 3      | MIL-P-53022B,<br>Type II | MIL-P-85285C,<br>Type II | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 19                  | 1/32"  | Pass      |       |
| Control 3      | MIL-P-53022B,<br>Type II | MIL-P-85285C,<br>Type II | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated             | 10                  | 1/32"  | Pass      |       |

#### Test Summary

All of the alternatives passed this requirement. Coating system 1, 3M Fluoropolymer Paint Replacement Product, coating system 5, Ameron PSX 700, and coating system 8, Morton powder coatings, exhibited slight filiform corrosion, however these coating systems met the acceptance criteria.

#### **4.2.5. X-Cut Adhesion by Tape Test**

##### Rationale

The X-cut with parallel lines scribe procedure increases the severity of this test over a dry tape adhesion test using a single “X” scribe and provides quantitative data for the adhesion of a coating system to the underlying metal substrate. All participants agreed that X-cut adhesion by tape test is a performance requirement. The X-cut adhesion by tape test results are listed in Table 18.

##### Test Description

This test was performed in accordance with ASTM D 3359-97, Test Method A. Each test coupon was immersed in distilled water at room temperature for 24 hours in accordance with FED-STD-141C, Method 6301.2. Each test coupon was removed from the water and wiped dry with a soft cloth. Within one minute of removal from the water, the test coupons were scribed. The scribing procedure included two parallel lines, one inch apart and an “X” between the lines. Note: this was a modification of the scribing technique recommended in FED-STD-141C, Method 6301.2.

Pressure sensitive tape was applied over the scribed area and smoothed down by passing a 4.5 lb. roller across it eight times. Then the tape was pulled off quickly and smoothly at a 45° angle to the surface. The test coupons were then visually examined for blistering and loss of adhesion.

The adhesion of each coating system to the substrate was evaluated according to ASTM 3359-97, Test Method A. The X-cut and parallel lines cut were inspected for removal of the coating from the substrate or primer(s). The adhesion was rated in accordance with the 0-5 scale outlined in ASTM 3359-97, paragraph 7, *Procedure*, where the 0A rating corresponds with coating removal beyond the scribed area through to 5A corresponding to no peeling or removal.

Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | ASTM D 3359-97 rating related to amount of coating removal   |
| <b>Coupons per Coating System</b>           | Three Al-1a, Al-1b, Al-1c, Al-1d, St-1a, St-1b, St-2a, St-2b, St-3   |
| <b>Trials per Coupon</b>                    | One  |
| <b>Control Coupons Required for Testing</b> | None   |
| <b>Acceptance Criteria</b>                  | Candidate coating performs as well or better than control coatings and greater than or equal to 4a as specified in ASTM D 3359-97. |

**Table 18. X-Cut Adhesion by Tape Test Results**

| Coating System | Primer               | Topcoat     | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|----------------------|-------------|---|-----------------|---|---|------------------|------------------------|-------------|
|                |                      |             |   |                 |   |   |                  |                        |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 4 | 4 | 4                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 4 | 4 | 4                | Incision               |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 4 | 3 | 4                | Intersection, Incision |             |
| <b>Average</b> |                      |             |   |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 4 | 4 | 4                | Incision               |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 4 | 4 | 4                | Incision               |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| <b>Average</b> |                      |             |   |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 3               | 3 | 3 | 3                | Intersection, Incision |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer               | Topcoat     | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|----------------------|-------------|--|-----------------|---|---|------------------|------------------------|-------------|
|                |                      |             |  |                 |   |   |                  |                        |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 2               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                      |             |  |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 3               | 4 | 4 | 4                | Intersection, Incision |             |
| <b>Average</b> |                      |             |  |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 4340-Blast clean, No pretreatment                                  | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 4340-Blast clean, No pretreatment                                  | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 4340-Blast clean, No pretreatment                                  | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| <b>Average</b> |                      |             |  |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 4340-Power tool clean, No pretreatment                             | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 4340-Power tool clean, No pretreatment                             | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 1              | MIL-P-53022B, Type I | 3M Applique | Steel 4340-Power tool clean, No pretreatment                             | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| <b>Average</b> |                      |             |  |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer               | Topcoat             | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail |
|----------------|----------------------|---------------------|--|-----------------|---|---|------------------|------------------------|-----------|
|                |                      |                     |  |                 |   |   |                  |                        |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 1020- Blast clean, No pretreatment   | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 1020- Blast clean, No pretreatment   | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 1020- Blast clean, No pretreatment   | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>3</b>         |                        | Fail      |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 1020- Power tool clean, No Pretreatment  | 2               | 2 | 3 | 2                | Intersection, Incision |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 1020- Power tool clean, No Pretreatment  | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 1020- Power tool clean, No Pretreatment  | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>3</b>         |                        | Fail      |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 304-Cleaned and scuffed  | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 304-Cleaned and scuffed  | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| 1              | MIL-P-53022B, Type I | 3M Applique         | Steel 304-Cleaned and scuffed  | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>3</b>         |                        | Fail      |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 3               | 3 | 3 | 3                | Intersection, Incision |           |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 3               | 3 | 3 | 3                | Intersection, Incision |           |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer               | Topcoat             | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|----------------------|---------------------|---|-----------------|---|---|------------------|------------------------|-------------|
|                |                      |                     |   |                 |   |   |                  |                        |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 4 | 4 | 4                | Intersection, Incision |             |
| <b>Average</b> |                      |                     |   |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 4               | 4 | 4 | 4                | Intersection, Incision |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 4               | 4 | 4 | 4                | Intersection, Incision |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                      |                     |   |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 2               | 2 | 2 | 2                | Intersection, Incision |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 2               | 2 | 2 | 2                | Intersection, Incision |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 4               | 4 | 5 | 4                | Incision               |             |
| <b>Average</b> |                      |                     |   |                 |   |   | <b>3</b>         |                        | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated              | 4               | 5 | 5 | 5                | Incision               |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer               | Topcoat             | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred      | Pass/Fail   |
|----------------|----------------------|---------------------|--|-----------------|---|---|------------------|-----------------------------|-------------|
|                |                      |                     |  |                 |   |   |                  |                             |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 4 | 5                | Incision                    |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-65, Nonchromate conversion coated | 4               | 4 | 4 | 4                | Incision                    |             |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>4</b>         |                             | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 4340-Blast clean,<br>No pretreatment                                   | 5               | 5 | 5 | 5                | No Failure                  |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 4340-Blast clean,<br>No pretreatment                                   | 5               | 5 | 5 | 5                | No Failure                  |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 4340-Blast clean,<br>No pretreatment                                   | 5               | 4 | 4 | 4                | Incision                    |             |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>5</b>         |                             | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 4340-Power tool<br>clean, No pretreatment                              | 5               | 4 | 4 | 4                | Incision                    |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 4340-Power tool<br>clean, No pretreatment                              | 5               | 5 | 5 | 5                | No Failure                  |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 4340-Power tool<br>clean, No pretreatment                              | 4               | 5 | 4 | 4                | Beyond the<br>Area of the X |             |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>5</b>         |                             | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Blast clean,<br>No pretreatment                                  | 4               | 5 | 4 | 4                | Incision                    |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Blast clean,<br>No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure                  |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Blast clean,<br>No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure                  |             |
| <b>Average</b> |                      |                     |  |                 |   |   | <b>5</b>         |                             | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Power tool<br>clean, No Pretreatment                             | 5               | 4 | 4 | 4                | Incision                    |             |
| 2              | MIL-P-53022B, Type I | Fluorogrip, Grade E | Steel 1020- Power tool<br>clean, No Pretreatment                             | 5               | 5 | 5 | 5                | No Failure                  |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                                     | Topcoat                   | Substrate                                     | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|--|---------------------------|---|-----------------|---|---|------------------|------------------------|-------------|
|                |  |                           |   |                 |   |   |                  |                        |             |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Steel 304-Cleaned and scuffed                 | 5               | 5 | 4 | 5                | Incision               |             |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Steel 304-Cleaned and scuffed                 | 5               | 5 | 4 | 5                | Incision               |             |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Steel 304-Cleaned and scuffed                 | 5               | 4 | 4 | 4                | Incision               |             |
| <b>Average</b> |  |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcpat | Steel 4340-Blast clean, No pretreatment       | 5               | 4 | 4 | 4                | Incision               |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcpat | Steel 4340-Blast clean, No pretreatment       | 5               | 5 | 5 | 5                | No Failure             |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcpat | Steel 4340-Blast clean, No pretreatment       | 4               | 4 | 4 | 4                | Incision               |             |
| <b>Average</b> |  |                           |   |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcpat | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcpat | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcpat | Steel 1020- Blast clean, No pretreatment      | 4               | 4 | 4 | 4                | Incision               |             |
| <b>Average</b> |  |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcpat | Steel 4340-Blast clean, No pretreatment       | 5               | 5 | 5 | 5                | No Failure             |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcpat | Steel 4340-Blast clean, No pretreatment       | 5               | 5 | 5 | 5                | No Failure             |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcpat | Steel 4340-Blast clean, No pretreatment       | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcpat | Steel 1020- Blast clean, No pretreatment      | 3               | 5 | 5 | 4                | Incision               |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                                     | Topcoat                   | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|--|---------------------------|--|-----------------|---|---|------------------|------------------------|-------------|
|                |  |                           |  |                 |   |   |                  |                        |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment   | 5               | 5 | 5 | 5                | No Failure             |             |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment   | 4               | 4 | 4 | 4                | Incision               |             |
| <b>Average</b> |  |                           |  |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2               | 2 | 2 | 2                | Intersection, Incision |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 3               | 3 | 4 | 3                | Intersection, Incision |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 3               | 3 | 4 | 3                | Intersection, Incision |             |
| <b>Average</b> |  |                           |  |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 2               | 2 | 2 | 2                | Intersection, Incision |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 2               | 2 | 2 | 2                | Intersection, Incision |             |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 3               | 3 | 2 | 3                | Intersection, Incision |             |
| <b>Average</b> |  |                           |  |                 |   |   | <b>2</b>         |                        | <b>Fail</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer | Topcoat        | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|--------|----------------|--|-----------------|---|---|------------------|--|-------------|
|                |        |                |  |                 |   |   |                  |  |             |
| 5              | None   | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 2               | 2 | 1 | 2                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 1               | 2 | 2 | 2                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 3               | 2 | 0 | 2                | Intersection, Incision, Beyond the Area of the X |             |
| <b>Average</b> |        |                |  |                 |   |   | <b>2</b>         |  | Fail        |
| 5              | None   | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 2               | 2 | 2 | 2                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 2               | 2 | 3 | 2                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 3               | 2 | 3 | 3                | Intersection, Incision                           |             |
| <b>Average</b> |        |                |  |                 |   |   | <b>2</b>         |  | Fail        |
| 5              | None   | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision                           |             |
| <b>Average</b> |        |                |  |                 |   |   | <b>4</b>         |  | <b>Pass</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer | Topcoat        | Substrate                                     | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|--------|----------------|---|-----------------|---|---|------------------|--|-------------|
|                |        |                |   |                 |   |   |                  |  |             |
| 5              | None   | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment  | 1               | 0 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |             |
| 5              | None   | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment  | 1               | 0 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |             |
| 5              | None   | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment  | 1               | 0 | 1 | 1                | Intersection, Incision, Beyond the Area of the X |             |
| <b>Average</b> |        |                |   |                 |   |   | <b>0</b>         |  | <b>Fail</b> |
| 5              | None   | Ameron PSX 700 | Steel 1020- Blast clean, No pretreatment      | 3               | 3 | 3 | 3                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Steel 1020- Blast clean, No pretreatment      | 4               | 4 | 4 | 4                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Steel 1020- Blast clean, No pretreatment      | 4               | 3 | 4 | 4                | Intersection, Incision                           |             |
| <b>Average</b> |        |                |   |                 |   |   | <b>4</b>         |  | <b>Pass</b> |
| 5              | None   | Ameron PSX 700 | Steel 1020- Power tool clean, No Pretreatment | 3               | 3 | 3 | 3                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Steel 1020- Power tool clean, No Pretreatment | 2               | 2 | 2 | 2                | Intersection, Incision                           |             |
| 5              | None   | Ameron PSX 700 | Steel 1020- Power tool clean, No Pretreatment | 3               | 3 | 3 | 3                | Intersection, Incision                           |             |
| <b>Average</b> |        |                |   |                 |   |   | <b>3</b>         |  | <b>Fail</b> |
| 5              | None   | Ameron PSX 700 | Steel 304-Cleaned and scuffed                 | 1               | 4 | 0 | 2                | Intersection, Incision, Beyond the Area of the X |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer        | Topcoat        | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|---------------|----------------|---|-----------------|---|---|------------------|--|-------------|
|                |               |                |   |                 |   |   |                  |  |             |
| 5              | None          | Ameron PSX 700 | Steel 304-Cleaned and scuffed   | 0               | 3 | 1 | 1                | Intersection, Incision, Beyond the Area of the X |             |
| 5              | None          | Ameron PSX 700 | Steel 304-Cleaned and scuffed   | 2               | 3 | 0 | 2                | Intersection, Incision, Beyond the Area of the X |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>2</b>         |  | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2               | 2 | 2 | 2                | Intersection, Incision                           |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2               | 2 | 2 | 2                | Intersection, Incision                           |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2               | 2 | 2 | 2                | Intersection, Incision                           |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>2</b>         |  | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 1               | 2 | 1 | 1                | Intersection, Incision                           |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 2               | 2 | 1 | 2                | Intersection, Incision                           |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer        | Topcoat        | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail |
|----------------|---------------|----------------|--|-----------------|---|---|------------------|------------------------|-----------|
|                |               |                |  |                 |   |   |                  |                        |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93   | 2               | 2 | 2 | 2                | Intersection, Incision |           |
| <b>Average</b> |               |                |  |                 |   |   | <b>2</b>         |                        | Fail      |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 2               | 2 | 3 | 2                | Intersection, Incision |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 2               | 2 | 3 | 2                | Intersection, Incision |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 2               | 2 | 2 | 2                | Intersection, Incision |           |
| <b>Average</b> |               |                |  |                 |   |   | <b>2</b>         |                        | Fail      |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 2               | 3 | 2 | 2                | Intersection, Incision |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 2               | 2 | 2 | 2                | Intersection, Incision |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 2               | 3 | 2 | 2                | Intersection, Incision |           |
| <b>Average</b> |               |                |  |                 |   |   | <b>2</b>         |                        | Fail      |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision |           |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 5 | 4                | Intersection, Incision |           |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer        | Topcoat        | Substrate                                     | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|---------------|----------------|---|-----------------|---|---|------------------|------------------------|-------------|
|                |               |                |   |                 |   |   |                  |                        |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>4</b>         |                        | <b>Pass</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment  | 3               | 3 | 4 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment  | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment  | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Blast clean, No pretreatment      | 4               | 4 | 4 | 4                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Blast clean, No pretreatment      | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Blast clean, No pretreatment      | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Power tool clean, No Pretreatment | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Power tool clean, No Pretreatment | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 1020- Power tool clean, No Pretreatment | 3               | 2 | 3 | 3                | Intersection, Incision |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 304-Cleaned and scuffed                 | 2               | 3 | 3 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 304-Cleaned and scuffed                 | 3               | 3 | 3 | 3                | Intersection, Incision |             |
| 6              | Dimetcote 9HS | Ameron PSX 700 | Steel 304-Cleaned and scuffed                 | 2               | 2 | 2 | 2                | Intersection, Incision |             |
| <b>Average</b> |               |                |   |                 |   |   | <b>3</b>         |                        | <b>Fail</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer     | Topcoat        | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail |
|----------------|------------|----------------|---|-----------------|---|---|------------------|--|-----------|
|                |            |                |   |                 |   |   |                  |  |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| <b>Average</b> |            |                |   |                 |   |   | <b>0</b>         |  | Fail      |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 1               | 0 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| <b>Average</b> |            |                |   |                 |   |   | <b>0</b>         |  | Fail      |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 3               | 3 | 3 | 3                | Intersection                                     |           |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer     | Topcoat        | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail |
|----------------|------------|----------------|--|-----------------|---|---|------------------|--|-----------|
|                |            |                |  |                 |   |   |                  |  |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Clened per ASTM F 22-65, No pretreatment                | 3               | 4 | 4 | 4                | Intersection                                     |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Clened per ASTM F 22-65, No pretreatment                | 3               | 3 | 4 | 3                | Intersection, Incision                           |           |
| <b>Average</b> |            |                |  |                 |   |   | <b>3</b>         |  | Fail      |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 0               | 0 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |           |
| 7              | Devoe 304H | Ameron PSX 700 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| <b>Average</b> |            |                |  |                 |   |   | <b>0</b>         |  | Fail      |
| 7              | Devoe 304H | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 3               | 4 | 4 | 4                | Intersection, Incision                           |           |
| 7              | Devoe 304H | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 2               | 2 | 3 | 2                | Intersection, Incision                           |           |
| 7              | Devoe 304H | Ameron PSX 700 | Steel 4340-Blast clean, No pretreatment                                  | 3               | 3 | 3 | 3                | Intersection                                     |           |
| <b>Average</b> |            |                |  |                 |   |   | <b>3</b>         |  | Fail      |
| 7              | Devoe 304H | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment                             | 4               | 3 | 3 | 3                |  |           |
| 7              | Devoe 304H | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment                             | 4               | 3 | 3 | 3                | Intersection                                     |           |
| 7              | Devoe 304H | Ameron PSX 700 | Steel 4340-Power tool clean, No pretreatment                             | 3               | 3 | 3 | 3                | Intersection, Incision                           |           |
| <b>Average</b> |            |                |  |                 |   |   | <b>3</b>         |  | Fail      |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|--|--|--|-----------------|---|---|------------------|--|-------------|
|                |  |  |  |                 |   |   |                  |  |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Blast clean, No pretreatment   | 4               | 5 | 5 | 5                | Incision   |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Blast clean, No pretreatment   | 4               | 4 | 4 | 4                | Intersection                                     |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Blast clean, No pretreatment   | 5               | 4 | 4 | 4                | Intersection, Incision                           |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>4</b>         |  | <b>Pass</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Power tool clean, No Pretreatment  | 3               | 3 | 3 | 3                | Intersection, Incision                           |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Power tool clean, No Pretreatment  | 4               | 3 | 4 | 4                | Intersection, Incision                           |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 1020- Power tool clean, No Pretreatment  | 3               | 2 | 3 | 3                | Intersection, Incision                           |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>3</b>         |  | <b>Fail</b> |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 304-Cleaned and scuffed  | 0               | 1 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 304-Cleaned and scuffed  | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |             |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Steel 304-Cleaned and scuffed  | 1               | 0 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>0</b>         |  | <b>Fail</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure                                       |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|--|--|---|-----------------|---|---|------------------|------------------------|-------------|
|                |  |  |   |                 |   |   |                  |                        |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|--|--|--|-----------------|---|---|------------------|------------------------|-------------|
|                |  |  |  |                 |   |   |                  |                        |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 4340-Power tool clean, No pretreatment                             | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 4340-Power tool clean, No pretreatment                             | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 4340-Power tool clean, No pretreatment                             | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Blast clean, No pretreatment                                 | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Blast clean, No pretreatment                                 | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Blast clean, No pretreatment                                 | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|--|--|--|-----------------|---|---|------------------|------------------------|-------------|
|                |  |  |  |                 |   |   |                  |                        |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Power tool clean, No Pretreatment  | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Power tool clean, No Pretreatment  | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 1020- Power tool clean, No Pretreatment  | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 304-Cleaned and scuffed  | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 304-Cleaned and scuffed  | 5               | 5 | 5 | 5                | No Failure             |             |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Steel 304-Cleaned and scuffed  | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |  |  |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5               | 5 | 5 | 5                | No Failure             |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                       | Topcoat                   | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|------------------------------|---------------------------|--|-----------------|---|---|------------------|------------------------|-------------|
|                |                              |                           |  |                 |   |   |                  |                        |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93   | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93   | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |  |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure             |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                       | Topcoat                   | Substrate                                     | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|------------------------------|---------------------------|---|-----------------|---|---|------------------|------------------------|-------------|
|                |                              |                           |   |                 |   |   |                  |                        |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 4340-Blast clean, No pretreatment       | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 4340-Blast clean, No pretreatment       | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 4340-Power tool clean, No pretreatment  | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 4340-Power tool clean, No pretreatment  | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 4340-Power tool clean, No pretreatment  | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 304-Cleaned and scuffed                 | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 304-Cleaned and scuffed                 | 5               | 5 | 5 | 5                | No Failure             |             |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510S9 Sky White | Steel 304-Cleaned and scuffed                 | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |                              |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                     | Topcoat                   | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|----------------------------|---------------------------|---|-----------------|---|---|------------------|--|-------------|
|                |                            |                           |   |                 |   |   |                  |  |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 3               | 3 | 3 | 3                | Incision   |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 3 | 4 | 4                | Intersection, Incision                           |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 3 | 4 | 4                | Incision   |             |
| <b>Average</b> |                            |                           |   |                 |   |   | <b>4</b>         |  | <b>Pass</b> |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 3               | 4 | 3 | 3                | Intersection, Incision                           |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 2               | 1 | 0 | 1                | Intersection, Incision, Beyond the Area of the X |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 1               | 1 | 1 | 1                | Intersection, Incision                           |             |
| <b>Average</b> |                            |                           |   |                 |   |   | <b>2</b>         |  | <b>Fail</b> |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                     | Topcoat                   | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail |
|----------------|----------------------------|---------------------------|--|-----------------|---|---|------------------|--|-----------|
|                |                            |                           |  |                 |   |   |                  |  |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |           |
| <b>Average</b> |                            |                           |  |                 |   |   | <b>0</b>         |  | Fail      |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 3               | 2 | 2 | 2                | Incision   |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 3               | 3 | 4 | 3                | Incision   |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 4               | 3 | 4 | 4                | Incision   |           |
| <b>Average</b> |                            |                           |  |                 |   |   | <b>3</b>         |  | Fail      |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision                           |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision                           |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 4340-Blast clean, No pretreatment                                  | 4               | 4 | 4 | 4                | Intersection, Incision                           |           |
| <b>Average</b> |                            |                           |  |                 |   |   | <b>4</b>         |  | Pass      |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 4340-Power tool clean, No pretreatment                             | 1               | 1 | 2 | 1                | Incision   |           |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 4340-Power tool clean, No pretreatment                             | 0               | 2 | 0 | 1                | Intersection, Incision, Beyond the Area of the X |           |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer                     | Topcoat                   | Substrate                                     | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|----------------------------|---------------------------|---|-----------------|---|---|------------------|--|-------------|
|                |                            |                           |   |                 |   |   |                  |  |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 4340-Power tool clean, No pretreatment  | 1               | 2 | 0 | 1                | Intersection, Incision, Beyond the Area of the X |             |
| <b>Average</b> |                            |                           |   |                 |   |   | <b>1</b>         |  | <b>Fail</b> |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment      | 4               | 4 | 4 | 4                | Intersection, Incision                           |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment      | 4               | 4 | 4 | 4                | Intersection, Incision                           |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment      | 5               | 4 | 4 | 4                | Incision   |             |
| <b>Average</b> |                            |                           |   |                 |   |   | <b>4</b>         |  | <b>Pass</b> |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 1020- Power tool clean, No Pretreatment | 2               | 1 | 3 | 2                | Intersection, Incision                           |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 1020- Power tool clean, No Pretreatment | 1               | 2 | 0 | 1                | Intersection, Incision, Beyond the Area of the X |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 1020- Power tool clean, No Pretreatment | 2               | 2 | 2 | 2                | Incision   |             |
| <b>Average</b> |                            |                           |   |                 |   |   | <b>2</b>         |  | <b>Pass</b> |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 304-Cleaned and scuffed                 | 0               | 2 | 0 | 1                | Intersection, Incision, Beyond the Area of the X |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 304-Cleaned and scuffed                 | 0               | 3 | 0 | 1                | Incision, Beyond the Area of the X               |             |
| 10             | Deft 44-GY-16, Deft 44-W-7 | Defthane Zero VOC Topcoat | Steel 304-Cleaned and scuffed                 | 0               | 3 | 0 | 1                | Incision, Beyond the Area of the X               |             |
| <b>Average</b> |                            |                           |   |                 |   |   | <b>1</b>         |  | <b>Fail</b> |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer        | Topcoat                   | Substrate   | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|---------------|---------------------------|---|-----------------|---|---|------------------|--|-------------|
|                |               |                           |   |                 |   |   |                  |  |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 2               | 5 | 5 | 4                | Incision   |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5               | 5 | 5 | 5                | No Failure                                       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4               | 4 | 4 | 4                | Incision   |             |
| <b>Average</b> |               |                           |   |                 |   |   | <b>4</b>         |  | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 4               | 4 | 4 | 4                | Incision   |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 4               | 4 | 4 | 4                | Incision   |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 4               | 4 | 4 | 4                | Incision   |             |
| <b>Average</b> |               |                           |   |                 |   |   | <b>4</b>         |  | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment                            | 0               | 1 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer        | Topcoat                   | Substrate  | Method A Result |   |   | Method A Average | Where Failure Occurred                           | Pass/Fail   |
|----------------|---------------|---------------------------|--|-----------------|---|---|------------------|--|-------------|
|                |               |                           |  |                 |   |   |                  |  |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 0               | 0 | 0 | 0                | Beyond the Area of the X                         |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, No pretreatment               | 1               | 0 | 0 | 0                | Intersection, Incision, Beyond the Area of the X |             |
| <b>Average</b> |               |                           |  |                 |   |   | <b>0</b>         |  | Fail        |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure                                       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 3 | 4                | Incision   |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Aluminum 2024-T3-Cleaned per ASTM F 22-65, Nonchromate conversion coated | 5               | 5 | 5 | 5                | No Failure                                       |             |
| <b>Average</b> |               |                           |  |                 |   |   | <b>5</b>         |  | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure                                       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure                                       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 4340-Blast clean, No pretreatment                                  | 5               | 5 | 5 | 5                | No Failure                                       |             |
| <b>Average</b> |               |                           |  |                 |   |   | <b>5</b>         |  | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 4340-Power tool clean, No pretreatment                             | 5               | 5 | 5 | 5                | No Failure                                       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 4340-Power tool clean, No pretreatment                             | 5               | 5 | 5 | 5                | No Failure                                       |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 4340-Power tool clean, No pretreatment                             | 5               | 5 | 5 | 5                | No Failure                                       |             |

(Table 18. continued on next page)

**Table 18. X-Cut Adhesion by Tape Test Results (continued)**

| Coating System | Primer        | Topcoat                   | Substrate                                     | Method A Result |   |   | Method A Average | Where Failure Occurred | Pass/Fail   |
|----------------|---------------|---------------------------|---|-----------------|---|---|------------------|------------------------|-------------|
|                |               |                           |   |                 |   |   |                  |                        |             |
| <b>Average</b> |               |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020- Blast clean, No pretreatment      | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |               |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 1020- Power tool clean, No Pretreatment | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |               |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 304-Cleaned and scuffed                 | 5               | 5 | 5 | 5                | No Failure             |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 304-Cleaned and scuffed                 | 5               | 5 | 5 | 5                | No Failure             |             |
| 11             | Aqua-Poxy 912 | Defthane Zero VOC Topcoat | Steel 304-Cleaned and scuffed                 | 5               | 5 | 5 | 5                | No Failure             |             |
| <b>Average</b> |               |                           |   |                 |   |   | <b>5</b>         |                        | <b>Pass</b> |

### Test Summary

The adhesion of coatings to the test coupons was highly substrate dependent. The coating systems that exhibited the best adhesion over most or all of the substrates tested are: coating system 2, Fluorogrip, Grade E; coating system 3, Platt Bros. 100% Zinc Metallizing Wire with Defthane Zero VOC Topcoat; coating system 4, Platt Bros. Zn/Alum 85/15 Metallizing Wire with Defthane Zero VOC Topcoat; coating system 8, Morton Powdercoats; coating system 9, DuPont Powdercoats; and coating system 11, Aqua-Poxy 912 with Defthane Zero VOC Topcoat.

### **4.2.6. Mandrel Bend Flexibility**

#### Rationale

This method determines whether the coating systems will provide the necessary flexibility when compared to the other more conventional coatings. All participants have agreed that mandrel bend flexibility is a performance requirement. The mandrel bend flexibility test results are listed in Table 19.

#### Test Description

This test evaluated coating flexibility limits and adhesion to substrate when the test coupon was bent around a ¼ inch fixed diameter mandrel. The mandrel bend flexibility test was performed in accordance with ASTM D 522-93a (*Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings*, approved September 15, 1993), Test Method B. Thickness measurements were made on the test coupons prior to mandrel bend testing. The test coupons were placed over a ¼” mandrel with the uncoated side in contact with the mandrel. The test coupons were then bent approximately 180° around the mandrel at a uniform velocity in a time of 15 seconds with steady finger pressure. The test coupons were removed from the mandrel and visually examined for cracking. If no cracking was evident, the percent elongation of the coating was calculated.

#### Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | ¼ inch diameter mandrel  |
| <b>Coupons per Coating System</b>           | Three Al-2, St-1a (MWAS only)  |
| <b>Trials per Coupon</b>                    | One  |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"><li>• One coupon coated with MIL-P-53022B, and MIL-C-46168D</li><li>• One coupon coated with MIL-P-53022B and MIL-PRF-85285</li><li>• One coupon coated with NASA coating system</li></ul> |
| <b>Acceptance Criteria</b>                  | No peeling or delamination from the substrate and no cracking greater than ¼ inch from the edges.  |

**Table 19. Mandrel Bend Flexibility Results**

| Coating System | Primer                                     | Topcoat                   | Substrate  | Distance of Failure from edge of panel | Pass/Fail   | % Elongation |
|----------------|--|---------------------------|--|--|-------------|--------------|
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 18.66        |
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 18.97        |
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 19.05        |
| <b>Average</b> |  |                           |  |  | <b>Pass</b> | <b>18.89</b> |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 21.36        |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 21.60        |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 21.31        |
| <b>Average</b> |  |                           |  |  | <b>Pass</b> | <b>21.42</b> |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 4340-Blast cleaned, No pretreatment                              | 2 3/4"                                 |             | NA           |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 4340-Blast cleaned, No pretreatment                              | 1 1/4"                                 |             | NA           |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | Steel 4340-Blast cleaned, No pretreatment                              | NA                                     |             | 17.33        |
| <b>Average</b> |  |                           |  |  | <b>Fail</b> | <b>NA</b>    |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 4340-Blast cleaned, No pretreatment                              | 4"                                     |             | NA           |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 4340-Blast cleaned, No pretreatment                              | 4"                                     |             | NA           |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | Steel 4340-Blast cleaned, No pretreatment                              | 4"                                     |             | NA           |
| <b>Average</b> |  |                           |  |  | <b>Fail</b> | <b>NA</b>    |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 2"                                     |             | NA           |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 1 1/4"                                 |             | NA           |
| 5              | None                                       | Ameron PSX 700            | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 1 1/8"                                 |             | NA           |
| <b>Average</b> |  |                           |  |  | <b>Fail</b> | <b>NA</b>    |

(Table 19. continued on next page)

**Table 19. Mandrel Bend Flexibility Results (continued)**

| Coating System | Primer                                 | Topcoat                                    | Substrate  | Distance of Failure from edge of panel | Pass/Fail   | % Elongation |
|----------------|--|--|--|--|-------------|--------------|
| 6              | Dimetcote 9HS                          | Ameron PSX 700                             | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| 6              | Dimetcote 9HS                          | Ameron PSX 700                             | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| 6              | Dimetcote 9HS                          | Ameron PSX 700                             | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| <b>Average</b> |  |  |  |  | <b>Fail</b> | <b>NA</b>    |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| 7              | Devoe 304H                             | Ameron PSX 700                             | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| <b>Average</b> |  |  |  |  | <b>Fail</b> | <b>NA</b>    |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 18.02        |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 17.59        |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer | Morton 30-1007 Corvel Clean White U 1578-1 | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 18.02        |
| <b>Average</b> |  |  |  |  | <b>Pass</b> | <b>17.88</b> |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 1/4"                                   |             | NA           |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"                                     |             | NA           |
| 9              | DuPont ELH503S5 Gray Morning           | DuPont PFW510S9 Sky White                  | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 1 3/4"                                 |             | NA           |
| <b>Average</b> |  |  |  |  | <b>Fail</b> | <b>NA</b>    |
| 10             | Deft 44-GY-16, Deft 44-W-7             | Defthane Zero VOC Topcoat                  | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 15.85        |
| 10             | Deft 44-GY-16, Deft 44-W-7             | Defthane Zero VOC Topcoat                  | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 15.86        |
| 10             | Deft 44-GY-16, Deft 44-W-7             | Defthane Zero VOC Topcoat                  | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA                                     |             | 15.90        |
| <b>Average</b> |  |  |  |  | <b>Pass</b> | <b>15.87</b> |

(Table 19. continued on next page)

**Table 19. Mandrel Bend Flexibility Results (continued)**

| <b>Coating System</b> | <b>Primer</b>               | <b>Topcoat</b>            | <b>Substrate</b>   | <b>Distance of Failure from edge of panel</b> | <b>Pass/Fail</b> | <b>% Elongation</b> |
|-----------------------|-----------------------------|---------------------------|--|---|------------------|---------------------|
| 11                    | Aqua-Poxy 912               | Defthane Zero VOC Topcoat | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA  |                  | 16.34               |
| 11                    | Aqua-Poxy 912               | Defthane Zero VOC Topcoat | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA  |                  | 16.44               |
| 11                    | Aqua-Poxy 912               | Defthane Zero VOC Topcoat | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA  |                  | 16.44               |
| <b>Average</b>        |                             |                           |  |   | <b>Pass</b>      | <b>16.41</b>        |
| C1                    | MIL-P-53022B, Type II       | MIL-C-46168D              | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"  | Fail             | NA                  |
| C2                    | CATHACOAT 304 K, DEVRAN 201 | DEVTHANE 369              | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | 4"  | Fail             | NA                  |
| C2                    | CATHACOAT 304 K, DEVRAN 201 | DEVTHANE 369              | Steel 4340-Blast cleaned, No pretreatment                              | 5/8"  | Fail             | NA                  |
| C3                    | MIL-P-53022B, Type II       | MIL-P-85285C, Type II     | Aluminum 2024-T0-Cleaned per ASTM F-22-65, Anodized per MIL-A-8625F-93 | NA  | <b>Pass</b>      | 15.46               |
| C3                    | MIL-P-53022B, Type II       | MIL-P-85285C, Type II     | Steel 4340-Blast cleaned, No pretreatment                              | NA  | <b>Pass</b>      | 15.48               |

### Test Summary

Coatings from film technology, powder coating, and waterborne coatings passed this requirement. Film technology coatings are: 3M Fluoropolymer Paint Replacement Product and Fluorogrip, Grade E. The powder coat that passed this requirement is the Morton Powdercoats. The waterborne coatings are Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat and also Aqua-Poxy 912 with Defthane Zero VOC Topcoat.

## **4.2.7. Accelerated Storage Stability**

### Rationale

The stability of a coating system is an important parameter in determining whether a coating is acceptable for depot and organizational storage for maintenance activities. This test simulates 6 months to 1 year of storage at  $73\pm 3.5^{\circ}\text{F}$  ( $23\pm 2^{\circ}\text{C}$ ). All participants have agreed that the storage stability of a coating system is a performance requirement. The accelerated storage stability test results are listed in Table 20.

### Test Description

This test evaluated any changes in consistency and coating quality that may occur when coatings are stored at a temperature above  $32^{\circ}\text{F}$  ( $0^{\circ}\text{C}$ ). This test was not applicable to MWAS coatings.

Duplicate samples of the coatings in the original unopened containers were obtained. One of the duplicate samples was opened and the condition inside the can was noted. Conditions included skinning, corrosion on the interior of the can, odors of putrefaction, rancidity, or souring. The samples were weighed to determine any changes in mass that may occur during storage.

After weighing, the unopened sample was stored, undisturbed at  $125\pm 2^{\circ}\text{F}$  ( $52\pm 1^{\circ}\text{C}$ ) for 1 month. The stored sample was then allowed to cool to  $73\pm 3.5^{\circ}\text{F}$  ( $23\pm 2^{\circ}\text{C}$ ). The containers were then opened and conditions again noted. Finally the coatings were mixed and applied to test coupons.

The finish of the test coupons was rated according to ASTM D 1849-95 (*Standard Test Method for Package Stability of Paint*, approved August 15, 1995).

Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | 125±2°F (52±1°C)<br>Quart containers (as applicable)  |
| <b>Coupons per Coating System</b>           | One Al-1a   |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | None  |
| <b>Acceptance Criteria</b>                  | No skinning, grains, lumps in the coating; no pressure buildup, or corrosion on the container, odor of spoilage or cloudy appearance of any catalyst (as applicable). |

Table 20. Accelerated Storage Stability Results

| Coating                   | Total Time in Oven (days) | Storage Temp. (C) | Initial Mass (kg)  | Final Mass (kg)    | Consistency Changes   | Finish of Brushed Film | Pass/Fail   |
|---------------------------|---------------------------|-------------------|--------------------|--------------------|---|------------------------|-------------|
| Dimetcote 9HS             | 30                        | 52                | L 1.904<br>P 8.447 | L 1.897<br>P 8.444 | NA  | 0                      | Fail        |
| Devoe 304H                | 30                        | 52                | L 1.102<br>P 3.011 | L 1.100<br>P 3.010 | NA  | 6                      | Fail        |
| Morton 13-7004            | 30                        | 52                | 1.281              | 1.283              | NA  | 4                      | Fail        |
| DuPont ELH503S5           | 30                        | 52                | 0.687              | 0.689              | NA  | 4                      | Fail        |
| Deft 44-GY-16             | 30                        | 52                | A 4.248<br>B 0.515 | A 4.246<br>B 0.515 | NA  | 2                      | Fail        |
| Deft 44-W-7               | 30                        | 52                | A 5.003<br>B 1.202 | A 5.001<br>B 1.202 | Putrid Odor in Can A  | 2                      | Fail        |
| Aqua-Poxy 912             | 30                        | 52                | A 5.786<br>B 5.213 | A 5.783<br>B 5.210 | Bottom of Can A bulging<br>Pressure in Can B-Bottom solidified, tan color | 8                      | Fail        |
| 3M Fluoropolymer          | 30                        | 52                | 0.236              | 0.235              | Adhesive odor   | 8                      | <b>Pass</b> |
| Fluorogrip, Grade E       | 30                        | 52                | 0.208              | 0.208              | Adhesive odor   | 8                      | <b>Pass</b> |
| Defthane Zero VOC Topcoat | 30                        | 52                | A 3.078<br>B 1.222 | A 3.079<br>B 1.223 | NA  | 4                      | Fail        |
| Ameron PSX 700            | 30                        | 52                | R 4.177<br>C 0.858 | A 4.176<br>B 0.859 | NA  | 2                      | Fail        |
| Morton 30-1007            | 30                        | 52                | 0.77               | 0.772              | Powder solidified   | NA                     | Fail        |
| DuPont PFW510S9           | 30                        | 52                | 0.766              | 0.768              | Powder solidified   | NA                     | Fail        |

### Test Summary

The film technology coatings performed best in this test. The film technology coatings are 3M Fluoropolymer Paint Replacement Product and Fluorogrip, Grade E.

## **4.3. Extended Tests**

### **4.3.1. 18-Month Marine Environment Test (NASA Requirement)**

#### Rationale

This test documents the non-simulated exposure of the coatings to UV radiation, as well as various cycles of salt spray exposure. NASA requires this test for validation of alternative coating systems. The 18-month Marine environment test results are listed in Table 21.

#### Test Description

This test evaluates the performance of the test and control coupons during and after an 18-month outdoor exposure in a marine environment. All surfaces of the NASA-supplied carbon steel composite test coupon were coated with the alternative coating systems. The test coupons were installed at the Kennedy Space Center (KSC) outdoor exposure rack 100 feet from the ocean high tide line.

The test coupons were rinsed with 10% Hydrochloric Acid/ Alumina Powder slurry every six weeks in order to simulate launch conditions. All KSC test rack procedures for fasteners, exposure angle, and inspection interval were followed. The evaluation process consisted of adhesion testing, gloss testing and visual evaluations. Only visual evaluations were considered for acceptance criteria.

At the conclusion of the test, the test coupon condition was rated according to ASTM D 610-95 (*Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces*, approved September 15, 1995). Test coupons were graded according to the numerical grading scale in ASTM D 610-95, Table 1, *Scale and Description of Rust Grades*, where 0 indicates 100% surface rusting and 10 indicates less than 0.01% of surface rusting.

Acceptance criteria are based on regulations stated in NASA-STD-5008; which states that an inorganic zinc primer must receive a corrosion rating of 9 or better and a topcoated inorganic zinc primer must receive a corrosion rating of 8 or better after eighteen months of exposure at the KSC Beach Corrosion Test Site.

Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | 100 feet from the ocean high tide line at the Kennedy Space Center   |
| <b>Coupons per Coating System</b>           | Four, specially supplied by NASA, coating systems 6 through 11 only  |
| <b>Trials per Coupon</b>                    | One  |
| <b>Control Coupons Required for Testing</b> | One coupon coated with the NASA control coating system   |
| <b>Acceptance Criteria</b>                  | Panel condition rated 9 or better per ASTM D 610-95 for inorganic zinc primers and panel condition rated 8 or better for topcoated inorganic zinc primers. |

**Table 21. 18-Month Marine Environment Test Results**

| Coating System | Primer                                       | Topcoat  | Exposure | Duration  | Visual Ratings |    | Average Rating |    |     | Pass/Fail |
|----------------|--|--|----------|-----------|----------------|----|----------------|----|-----|-----------|
|                |  |  |          |           |                |    |                |    |     |           |
| 6              | Dimetcote 9HS                                | None   | Normal   | 18 months | 10             | 10 | 10             | 10 | 10  | Pass      |
| 6              | Dimetcote 9HS                                | Ameron PSX 700                                   | Normal   | 18 months | 9              | 9  | 9              | 9  | 9   | Pass      |
| 6              | Dimetcote 9HS                                | Ameron PSX 700                                   | Acid     | 18 months | 9              | 9  | 9              | 9  | 9   | Pass      |
| 7              | Devoe 304H                                   | None   | Normal   | 18 months | 10             | 10 | 10             | 10 | 10  | Pass      |
| 7              | Devoe 304H                                   | Ameron PSX 700                                   | Normal   | 18 months | 8              | 8  | 7              | 7  | 7.5 | Fail      |
| 7              | Devoe 304H                                   | Ameron PSX 700                                   | Acid     | 18 months | 7              | 8  | 7              | 8  | 7.5 | Fail      |
| 8              | Morton 13-7004<br>Corvel Zinc Rich<br>Primer | Morton 30-1007<br>Corvel Clean White U<br>1578-1 | Normal   | 16 months | 2              | 2  | 2              | 2  | 2   | Fail      |
| 8              | Morton 13-7004<br>Corvel Zinc Rich<br>Primer | Morton 30-1007<br>Corvel Clean White U<br>1578-1 | Acid     | 16 months | 2              | 2  | 2              | 2  | 2   | Fail      |
| 9              | DuPont ELH503S5<br>Gray Morning              | DuPont PFW510S9<br>Sky White                     | Normal   | 16 months | 3              | 3  | 2              | 2  | 2.5 | Fail      |
| 9              | DuPont ELH503S5<br>Gray Morning              | DuPont PFW510S9<br>Sky White                     | Acid     | 16 months | 3              | 3  | 2              | 2  | 2.5 | Fail      |
| 10             | Deft 44-GY-16, Deft<br>44-W-7                | Deft Zero VOC<br>Topcoat                         | Normal   | 16 months | 3              | 3  | 5              | 3  | 3.5 | Fail      |
| 10             | Deft 44-GY-16, Deft<br>44-W-7                | Deft Zero VOC<br>Topcoat                         | Acid     | 16 months | 2              | 2  | 3              | 3  | 2.5 | Fail      |
| 11             | Aqua-Poxy 912                                | Defthane Zero VOC<br>Topcoat                     | Normal   | 16 months | 4              | 4  | 2              | 2  | 3   | Fail      |
| 11             | Aqua-Poxy 912                                | Defthane Zero VOC<br>Topcoat                     | Acid     | 16 months | 3              | 3  | 2              | 2  | 2.5 | Fail      |

### Test Summary

Coating System 6, Dimetcote 9HS with Ameron PSX 700 passed the acceptance criteria for the 18-month Marine Environment Test. The Devoe 304H Zinc Rich Primer, from Coating System 7, also passed the acceptance criteria under normal conditions for this test as reported by NASA. All of the waterborne and powder coatings did not meet acceptance criteria set by NASA and therefore would not be an acceptable alternative in launch environments.

### **4.3.2. Cyclic Corrosion Resistance (Air Force (AF), NASA, Army Requirement)**

#### Rationale

The AF, NASA, and Army participants have agreed that the GM Accelerated Corrosion Test provides an acceptable correlation between accelerated laboratory corrosion tests and actual corrosion experienced in field environments. Data from this test will be compared with the filiform corrosion resistance test data obtained in Paragraph 4.2.4 to determine whether a correlation exists between the two tests.

#### Test Description

This test evaluates the ability of coating systems to prevent corrosion when exposed to a simulated neutral pH corrosive environment. Tests were conducted on test coupons in accordance with GM 9540P, (*Accelerated Corrosion Test*, approved December 1997). This test was run for 80 cycles. One cycle is equal to 24 hours. One cycle is as follows:

- Step 1.** Expose the test coupons to salt water solution containing 0.9% sodium chloride, 0.1% calcium chloride, and 0.25% sodium bicarbonate); Spray for one minute.
- Step 2.** Allow the test coupon to remain at ambient atmospheric conditions for 89 minutes.
- Step 3.** Repeat steps 1 and 2 for a total of 4 times.
- Step 4.** Expose the test coupon to high humidity conditions (in accordance with GM 4465P at  $120\pm 3^{\circ}\text{F}$  ( $49\pm 2^{\circ}\text{C}$ ) and 1-2 ml/hr collection rate) for 8 hours.
- Step 5.** Expose the test coupon to a dry off condition at  $140\pm 3^{\circ}\text{F}$  ( $60\pm 2^{\circ}\text{C}$ ) and <30% RH for 8 hours.

Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | <p>Exposure conditions include:</p> <ul style="list-style-type: none"> <li>• Salt Water Solution: 0.9% NaCl, 0.1% CaCl<sub>2</sub>, and 0.25% NaHCO<sub>3</sub></li> <li>• Solution Acidity: pH between 6.0 and 8.0</li> </ul> <p>Test Duration: 80 test cycles</p> |
| <b>Coupons per Coating System</b>           | Three: Al-1a, Al-1b, Al-1c, Al-1d, Al-3a, Al-3b, St-1a, St-1b, St-2a, St-2b, St-3   |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | <ul style="list-style-type: none"> <li>• One coupon coated with MIL-P-53022B, and MIL-C-46168D</li> <li>• One coupon coated with MIL-P-53022B and MIL-PRF-85285</li> <li>• One coupon coated with NASA coating system (steel panels only)</li> </ul>                |
| <b>Acceptance Criteria</b>                  | <ul style="list-style-type: none"> <li>• Candidate coating performs as well as or better than control coatings,</li> <li>• No significant blistering, softening, or lifting of coating.</li> </ul>  |

Panels were evaluated according to the following scale: 0-no corrosion, 1-minor corrosion, 2-minor-to-moderate corrosion, 3-moderate corrosion, 4-major corrosion, and 5-severe corrosion. Results, as reported by CTIO, are listed in Table 22.

Table 22. Cyclic Corrosion Resistance Results

| Coating system | Primer                                     | Topcoat                   | Al-1a |      |       | Al-1b |      |       | Al-1c |      |       | Al-1d |      |       | Al-3a |      |       | Al-3b |      |       | St1-a |      |       | St1-b |      |       | St2-a |      |       | St2-b |      |       | St-3 |      |       |      |
|----------------|--|---------------------------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|------|------|-------|------|
|                |  |                           | corr  | ucut | blist | corr | ucut | blist | corr |
| 1              | MIL-P-53022B, Type I                       | 3M Applique               | 0.0   | 1.0  | 0.0   | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | 0.0   | 0.0  | 0.0   | 3.0   | 3.0  | 4.0   | 3.0   | 4.0  | 5.0   | 2.0   | 3.0  | 3.0   | 3.0   | 4.0  | 5.0   | 0.0  | 0.0  | 0.0   |      |
|                |  |                           | 0.0   | 1.0  | 0.0   | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | 0.0   | 0.0  | 0.0   | 2.0   | 3.0  | 3.0   | 3.0   | 4.0  | 5.0   | 3.0   | 3.0  | 3.0   | 3.0   | 3.0  | 4.0   | 5.0  | 0.0  | 0.0   | 0.0  |
|                |  |                           | 0.3   |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 0.0   |      |       | 2.8   |      |       | 4.2   |      |       | 3.0   |      |       | 4.0   |      |       | 0.0  |      |       |      |
|                |  |                           | Pass  |      |       |       |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      |       |      |      |       |      |
| C1             |  |                           | Pass  |      |       |       |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      |       |      |      |       |      |
| C2             |  |                           | Pass  |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass |      |       |      |
| C3             |  |                           | Pass  |      |       |       |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      |       |      |      |       |      |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E       | 0.0   | 0.0  | 2.0   | 0.0   | 1.0  | 2.0   | 1.0   | 2.0  | 3.0   | 0.0   | 1.0  | 1.0   | 0.0   | 1.0  | 2.0   | 0.0   | 1.0  | 2.0   | 3.0   | 3.0  | 2.0   | 2.0   | 3.0  | 4.0   | 3.0   | 3.0  | 3.0   | 3.0   | 3.0  | 5.0   | 0.0  | 0.0  | 1.0   | 2.0  |
|                |  |                           | 1.0   | 1.0  | 1.0   | 0.0   | 1.0  | 2.0   | 1.0   | 2.0  | 2.0   | 0.0   | 1.0  | 1.0   | 0.0   | 1.0  | 2.0   | 0.0   | 1.0  | 2.0   | 3.0   | 3.0  | 2.0   | 2.0   | 3.0  | 4.0   | 4.0   | 3.0  | 3.0   | 3.0   | 4.0  | 2.0   | 0.0  | 1.0  | 2.0   |      |
|                |  |                           | 1.0   | 1.0  | 1.0   | 0.0   | 0.0  | 2.0   | 1.0   | 2.0  | 2.0   | 0.0   | 1.0  | 2.0   | 0.0   | 1.0  | 2.0   | 0.0   | 1.0  | 1.0   | 3.0   | 3.0  | 2.0   | 3.0   | 4.0  | 4.0   |       |      |       |       | 3.0  | 4.0   | 5.0  | 0.0  | 1.0   | 2.0  |
|                |  |                           | 0.9   |      |       | 0.9   |      |       | 1.8   |      |       | 0.8   |      |       | 1.0   |      |       | 0.8   |      |       | 2.7   |      |       | 3.2   |      |       | 3.2   |      |       | 3.2   |      |       | 1.0  |      |       |      |
| C1             |  |                           | Fail  |      |       | Fail  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| C2             |  |                           | Fail  |      |       | Fail  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| C3             |  |                           | Fail  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       |      |      |       |      |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | 3.0   | 0.0   | 3.0  | *     | *     | *    | 3.0   | 0.0   | 3.0  | *     | *     | *    | *     | *    | *    | *     |      |
|                |  |                           | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | 3.0   | 0.0  | 3.0   | *     | *    | *     | 3.0   | 0.0  | 3.0   | *     | *    | *     | *    | *    | *     | *    |
|                |  |                           | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | 3.0   | 0.0  | 3.0   | *     | *    | *     | 3.0   | 0.0  | 3.0   | *     | *    | *     | *    | *    | *     | *    |
|                |  |                           | 2.0   |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 2.0   |      |       | 2.0   |      |       | 2.0   |      |       | 2.0   |      |       | 2.0  |      |       |      |
| C1             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       |       |      |       |      |      |       |      |
| C2             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       |       |      |       |      |      |       |      |
| C3             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       |       |      |       |      |      |       |      |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | 1.0  | 0.0   | 0.0   | *    | *     | *     | 1.0  | 0.0   | 0.0   | *    | *     | *     | *    | *     | *    | *    |       |      |
|                |  |                           | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | 1.0   | 0.0   | 0.0  | *     | *     | *    | 1.0   | 0.0   | 0.0  | *     | *     | *    | *     | *    | *    | *     |      |
|                |  |                           | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | 1.0   | 0.0   | 0.0  | *     | *     | *    | 1.0   | 0.0   | 0.0  | *     | *     | *    | *     | *    | *    | *     |      |
|                |  |                           | 0.3   |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 0.3   |      |       | 0.3   |      |       | 0.3   |      |       | 0.3   |      |       | 0.3  |      |       |      |
| C1             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       |       |      |       |      |      |       |      |
| C2             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       |       |      |       |      |      |       |      |
| C3             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       |       |      |       |      |      |       |      |
| 5              | None                                       | Ameron PSX 700            | 0.0   | 3.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 2.0  | 0.0   | 1.0   | 0.0  | 0.0   | 2.0   | 3.0  | 3.0   | 2.0   | 4.0  | 5.0   | *     | *    | *     | 3.0   | 5.0  | 5.0   | 0.0  | 4.0  | 0.0   |      |
|                |  |                           | 0.0   | 1.0  | 1.0   | 0.0   | 0.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 2.0  | 0.0   | 0.0   | 2.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 3.0  | 4.0   | 2.0   | 4.0  | 5.0   | *     | *    | *     |       |      |       | 0.0  | 3.0  | 0.0   |      |
|                |  |                           | 0.0   | 1.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 2.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 3.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 3.0  | 3.0   | 2.0   | 5.0  | 5.0   | *     | *    | *     |       |      |       | 0.0  | 2.0  | 0.0   |      |
|                |  |                           | 0.7   |      |       | 0.0   |      |       | 0.4   |      |       | 0.4   |      |       | 0.8   |      |       | 0.6   |      |       | 2.8   |      |       | 3.8   |      |       | 4.3   |      |       | 1.0   |      |       |      |      |       |      |
| C1             |  |                           | Fail  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| C2             |  |                           | Fail  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| C3             |  |                           | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| 6              | Dimetcote 9HS                              | Ameron PSX 700            | 0.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 2.0  | 0.0   | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 1.0  | 0.0   | 1.0  | 0.0  | 0.0   |      |
|                |  |                           | 0.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 2.0  | 1.0   | 1.0  | 0.0  | 0.0   |      |
|                |  |                           |       |      |       | 1.0   | 0.0  | 0.0   | 1.0   | 1.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 2.0  | 1.0   | 1.0  | 0.0  | 0.0   |      |
|                |  |                           | 0.3   |      |       | 0.4   |      |       | 0.3   |      |       | 0.3   |      |       | 0.3   |      |       | 0.4   |      |       | 0.7   |      |       | 0.8   |      |       | 0.7   |      |       | 1.4   |      |       | 0.3  |      |       |      |
| C1             |  |                           | Pass  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       |      |      |       |      |
| C2             |  |                           | Pass  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       |      |      |       |      |
| C3             |  |                           | Pass  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       |      |      |       |      |
| 7              | Devoe 304 H                                | Ameron PSX 700            | 1.0   | 5.0  | 0.0   | 0.0   | 2.0  | 0.0   | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | 2.0  | 1.0   | 1.0   | 2.0  | 3.0   | 2.0   | 2.0  | 2.0   | 1.0   | 1.0  | 3.0   | 2.0   | 3.0  | 0.0   | 4.0  | 0.0  |       |      |
|                |  |                           | 1.0   | 5.0  | 0.0   | 0.0   | 3.0  | 0.0   | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | 2.0   | 1.0   | 1.0  | 2.0   | 2.0   | 2.0  | 2.0   | 1.0   | 1.0  | 3.0   | 2.0   | 3.0  | 0.0   | 2.0  | 0.0  |       |      |
|                |  |                           | 1.0   | 5.0  | 0.0   | 1.0   | 5.0  | 0.0   | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | 2.0   | 1.0   | 1.0  | 4.0   | 3.0   | 3.0  | 2.0   | 1.0   | 1.0  | 3.0   | 3.0   | 3.0  | 1.0   | 5.0  | 0.0  |       |      |
|                |  |                           | 2.0   |      |       | 1.2   |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 1.3   |      |       | 2.6   |      |       | 1.3   |      |       | 2.8   |      |       | 1.3  |      |       |      |
| C1             |  |                           | Fail  |      |       | Fail  |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| C2             |  |                           | Fail  |      |       | Fail  |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
| C3             |  |                           | Fail  |      |       | Fail  |      |       |       |      |       |       |      |       |       |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       |      |      |       |      |
|                | Morton 13-7004                             | Morton 30-1007            | 1.0   | 0.0  | 1.0   | 0.0   | 0.0  | 0.0   | 1.0   | 1.0  | 2.0   | 0.0   | 0.0  | 1.0   | 0.0   | 0.0  | 1.0   | 0.0   | 0.0  | 2.0   | 3.0   | 2.0  | 3.0   | 3.0   | 5.0  | 2.0   | 2.0   | 3.0  | 5.0   | 5.0   | 5.0  | 0.0   | 2.0  | 0.0  |       |      |

(Table 22. continued on next page)

**Table 22. Cyclic Corrosion Resistance Results (continued)**

| Coating system | Primer                       | Topcoat                     | Al-1a |      |       | Al-1b |      |       | Al-1c |      |       | Al-1d |      |       | Al-3a |      |       | Al-3b |      |       | St1-a |      |       | St1-b |      |       | St-2a |      |       | St-2b |      |       | St-3 |      |       |     |
|----------------|------------------------------|-----------------------------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|------|------|-------|-----|
|                |                              |                             | corr  | ucut | blist | corr | ucut | blist |     |
| 8              | Corvel Zinc Rich Primer      | Corvel Clean White U 1578-1 | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 1.0  | 2.0   | 1.0   | 0.0  | 1.0   | 0.0   | 1.0  | 1.0   | 0.0   | 0.0  | 0.0   | 2.0   | 3.0  | 3.0   | 2.0   | 4.0  | 5.0   | 2.0   | 2.0  | 3.0   | 4.0   | 5.0  | 5.0   | 0.0  | 2.0  | 0.0   |     |
| Average        |                              |                             | 0.0   | 0.0  | 1.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 2.0   | 1.0   | 0.0  | 0.0   | 0.0   | 1.0  | 1.0   | 0.0   | 0.0  | 0.0   | 2.0   | 2.0  | 2.0   | 2.0   | 3.0  | 4.0   | 2.0   | 3.0  | 4.0   | 4.0   | 4.0  | 3.0   | 0.0  | 2.0  | 0.0   |     |
| C1             |                              |                             | Fail  |      |       | Fail  |      |       | Pass  |      |       | Fail  |      |       | Fail  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |       |      | Fail  |      |      |       |     |
| C2             |                              |                             |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |      |      |       |     |
| C3             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |       |      | Fail  |      |      |       |     |
| 9              | DuPont ELH503S5 Gray Morning | DuPont PFW510Sp Sky White   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| Average        |                              |                             | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| C1             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |       |      | Pass  |      |      |       |     |
| C2             |                              |                             |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |      |      |       |     |
| C3             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |       |      | Pass  |      |      |       |     |
| 10             | Defl 44-GY-16, Defl 44-W-7   | Defthane Zero VOC Topcoat   | 1.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 1.0   | 1.0  | 1.0   | 0.0   | 1.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| Average        |                              |                             | 0.2   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.9   | 0.9  | 0.9   | 0.2   | 0.2  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| C1             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |       |      | Fail  |      |      |       |     |
| C2             |                              |                             |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |      |      |       |     |
| C3             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |      |      |       |     |
| 11             | Aqua-Poxy 912                | Defthane Zero VOC Topcoat   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 1.0  | 1.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| Average        |                              |                             | 0.3   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.9   | 0.9  | 0.9   | 0.1   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| C1             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |       |      | Pass  |      |      |       |     |
| C2             |                              |                             |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |      |      |       |     |
| C3             |                              |                             | Pass  |      |       | Pass  |      |       | Pass  |      |       | Pass  |      |       | Fail  |      |       | Pass  |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Pass  |       |      | Fail  |      |      |       |     |
| C1             | MIL-P-53022B, Type II        | MIL-C-46168D                | 1.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 2.0   | 0.0  | 4.0   | 1.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| Average        |                              |                             | 0.3   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 2.0   | 0.0  | 4.0   | 1.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0   | 0.0  | 0.0   | 0.0  | 0.0  |       |     |
| C2             | CATHACAT 304K, DEVTRAN 201   | DEVTHANE 369                | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *     | *    | *     | *    | *    | *     |     |
| Average        |                              |                             |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |      |      |       |     |
| C3             | MIL-P-53022B, Type II        | MIL-P-85285C, Type II       | 1.0   | 1.0  | 0.0   | 0.0   | 1.0  | 0.0   | 1.0   | 2.0  | 2.0   | 1.0   | 1.0  | 1.0   | 1.0   | 0.0  | 0.0   | 0.0   | 0.0  | 1.0   | 0.0   | 4.0  | 3.0   | 3.0   | 5.0  | 5.0   | 5.0   | 4.0  | 3.0   | 3.0   | 2.0  | 4.0   | 5.0  | 0.0  | 0.0   | 0.0 |
| Average        |                              |                             | 0.7   | 0.3  | 0.0   | 0.0   | 0.3  | 0.0   | 1.7   | 1.7  | 1.7   | 1.0   | 1.0  | 1.0   | 0.3   | 0.3  | 0.3   | 0.3   | 0.3  | 0.3   | 0.3   | 3.3  | 3.3   | 3.3   | 5.0  | 5.0   | 5.0   | 3.3  | 3.3   | 3.3   | 3.7  | 3.7   | 3.7  | 0.0  | 0.0   | 0.0 |

each entry is average of corrosion, undercutting, and blistering ratings  
 \*Not Tested

### Test Summary

This test was also highly substrate dependent. The coating systems that performed the best overall in this test are as follows: coating system 1, 3M Fluoropolymer Paint Replacement Product; coating system 9, DuPont Powdercoats; coating system 10, Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat; and coating system 11, Aqua-Poxy 912 with Defthane Zero VOC Topcoat.

See Appendix D for photographs of the cyclic corrosion resistance test coupons.

### **4.3.3. SO<sub>2</sub> Corrosion Resistance (Navy Requirement)**

#### Rationale

This test evaluates the corrosion protection of a coating system when a coated substrate is exposed to an acidic, corrosive environment such as acid rain. The Navy requires this test for validation of alternative coating systems.

#### Test Description

This test evaluated the ability of a coating system to prevent corrosion when exposed to corrosive conditions resulting from air pollutants, which cause an acidic environment. This test was performed by following ASTM G 85-98 (*Standard Practice for Modified Salt Spray (Fog) Testing*, approved April 10, 1998), Annex 4. An “X” incision was scribed through the coating so that the smaller angle of the “X” is 30 to 45 degrees. The scribes have a 45° bevel and each line of the “X” is approximately 4 inches long. The back and edges of the coupons were covered with wax, paint, tape, or another material, to prevent corrosion products from contaminating the corrosion chamber. The scribed coupons were then placed in a salt spray chamber for 500 hours.

After 500 hours of exposure time, the test coupons were removed from the salt spray chamber. Each test coupon was cleaned gently and dried. Each test coupon was then examined visually for blistering, loss of adhesion, and corrosion on both the scribed and unscribed areas of the test coupon. Slight corrosion in the scribe was acceptable as long as it did not undercut the paint film. Corrosive salts or oxides running down the surface of the test coupon are considered evidence of severe corrosion and are not acceptable. The test coupons were evaluated and rated in accordance with ASTM 1654-92 (*Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments*, approved October 15, 1992), Procedure A, Method 1.

Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | <ul style="list-style-type: none"><li>• Test Coupons placed at a 15 to 30°angle.</li><li>• Temperature of the exposed salt spray zone: 95±3°F (35±1.7°C)</li><li>• Uniform SO<sub>2</sub> gas dispersion throughout the salt fog chamber</li></ul> |
| <b>Coupons per Coating System</b>           | Three: Al-1a, Al-1b, Al-1c, Al-1d, Al-3a, Al-3b, St-1a, St-1b, St-2a, St-2b  |
| <b>Trials per Coupon</b>                    | One  |
| <b>Control Coupons Required for Testing</b> | One coupon coated with MIL-P-53022B and MIL-PRF-85285  |
| <b>Acceptance Criteria</b>                  | <ul style="list-style-type: none"><li>• No blistering or lifting after 500 hours. Slight substrate corrosion only. Slight substrate corrosion acceptable.</li></ul>  |

Results, as reported by NAWCAD, are listed in Table 23.

**Table 23. SO<sub>2</sub> Corrosion Resistance Results**

| <b>Coating</b>                  | <b>Substrate Code</b> | <b>Substrate Description</b>   | <b>Avg. ASTM D 1654 Value</b> | <b>Blistering Away from Scribe Present</b> | <b>Pass/Fail</b> |
|---------------------------------|-----------------------|--|-------------------------------|--|------------------|
| MIL-P-53022/3M Applique         | A-1a                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 10                            | no   | Pass             |
|                                 | A-1B                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 10                            | no   | Pass             |
|                                 | A-1C                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, No Pretreatment                               | 0                             | no   | Fail             |
|                                 | A-1D                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Nonchromate<br>conversion coated              | 10                            | no   | Pass             |
|                                 | A-3A                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 4                             | no   | Fail             |
|                                 | A-3B                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 7                             | no   | Fail             |
|                                 | S-1A                  | Steel 4340- Blast clean, no<br>pretreatment  | 10                            | no   | Pass             |
|                                 | S-1B                  | Steel 4340- Power tool<br>clean, No pretreatment   | 6.7                           | no   | Fail             |
|                                 | S-2A                  | Steel 1020- Blast clean,<br>No pretreatment  | 10                            | no   | Pass             |
|                                 | S-2B                  | Steel 1020- Power tool<br>clean, No pretreatment   | 0                             | no   | Fail             |
| MIL-P-53022/Fluorogrip applique | A-1A                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 10                            | no   | Pass             |
|                                 | A-1B                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 10                            | no   | Pass             |
|                                 | A-1C                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, No Pretreatment                               | 0                             | no   | Fail             |
|                                 | A-1D                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Nonchromate<br>conversion coated              | 10                            | no   | Pass             |
|                                 | A-3A                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 10                            | no   | Pass             |
|                                 | A-3B                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 4                             | no   | Fail             |
|                                 | S-1A                  | Steel 4340- Blast clean, no<br>pretreatment  | 6                             | no   | Fail             |
|                                 | S-1B                  | Steel 4340- Power tool<br>clean, no pretreatment   | 0                             | no   | Fail             |
|                                 | S-2A                  | Steel 1020- Blast clean,<br>No pretreatment  | 9                             | no   | Pass             |

(Table 23. continued on next page)

**Table 23. SO<sub>2</sub> Corrosion Resistance Results (continued)**

| <b>Coating</b>                     | <b>Substrate Code</b> | <b>Substrate Description</b>   | <b>Avg. ASTM D 1654 Value</b> | <b>Blistering Away from Scribe Present</b> | <b>Pass/Fail</b> |
|------------------------------------|-----------------------|--|-------------------------------|--|------------------|
|                                    | S-2B                  | Steel 1020- Power tool clean, No pretreatment  | 0                             | no   | Fail             |
| Platt 100% Zinc/Defl 0 VOC Topcoat | S-1A                  | Steel 4340- Blast clean, no pretreatment   | 10                            | no   | Pass             |
|                                    | S-2A                  | Steel 1020- Blast clean, No pretreatment   | 9.7                           | no   | Pass             |
| Platt Zn/Al/Defl 0 VOC Topcoat     | S-1A                  | Steel 4340- Blast clean, no pretreatment   | 10                            | no   | Pass             |
|                                    | S-2A                  | Steel 1020- Blast clean, No pretreatment   | 10                            | no   | Pass             |
| no primer/Ameron PSX 700           | A-1A                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 0                             | no   | Fail             |
|                                    | A-1B                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 7.3                           | no   | Fail             |
|                                    | A-1C                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, No Pretreatment                            | 5                             | no   | Fail             |
|                                    | A-1D                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated              | 0                             | no   | Fail             |
|                                    | A-3A                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 5                             | no   | Fail             |
|                                    | A-3B                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5.3                           | no   | Fail             |
|                                    | S-1A                  | Steel 4340- Blast clean, no pretreatment   | 4                             | no   | Fail             |
|                                    | S-1B                  | Steel 4340- Power tool clean, no pretreatment  | 0                             | no   | Fail             |
|                                    | S-2A                  | Steel 1020- Blast clean, No pretreatment   | 0                             | no   | Fail             |
|                                    | S-2B                  | Steel 1020- Power tool clean, No pretreatment  | 0                             | no   | Fail             |
| Dimetcote 9HS/Ameron PSX 700       | A-1A                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 4                             | no   | Fail             |
|                                    | A-1B                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 8.7                           | no   | Pass             |
|                                    | A-1C                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, No Pretreatment                            | 10                            | no   | Pass             |
|                                    | A-1D                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated              | 0                             | no   | Fail             |
|                                    | A-3A                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 6                             | no   | Fail             |

(Table 23. continued on next page)

Table 23. SO<sub>2</sub> Corrosion Resistance Results (continued)

| Coating                   | Substrate Code | Substrate Description  | Avg. ASTM D 1654 Value | Blistering Away from Scribe Present | Pass/Fail |
|---------------------------|----------------|--|------------------------|-------------------------------------|-----------|
|                           | A-3B           | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 4.7                    | no                                  | Fail      |
|                           | S-1A           | Steel 4340- Blast clean, no<br>pretreatment  | 10                     | no                                  | Pass      |
|                           | S-1B           | Steel 4340- Power tool<br>clean, no pretreatment   | 6                      | no                                  | Fail      |
|                           | S-2A           | Steel 1020- Blast clean,<br>No pretreatment  | 7.7                    | no                                  | Fail      |
|                           | S-2B           | Steel 1020- Power tool<br>clean, No pretreatment   | 6                      | no                                  | Fail      |
| Devoe 304H/Ameron PSX 700 | A-1A           | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 0                      | no                                  | Fail      |
|                           | A-1B           | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 0                      | no                                  | Fail      |
|                           | A-1C           | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, No Pretreatment                               | 8.7                    | no                                  | Pass      |
|                           | A-1D           | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Nonchromate<br>conversion coated              | 0                      | no                                  | Fail      |
|                           | A-3A           | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 0                      | no                                  | Fail      |
|                           | A-3B           | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 0                      | no                                  | Fail      |
|                           | S-1A           | Steel 4340- Blast clean, no<br>pretreatment  | 8                      | no                                  | Pass      |
|                           | S-1B           | Steel 4340- Power tool<br>clean, no pretreatment   | 7.3                    | no                                  | Fail      |
|                           | S-2A           | Steel 1020- Blast clean,<br>No pretreatment  | 8                      | no                                  | Pass      |
|                           | S-2B           | Steel 1020- Power tool<br>clean, No pretreatment   | 10                     | no                                  | Pass      |

(Table 23. continued on next page)

**Table 23. SO<sub>2</sub> Corrosion Resistance Results (continued)**

| <b>Coating</b>                | <b>Substrate Code</b> | <b>Substrate Description</b>   | <b>Avg. ASTM D 1654 Value</b> | <b>Blistering Away from Scribe Present</b> | <b>Pass/Fail</b> |
|-------------------------------|-----------------------|--|-------------------------------|--|------------------|
| Morton Zinc Rich/Morton White | A-1A                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 10                            | no   | Pass             |
|                               | A-1B                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 10                            | no   | Pass             |
|                               | A-1C                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, No Pretreatment                               | 0                             | no   | Fail             |
|                               | A-1D                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Nonchromate<br>conversion coated              | 10                            | no   | Pass             |
|                               | A-3A                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 6.3                           | no   | Fail             |
|                               | A-3B                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 8                             | yes  | Pass             |
|                               | S-1A                  | Steel 4340- Blast clean, no<br>pretreatment  | 10                            | no   | Pass             |
|                               | S-1B                  | Steel 4340- Power tool<br>clean, no pretreatment   | 10                            | no   | Pass             |
|                               | S-2A                  | Steel 1020- Blast clean,<br>No pretreatment  | 10                            | no   | Pass             |
|                               | S-2B                  | Steel 1020- Power tool<br>clean, No pretreatment   | 6.7                           | no   | Fail             |
| DuPont gray/DuPont White      | A-1A                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 9.3                           | no   | Pass             |
|                               | A-1B                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 10                            | no   | Pass             |
|                               | A-1C                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, No Pretreatment                               | 7                             | no   | Fail             |
|                               | A-1D                  | Aluminum 2024-T3-<br>Cleaned per ASTM F 22-<br>65, Nonchromate<br>conversion coated              | 10                            | no   | Pass             |
|                               | A-3A                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Chromate conversion<br>coated per MIL-C-5541E | 9.3                           | no   | Pass             |
|                               | A-3B                  | Aluminum 6061-T6-<br>Cleaned per ASTM F 22-<br>65, Anodized per MIL-A-<br>8625F-93               | 10                            | no   | Pass             |
|                               | S-1A                  | Steel 4340- Blast clean, no<br>pretreatment  | 10                            | no   | Pass             |
|                               | S-1B                  | Steel 4340- Power tool<br>clean, no pretreatment   | 10                            | no   | Pass             |
|                               | S-2A                  | Steel 1020- Blast clean,<br>No pretreatment  | 10                            | no   | Pass             |

(Table 23. continued on next page)

**Table 23. SO<sub>2</sub> Corrosion Resistance Results (continued)**

| <b>Coating</b>  | <b>Substrate Code</b> | <b>Substrate Description</b>   | <b>Avg. ASTM D 1654 Value</b> | <b>Blistering Away from Scribe Present</b> | <b>Pass/Fail</b> |
|---|-----------------------|--|-------------------------------|--|------------------|
|   | S-2B                  | Steel 1020- Power tool clean, No pretreatment  | 10                            | no   | Pass             |
| Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | A-1A                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 8                             | no   | Pass             |
|   | A-1B                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 8.7                           | no   | Pass             |
|   | A-1C                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, No Pretreatment                            | 10                            | no   | Pass             |
|   | A-1D                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated              | 8                             | no   | Pass             |
|   | A-3A                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 6                             | no   | Fail             |
|   | A-3B                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 6                             | no   | Fail             |
|   | S-1A                  | Steel 4340- Blast clean, no pretreatment   | 10                            | no   | Pass             |
|   | S-1B                  | Steel 4340- Power tool clean, no pretreatment  | 0                             | no   | Fail             |
|   | S-2A                  | Steel 1020- Blast clean, No pretreatment   | 8.3                           | no   | Pass             |
|   | S-2B                  | Steel 1020- Power tool clean, No pretreatment  | 0                             | no   | Fail             |
| Aqua-Poxy 912/Deft 0 VOC Topcoat                      | A-1A                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 8.3                           | no   | Pass             |
|   | A-1B                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 7                             | no   | Fail             |
|   | A-1C                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, No Pretreatment                            | 0                             | no   | Fail             |
|   | A-1D                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated              | 10                            | no   | Pass             |
|   | A-3A                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 6                             | no   | Fail             |
|   | A-3B                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 4.7                           | no   | Fail             |
|   | S-1A                  | Steel 4340- Blast clean, no pretreatment   | 10                            | no   | Pass             |
|   | S-1B                  | Steel 4340- Power tool clean, no pretreatment  | 3.3                           | no   | Fail             |

(Table 23. continued on next page)

**Table 23. SO<sub>2</sub> Corrosion Resistance Results (continued)**

| <b>Coating</b>                          | <b>Substrate Code</b> | <b>Substrate Description</b>   | <b>Avg. ASTM D 1654 Value</b> | <b>Blistering Away from Scribe Present</b> | <b>Pass/Fail</b> |
|---|-----------------------|--|-------------------------------|--|------------------|
|   | S-2A                  | Steel 1020- Blast clean, No pretreatment   | 10                            | no   | <b>Pass</b>      |
|   | S-2B                  | Steel 1020- Power tool clean, No pretreatment  | 2                             | no   | <b>Fail</b>      |
| MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | A-1A                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 10                            | no   | <b>Pass</b>      |
|   | A-1B                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 5                             | no   | <b>Fail</b>      |
|   | A-1C                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, No Pretreatment                            | 0                             | no   | <b>Fail</b>      |
|   | A-1D                  | Aluminum 2024-T3- Cleaned per ASTM F 22-65, Nonchromate conversion coated              | 10                            | no   | <b>Pass</b>      |
|   | A-3A                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Chromate conversion coated per MIL-C-5541E | 7                             | no   | <b>Fail</b>      |
|   | A-3B                  | Aluminum 6061-T6- Cleaned per ASTM F 22-65, Anodized per MIL-A-8625F-93                | 8                             | no   | <b>Pass</b>      |
|   | S-1A                  | Steel 4340- Blast clean, no pretreatment   | 10                            | no   | <b>Pass</b>      |
|   | S-1B                  | Steel 4340- Power tool clean, no pretreatment  | 9                             | no   | <b>Pass</b>      |
|   | S-2A                  | Steel 1020- Blast clean, No pretreatment   | 10                            | no   | <b>Pass</b>      |
|   | S-2B                  | Steel 1020- Power tool clean, No pretreatment  | 0                             | no   | <b>Fail</b>      |

### Test Summary

This test was also highly substrate dependent. Overall the coating systems that performed best in this test are as follows: coating system 8, Morton Powdercoats; coating system 9, DuPont Powdercoats; coating system 10, Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat.

#### **4.3.4. B 117 Salt Fog Corrosion Resistance Test (Navy Requirement)**

##### Rationale

Navy participants required this test for validation of an alternative coating system.

##### Test Description

This test method evaluated a coating system's ability to prevent substrate corrosion and the effect that corrosion has on the adhesion of the coating system.

The salt fog chamber was operated in accordance with ASTM B 117-97 (*Standard Practice for Operating Salt Spray (Fog) Apparatus*, approved 1997). The test coupons were scribed with an "X" so that the smaller angle of the "X" is 30–45 degrees and the scribe went through the coating to the substrate. The scribe has a 45-degree bevel and each line of the "X" is approximately 4 inches in length. The back and edges of the test coupons were covered with wax, paint, tape, or another material that will prevent corrosion products from contaminating the salt fog chamber.

The test coupons were placed in the salt fog chamber for 2,000 hours. Test coupons with corrosion exceeding the acceptance criteria were removed from the salt spray chamber.

At the end of the test duration, the test coupons were removed from the salt spray chamber and cleaned by gently flushing them with running water. They were then dried with a stream of clean compressed air. The adhesion of the primer/topcoat system was evaluated in accordance with ASTM D 1654-92, *Procedure A, Method 1 (Air Blow-Off)*. The test coupons were then visually examined for corrosion. Slight corrosion in the scribe is acceptable as long as it does not undercut the paint film. Corrosive salts or oxides running down the surface of the coupon are considered evidence of severe corrosion and are not acceptable.

## Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | <ul style="list-style-type: none"><li>• Test coupons placed at a 15 to 30° angle.</li><li>• Temperature of the exposed salt spray zone: 95±3°F (35±1.7°C)</li><li>• Every 80 cm<sup>2</sup> horizontal area, two collectors gather 1.0–2.0 ml salt fog/hr</li><li>• 5% salt solution (5±1 parts by weight of NaCl in 95 parts of water)</li><li>• pH = 6.5-7.2 when atomized at 95°F (35°C)</li><li>• 2,000 hours</li></ul> |
| <b>Coupons per Coating System</b>           | Three: Al-1a, Al-1b, Al-1c, Al-1d, Al-3a, Al-3b, St-1a, St-1b, St-2a, St-2b   |
| <b>Trials per Coupon</b>                    | One   |
| <b>Control Coupons Required for Testing</b> | One coupon coated with MIL-P-53022B and MIL-PRF-85285, Type II  |
| <b>Acceptance Criteria</b>                  | No blistering or lifting after 2,000 hours. Slight substrate corrosion only.  |

Panels were evaluated according to the following scale: 0-no corrosion, 1-minor corrosion, 2-minor-to-moderate corrosion, 3-moderate corrosion, 4-major corrosion, and 5-severe corrosion. Results, as reported by CTIO, are listed in Table 24.

**Table 24. B117 Salt Fog Corrosion Resistance Results**

| coating system | Primer                                     | Topcoat                                    | Al-1a |      |       | Al-1b |      |       | Al-1c |      |       | Al-1d |      |       | Al-3a |      |       | Al-3b |      |       | St1-a |      |       | St1-b |      |       | St-2a  |      |       | St-2b |      |       |
|----------------|--|--|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|-------|------|-------|--------|------|-------|-------|------|-------|
|                |  |  | corr  | ucut | blist | corr   | ucut | blist | corr  | ucut | blist |
| 1              | MIL-P-53022B, Type I                       | 3M Applique                                |       |      |       | 1.0   | 1.0  | 1.0   | 2.0   | 1.0  | 3.0   | 4.0   | 1.0  | 2.0   | 3.0   | 4.0  | 0.0   |       |      |       |       |      |       | 5.0   | 3.0  | 4.0   | 5.0    | 3.0  | 2.0   | 5.0   | 3.0  | 2.0   |
| Average        |  |  | 1.0   | 1.0  | 1.0   | 1.0   | 1.0  | 0.0   | 2.0   | 3.0  | 4.0   | 4.0   | 3.0  | 2.0   | 3.0   | 4.0  | 0.0   |       |      |       |       |      |       | 4.0   | 3.0  | 4.0   | 3.3    | 3.0  | 2.0   | 3.3   | 3.0  | 2.0   |
| Pass/Fail      |  |  | Pass  | Pass | Pass  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Fail  | Fail | Fail  | Fail  | Fail | Fail  |       |      |       |       |      |       | Fail  | Fail | Fail  | Fail   | Fail | Fail  | Fail  | Fail | Fail  |
| 2              | MIL-P-53022B, Type I                       | Fluorogrip, Grade E                        | 1.0   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 1.0  | 1.0   |       |      |       | 1.0   | 1.0  | 0.0   | 2.0   | 1.0  | 0.0   | 4.0   | 1.0  | 0.0   |       |      |       | 4.0    | 1.0  | 0.0   | 4.0   | 1.0  | 0.0   |
| Average        |  |  | 1.1   | 1.0  | 0.0   | 1.0   | 1.0  | 0.0   | 2.0   | 1.0  | 1.0   | 2.0   | 1.0  | 2.0   | 1.0   | 1.0  | 0.0   | 2.0   | 1.0  | 0.0   | 4.0   | 1.0  | 0.0   | 4.0   | 1.0  | 0.0   | 4.0    | 1.0  | 0.0   | 4.0   | 1.0  | 0.0   |
| Pass/Fail      |  |  | Fail  | Pass | Pass  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Pass  | Pass | Pass  | Pass  | Pass | Pass  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Fail  | Fail | Fail  | Fail   | Fail | Fail  | Fail  | Fail | Fail  |
| 3              | Platt Bros. 100% Zinc Metallizing Wire     | Defthane Zero VOC Topcoat                  |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | note 1 |      |       |       |      |       |
| Average        |  |  |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |        |      |       |       |      |       |
| Pass/Fail      |  |  |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 5.0   | 0.0  | 0.0   | 5.0   | 0.0  | 0.0   | 5.0    | 0.0  | 0.0   |       |      |       |
| 4              | Platt Bros. Zn/Alum 85/15 Metallizing Wire | Defthane Zero VOC Topcoat                  |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 5.0   | 0.0  | 0.0   |       |      |       | 5.0    | 0.0  | 0.0   |       |      |       |
| Average        |  |  |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | 5.0   | 0.0  | 0.0   |       |      |       | 5.0    | 0.0  | 0.0   |       |      |       |
| Pass/Fail      |  |  |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       |       |      |       | Fail  | Fail | Fail  |       |      |       | Fail   | Fail | Fail  |       |      |       |
| 5              | None                                       | Ameron PSX 700                             | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 1.0   | 1.0   | 1.0  | 1.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 1.0  | 2.0   | 4.0   | 2.0  | 1.0   | 4.0   | 2.0  | 0.0   | 4.0    | 2.0  | 1.0   | 4.0   | 4.0  | 0.0   |
| Average        |  |  | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 1.0   | 1.0   | 2.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 3.0  | 0.0   | 1.0   | 1.0  | 2.0   | 4.0   | 2.0  | 0.0   | 4.0   | 2.0  | 0.0   | 4.0    | 1.0  | 0.0   | 4.0   | 4.0  | 1.0   |
| Pass/Fail      |  |  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Fail  | Fail | Fail  | Fail   | Fail | Fail  | Fail  | Fail | Fail  |
| 6              | Dimetcote 9HS                              | Ameron PSX 700                             | 1.0   | 1.0  | 3.0   | 1.0   | 0.0  | 0.0   | 3.0   | 3.0  | 2.0   |       |      |       |       |      |       |       |      |       |       |      |       | 2.0   | 0.0  | 0.0   | 2.0    | 0.0  | 0.0   | 2.0   | 1.0  | 1.0   |
| Average        |  |  | 1.5   | 1.0  | 2.0   | 1.0   | 0.0  | 0.0   | 3.0   | 3.0  | 2.0   |       |      |       |       |      |       |       |      |       |       |      |       | 2.0   | 1.0  | 0.0   | 2.0    | 0.0  | 0.0   | 2.0   | 1.0  | 2.0   |
| Pass/Fail      |  |  | Fail  | Pass | Pass  | Pass  | Pass | Pass  | Fail  | Fail | Fail  |       |      |       |       |      |       |       |      |       |       |      |       | Pass  | Pass | Pass  | Pass   | Pass | Pass  | Fail  | Fail | Fail  |
| 7              | Devoe 304H                                 | Ameron PSX 700                             | 1.0   | 4.0  | 3.0   | 1.0   | 2.0  | 2.0   | 3.0   | 0.0  | 2.0   | 1.0   | 4.0  | 1.0   | 1.0   | 3.0  | 1.0   | 1.0   | 3.0  | 2.0   | 3.0   | 3.0  | 0.0   | 4.0   | 3.0  | 0.0   | 3.0    | 2.0  | 1.0   | 4.0   | 1.0  | 0.0   |
| Average        |  |  | 1.0   | 4.0  | 3.0   | 1.0   | 2.0  | 2.0   | 3.0   | 0.0  | 3.0   | 1.0   | 4.0  | 3.0   | 1.0   | 2.0  | 3.0   | 1.0   | 3.0  | 3.0   | 4.0   | 4.0  | 0.0   | 4.0   | 3.0  | 0.0   | 4.0    | 3.0  | 0.0   | 3.0   | 2.0  | 0.0   |
| Pass/Fail      |  |  | Fail  | Fail | Fail  | Fail   | Fail | Fail  | Fail  | Fail | Fail  |
| 8              | Morton 13-7004 Corvel Zinc Rich Primer     | Morton 30-1007 Corvel Clean White U 1578-1 | 2.0   | 1.0  | 2.0   | 1.0   | 0.0  | 0.0   | 1.0   | 2.0  | 3.0   | 1.0   | 1.0  | 2.0   | 1.0   | 0.0  | 0.0   | 2.0   | 2.0  | 3.0   | 4.0   | 4.0  | 4.0   | 5.0   | 5.0  | 5.0   | 3.0    | 2.0  | 3.0   | 4.0   | 4.0  | 4.0   |
| Average        |  |  | 2.0   | 1.0  | 2.0   | 1.0   | 0.0  | 0.0   | 1.0   | 2.0  | 3.0   | 2.0   | 1.0  | 2.0   | 1.0   | 0.0  | 1.0   | 2.0   | 0.0  | 0.0   | 4.0   | 4.0  | 4.0   | 5.0   | 5.0  | 5.0   | 3.0    | 2.0  | 3.0   | 4.0   | 3.0  | 4.0   |
| Pass/Fail      |  |  | Fail  | Pass | Pass  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Pass  | Pass | Pass  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Fail  | Fail | Fail  | Fail  | Fail | Fail  | Fail   | Fail | Fail  | Fail  | Fail | Fail  |
| 9              | DuPont ELH503S5 Gray Morning               | DuPont PFW510S9 Sky White                  | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 2.0   | 0.0  | 0.0   | 3.0   | 2.0  | 3.0   | 5.0   | 3.0  | 2.0   | 4.0   | 3.0  | 2.0   | 5.0    | 3.0  | 2.0   | 5.0   | 3.0  | 2.0   |
| Average        |  |  | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 0.0   | 2.0   | 0.0  | 0.0   | 3.0   | 2.0  | 3.0   | 5.0   | 3.0  | 2.0   | 4.0   | 3.0  | 2.0   | 5.0    | 3.0  | 2.0   | 5.0   | 3.0  | 2.0   |
| Pass/Fail      |  |  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Fail   | Fail | Fail  | Fail  | Fail | Fail  |
| 10             | Defl 44-GY-16, Defl 44-W-7                 | Defthane Zero VOC Topcoat                  | 1.0   | 0.0  | 2.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 1.0   | 1.0   | 1.0  | 2.0   | 1.0   | 2.0  | 2.0   | 1.0   | 1.0  | 3.0   | 4.0   | 1.0  | 0.0   | 4.0   | 1.0  | 4.0   |        |      |       | 4.0   | 1.0  | 1.0   |
| Average        |  |  | 1.0   | 0.0  | 2.0   | 1.0   | 0.0  | 0.0   | 1.0   | 0.0  | 1.0   | 1.0   | 1.0  | 3.0   | 1.0   | 1.0  | 4.0   | 1.0   | 1.0  | 4.0   | 4.0   | 1.0  | 0.0   | 4.0   | 1.0  | 3.0   |        |      |       | 4.0   | 1.0  | 1.0   |
| Pass/Fail      |  |  | Pass  | Pass | Pass  | Fail  | Fail | Fail  | Fail  | Fail | Fail  | Fail  | Fail | Fail  |        |      |       | Fail  | Fail | Fail  |

(Table 24. continued on next page)

**Table 24. B117 Salt Fog Corrosion Resistance Results (continued)**

| coating system   | Primer                      | Topcoat                   | Al-1a       |      |       | Al-1b       |      |       | Al-1c       |      |       | Al-1d       |      |       | Al-3a       |      |       | Al-3b       |      |       | St1-a       |      |       | St1-b       |      |       | St-2a       |      |       | St-2b       |      |       |
|------------------|-----------------------------|---------------------------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|-------------|------|-------|
|                  |                             |                           | corr        | ucut | blist |
| <b>Average</b>   |                             |                           | <b>0.9</b>  |      |       | <b>0.3</b>  |      |       | <b>0.6</b>  |      |       | <b>1.6</b>  |      |       | <b>1.6</b>  |      |       | <b>1.4</b>  |      |       | <b>1.7</b>  |      |       | <b>2.8</b>  |      |       | <b>2.0</b>  |      |       |             |      |       |
| <b>Pass/Fail</b> |                             |                           | <b>Pass</b> |      |       | <b>Pass</b> |      |       | <b>Pass</b> |      |       | <b>Fail</b> |      |       |             |      |       |
| 11               | Aqua-Poxy 912               | Defthane Zero VOC Topcoat |             |      |       | 1.0         | 1.0  | 2.0   | 1.0         | 1.0  | 3.0   | 1.0         | 0.0  | 0.0   | 1.0         | 0.0  | 0.0   | 2.0         | 1.0  | 3.0   | 4.0         | 1.0  | 3.0   | 4.0         | 1.0  | 4.0   | 4.0         | 2.0  | 2.0   | 4.0         | 3.0  | 3.0   |
|                  |                             |                           |             |      |       | 1.0         | 1.0  | 2.0   | 1.0         | 1.0  | 3.0   | 1.0         | 1.0  | 1.0   | 1.0         | 0.0  | 0.0   | 2.0         | 1.0  | 3.0   | 4.0         | 2.0  | 1.0   | 4.0         | 1.0  | 4.0   | 4.0         | 2.0  | 2.0   | 4.0         | 2.0  | 2.0   |
|                  |                             |                           |             |      |       | 1.0         | 1.0  | 2.0   | 1.0         | 1.0  | 3.0   | 1.0         | 1.0  | 1.0   | 1.0         | 0.0  | 0.0   | 1.0         | 1.0  | 3.0   | 4.0         | 2.0  | 1.0   | 4.0         | 2.0  | 4.0   |             |      |       | 4.0         | 3.0  | 2.0   |
| <b>Average</b>   |                             |                           |             |      |       | <b>1.3</b>  |      |       | <b>1.7</b>  |      |       | <b>0.8</b>  |      |       | <b>0.3</b>  |      |       | <b>1.9</b>  |      |       | <b>2.4</b>  |      |       | <b>3.1</b>  |      |       | <b>2.7</b>  |      |       | <b>3.0</b>  |      |       |
| <b>Pass/Fail</b> |                             |                           |             |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Pass</b> |      |       | <b>Pass</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       |             |      |       |
| C1               | MIL-P-53022B, Type II       | MIL-C-46168D              |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       | 4.0         | 3.0  | 0.0   |             |      |       |             |      |       |
| <b>Average</b>   |                             |                           |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       | <b>2.3</b>  |      |       |             |      |       |             |      |       |
| <b>Pass/Fail</b> |                             |                           |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       | <b>Fail</b> |      |       |             |      |       |             |      |       |
| C2               | CATHACOAT 304K, DEVVRAN 201 | DEVTHANE 369              |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       | 4.0         | 1.0  | 0.0   | 4.0         | 1.0  | 0.0   | 4.0         | 1.0  | 0.0   | 4.0         | 1.0  | 0.0   |
| <b>Average</b>   |                             |                           |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       | <b>1.7</b>  |      |       | <b>1.7</b>  |      |       | <b>1.7</b>  |      |       | <b>1.7</b>  |      |       |
| <b>Pass/Fail</b> |                             |                           |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       |             |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       |
| C3               | MIL-P-53022B, Type II       | MIL-P-85285C, Type II     | 1.0         | 1.0  | 1.0   | 1.0         | 1.0  | 1.0   | 1.0         | 1.0  | 3.0   | 1.0         | 1.0  | 1.0   | 1.0         | 0.0  | 0.0   | 1.0         | 1.0  | 3.0   | 4.0         | 1.0  | 1.0   | 4.0         | 1.0  | 3.0   | 4.0         | 1.0  | 0.0   |             |      |       |
| <b>Average</b>   |                             |                           | <b>1.0</b>  |      |       | <b>1.0</b>  |      |       | <b>1.7</b>  |      |       | <b>1.0</b>  |      |       | <b>0.3</b>  |      |       | <b>1.7</b>  |      |       | <b>2.0</b>  |      |       | <b>2.7</b>  |      |       | <b>1.7</b>  |      |       |             |      |       |
| <b>Pass/Fail</b> |                             |                           | <b>Pass</b> |      |       | <b>Pass</b> |      |       | <b>Fail</b> |      |       | <b>Pass</b> |      |       | <b>Pass</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       | <b>Fail</b> |      |       |             |      |       |

note 1: panels covered with white corrosion product. No reading possible each entry is average of corrosion, undercutting, and blistering ratings

### Test Summary

The results of this test were also highly substrate dependent. Overall the following coating systems performed best in this test: coating system 5, Ameron PSX 700; coating system 9, DuPont Powdercoats; and coating system 10, Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat.

See Appendix D for photographs of the B 117 salt fog corrosion resistance test coupons.

## **4.3.5. Accelerated Weathering (Navy Requirement)**

### Rationale

Support Equipment coating systems must withstand outdoor exposure to the UV radiation of sunlight and repeated wet/dry cycles daily. This test documents the coating resistance to accelerated outdoor weather exposure conditions. Navy participants require this test for the validation of alternate coating systems.

### Test Description

This test is an extension of the Accelerated Weathering Test in paragraph 4.2.3 to 1,500 hours of exposure. This accelerated test measures any coating color or gloss degradation that may occur with exposure to simulated outdoor weathering.

Color and gloss measurements were made on each test coupon per ASTM D 2244-93 and ASTM D 523-89 (1999), respectively, prior to testing. Accelerated weathering chamber parameters were maintained at  $140\pm 5^{\circ}\text{F}$  ( $60\pm 3^{\circ}\text{C}$ ) and  $50\pm 5\%$  RH. A borosilicate glass inner and outer filter, were required to simulate sunlight. This test was conducted in cycles, one cycle being a total of two hours, which consists of 102 minutes of light only and 18 minutes of light and water spray.

The test coupons were exposed to simulated sunlight, and intermittent moisture for a total of 1,500 hours. The test coupons were inspected at 1,000 and 1,500 hours in accordance with ASTM G26-96, Test Method 1. At each inspection, color and gloss measurements were again taken to document any changes.

Test Methodology

|   |  |
|---|--|
| <b>Parameters</b>                           | <ul style="list-style-type: none"><li>• 140±5°F (60±3°C)</li><li>• 50±5% RH</li><li>• Borosilicate glass inner and outer filters</li><li>• One cycle: 102 minutes of light only and 18 minutes of light and water spray</li><li>• 0.35 W/m<sup>2</sup> incident at 340 nm</li><li>• 1,500 hours duration</li></ul> |
| <b>Coupons per Coating System</b>           | Use test coupons from paragraph 4.2.3  |
| <b>Trials per Coupon</b>                    | One  |
| <b>Control Coupons Required for Testing</b> | One coupon coated with MIL-P-53022B and MIL-PRF-85285, Type II   |
| <b>Acceptance Criteria</b>                  | Color change performance <2 units (ΔE) @ 1,000 hrs and 1,500 hours.  |

Results, as reported by CTIO, are listed in Table 25.

**Table 25. Accelerated Weathering Results**

| Coating System # | Coating System Primer/Topcoat                         | Xenon Arc |             |             | Ranking |         |         |
|------------------|---|-----------|-------------|-------------|---------|---------|---------|
|                  |   | 500 Hr    | 1010Hr      | 1500 Hr     |         |         |         |
|                  |   | mean      | mean        | mean        | 500 hr  | 1016 hr | 1500 hr |
| 1                | MIL-P-53022/3M Applique                               | 1.99      | 2.03        | 2.01        | 13      | 12      | 12      |
|                  | <b>Pass/Fail</b>                                      |           | Fail        | Fail        |         |         |         |
| 2                | MIL-P-53022/Fluorip applique                          | 4.75      | 8.72        | 15.28       | 14      | 14      | 14      |
|                  | <b>Pass/Fail</b>                                      |           | Fail        | Fail        |         |         |         |
| 3                | Platt 100% Zinc/ Deft 0 VOC Topcoat                   | 0.48      | 0.63        | 0.79        | 6       | 6       | 5       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 4                | Platt Zn/Al/85/15 Deft 0 VOC Topcoat                  | 0.84      | 0.96        | 1.22        | 9       | 8       | 9       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 5                | no primer/Ameron PSX 700                              | 1.12      | 1.22        | 1.29        | 11      | 10      | 10      |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 6                | Dimetcote 9HS/Ameron PSX 700                          | 0.88      | 0.98        | 1.00        | 10      | 9       | 7       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 7                | Devoe 304H/Ameron PSX 700                             | 1.24      | 1.38        | 1.45        | 12      | 11      | 11      |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 8                | Morton Zinc Rich/Morton White                         | 0.44      | 0.96        | 1.20        | 4       | 7       | 8       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 9                | DuPont gray/DuPont White                              | 0.31      | 0.24        | 0.37        | 2       | 2       | 2       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 10               | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 0.47      | 0.57        | 0.73        | 5       | 4       | 4       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| 11               | Aquapoxy 912/Deft 0 VOC Topcoat                       | 0.55      | 0.62        | 0.83        | 8       | 5       | 6       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| c1               | MIL-P-53022B Ty II/MIL-C-46168D                       | 0.44      | 2.36        | 6.79        | 3       | 13      | 13      |
|                  | <b>Pass/Fail</b>                                      |           | Fail        | Fail        |         |         |         |
| c2               | Devoe 304/ Devoe 201/Devthane 369                     | 0.49      | 0.51        | 0.64        | 7       | 3       | 3       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |
| c3               | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II               | 0.29      | 0.24        | 0.27        | 1       | 1       | 1       |
|                  | <b>Pass/Fail</b>                                      |           | <b>Pass</b> | <b>Pass</b> |         |         |         |

Readings are means of 3 readings per panel, averaging all panels per coating system.

#### Test Summary

All coating systems except coating systems 1, 3M Fluoropolymer Paint Replacement Product, and coating system 2, Fluorogrip, Grade E, passed this requirement.

#### **4.3.6. Fluid Resistance (AF, Army, Navy Requirement)**

##### Rationale

This test measures degradation of coating adhesion and hardness as a result of prolonged contact with specific common fluids. Air Force, Army, and Navy Participants have agreed that fluid resistance is a performance requirement.

##### Test Description

This procedure is used to determine the effect of fluid immersion on candidate coating systems.

Scratch hardness (pencil hardness) measurements were taken on each test coupon in accordance with ASTM D 3363-00 (*Standard Test Method for Film Hardness by Pencil Test*, approved November 15, 1992, re-approved 2000).

The test coupons were then immersed in the test fluids, for the duration outlined in *Test Methodology*. The test coupons were removed from the fluids and wiped dry with a clean cloth. They were immediately tested for scratch hardness (pencil hardness) again according to ASTM D 3363-00.

Test Methodology

| <b>Parameters</b> | <b>Fluid</b>                  | <b>Temp</b>  | <b>Duration</b> | <b>Test Coupons</b> | <b>Control Coupons</b>       | <b>Reqmt</b>   | <b>Acceptance Criteria</b>   |
|-------------------|-------------------------------|--------------|-----------------|---------------------|------------------------------|----------------|--|
|                   | Distilled Water               | 120°F (49°C) | 4 days          | 1 each St-2a        | 1 coupon per control coating | AF, Navy       | No objectionable discoloration, change in gloss, blistering, or swelling.<br><br>Scratch hardness ≤ 2 pencil hardness units from the control finishes. |
|                   | Fuel JP-5                     | Ambient      | 7 days          | 1 each St-2a        |                              | AF, Army, Navy |  |
|                   | Fuel JP-8                     | Ambient      | 7 days          | 1 each St-2a        |                              | AF, Army Navy  |  |
|                   | Diesel Fuel                   | Ambient      | 30 days         | 1 each St-2a        |                              | AF, Army, Navy |  |
|                   | Hydraulic Fluid (MIL-H-83282) | 150°F (66°C) | 24 hours        | 1 each St-2a        |                              | AF, Army, Navy |  |
|                   | Hydraulic Fluid (SKYDROL®)    | Ambient      | 7 days          | 1 each St-2a        |                              | AF, Army, Navy |  |
|                   | Lube Oil (MIL-L-23699)        | 150°F (66°C) | 24 hours        | 1 each St-2a        |                              | AF, Army, Navy |  |
|                   | Solvent (PD-680, Type II)     | Ambient      | 7 days          | 1 each St-2a        |                              | AF, Army, Navy |  |

Results, as reported by Naval Air Warfare Center Aircraft Division (NAWCAD), are listed in Table 26.

Table 26. Fluid Resistance Results

| Fluid           | Coating System  | Coating                                 | Initial Pencil Hardness | Final Pencil Hardness | Change in Pencil Hardness Units | Comments (objectionable change in gloss, color, swelling, blistering, etc.) | Pass/Fail               |
|-----------------|---|---|-------------------------|-----------------------|---------------------------------|---|-------------------------|
| Distilled Water | C1  | MIL-P-53022B Ty II/MIL-C-46168D         | >6H                     | F                     | -6                              | NONE  | NA                      |
|                 | C3  | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H                      | F                     | -2                              | NONE  | NA                      |
|                 | 1   | MIL-P-53022/3M Applique                 | 6B                      | <6B                   | -1                              | NONE  | Fail                    |
|                 | 2   | MIL-P-53022/Fluorogrip applique         | <6B                     | 6B                    | +1                              | NONE  | Fail                    |
|                 | 3   | Platt 100% Zinc/Delft 0 VOC Topcoat     | >6H                     | B                     | -6                              | NONE  | Pass                    |
|                 | 4   | Platt Zn/Al/Delft 0 VOC Topcoat         | 5H                      | H                     | -4                              | NONE  | Pass                    |
|                 | 5   | no primer/Ameron PSX 700                | F                       | HB                    | -1                              | NONE  | Pass                    |
|                 | 6   | Dimetecote 9HS/Ameron PSX 700           | F                       | H                     | +1                              | NONE  | Pass                    |
|                 | 7   | Devco 304H/Ameron PSX 700               | 2B                      | 2B                    | 0                               | NONE  | Fail                    |
|                 | 8   | Morton Zinc Rich/Morton White           | 3H                      | HB                    | -4                              | NONE  | Pass                    |
|                 | 9   | DuPont gray/DuPont White                | F                       | F                     | 0                               | NONE  | Pass                    |
| 10              | Delft Zinc Rich/Intermediate Primer/Delft 0 VOC Topcoat | 2H                                      | 3B                      | -6                    | NONE                            | Fail  |                         |
| 11              | Aqua-Poxy 912/Delft 0 VOC Topcoat                       | B                                       | 4B                      | -3                    | NONE                            | Fail  |                         |
| Fuel JP-5       | C1  | MIL-P-53022B Ty II/MIL-C-46168D         | >6H                     | 5H                    | -1                              | NONE  | NA                      |
|                 | C3  | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H                      | F                     | -2                              | NONE  | NA                      |
|                 | 1   | MIL-P-53022/3M Applique                 | 6B                      | <6B                   | -1                              | NONE  | Fail                    |
|                 | 2   | MIL-P-53022/Fluorogrip applique         | <6B                     | <6B                   | 0                               | NONE  | Fail                    |
|                 | 3   | Platt 100% Zinc/Delft 0 VOC Topcoat     | >6H                     | 2H                    | -4                              | NONE  | *Fail - C1<br>Pass - C3 |
|                 | 4   | Platt Zn/Al/Delft 0 VOC Topcoat         | 5H                      | 2H                    | -3                              | NONE  | *Fail - C1<br>Pass - C3 |
|                 | 5   | no primer/Ameron PSX 700                | F                       | B                     | -2                              | NONE  | *Fail - C1<br>Pass - C3 |
|                 | 6   | Dimetecote 9HS/Ameron PSX 700           | F                       | F                     | 0                               | NONE  | *Fail - C1<br>Pass - C3 |
|                 | 7   | Devco 304H/Ameron PSX 700               | 2B                      | 2B                    | 0                               | NONE  | *Fail - C1<br>Pass - C3 |
|                 | 8   | Morton Zinc Rich/Morton White           | 3H                      | 2H                    | -1                              | NONE  | *Fail - C1<br>Pass - C3 |
|                 | 9   | DuPont gray/DuPont White                | F                       | F                     | 0                               | NONE  | *Fail - C1<br>Pass - C3 |
| 10              | Delft Zinc Rich/Intermediate Primer/Delft 0 VOC Topcoat | 2H                                      | F                       | -2                    | NONE                            | *Fail - C1<br>Pass - C3   |                         |
| 11              | Aqua-Poxy 912/Delft 0 VOC Topcoat                       | B                                       | B                       | 0                     | NONE                            | *Fail - C1<br>Pass - C3   |                         |

\*Coating failed when compared to C1, Passed when compared to C3

(Table 26. continued on next page)

**Table 26. Fluid Resistance Results (continued)**

|                  |                                  |   |     |     |      |                         |                          |
|------------------|----------------------------------|---|-----|-----|------|-------------------------|--------------------------|
| <b>Fuel JP-8</b> | C1                               | MIL-P-53022B Ty II/MIL-C-46168D                       | >6H | 3H  | -3   | NONE                    | NA                       |
|                  | C3                               | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II               | 2H  | F   | -2   | NONE                    | NA                       |
|                  | 1                                | MIL-P-53022/3M Applique                               | 6B  | 6B  | 0    | NONE                    | Fail                     |
|                  | 2                                | MIL-P-53022/Fluorogrip applique                       | <6B | <6B | 0    | NONE                    | Fail                     |
|                  | 3                                | Platt 100% Zinc/Deft 0 VOC Topcoat                    | >6H | 3H  | -3   | NONE                    | **Pass - C1<br>Fail - C2 |
|                  | 4                                | Platt Zn/Al/Deft 0 VOC Topcoat                        | 5H  | 2H  | -3   | NONE                    | Pass                     |
|                  | 5                                | no primer/Ameron PSX 700                              | F   | 2B  | -3   | NONE                    | Fail                     |
|                  | 6                                | Dimetcote 9HS/Ameron PSX 700                          | F   | B   | -2   | NONE                    | *Fail - C1<br>Pass - C3  |
|                  | 7                                | Devoe 304H/Ameron PSX 700                             | 2B  | 4B  | -2   | NONE                    | Fail                     |
|                  | 8                                | Morton Zinc Rich/Morton White                         | 3H  | 2H  | -1   | NONE                    | Pass                     |
|                  | 9                                | DuPont gray/DuPont White                              | F   | F   | 0    | NONE                    | *Fail - C1<br>Pass - C3  |
|                  | 10                               | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 2H  | F   | -2   | NONE                    | *Fail - C1<br>Pass - C3  |
| 11               | Aqua-Poxy 912/Deft 0 VOC Topcoat | B   | B   | 0   | NONE | *Fail - C1<br>Pass - C3 |                          |

\*Coating failed when compared to C1, Passed when compared to C3

\*\*Coating passed when compared to C1, failed when compared to C3

|                    |                    |   |   |     |    |          |                         |
|--------------------|--------------------|---|---|-----|----|----------|-------------------------|
| <b>Diesel Fuel</b> | C1                 | MIL-P-53022B Ty II/MIL-C-46168D         | >6H   | >6H | 0  | SL STAIN | NA                      |
|                    | C3                 | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H  | F   | -2 | SL STAIN | NA                      |
|                    | 1                  | MIL-P-53022/3M Applique                 | 6B  | <6B | -1 | NONE     | Fail                    |
|                    | 2                  | MIL-P-53022/Fluorogrip applique         | <6B   | <6B | 0  | NONE     | Fail                    |
|                    | 3                  | Platt 100% Zinc/Deft 0 VOC Topcoat      | >6H   | 2H  | -4 | SL STAIN | *Fail - C1<br>Pass - C3 |
|                    | 4                  | Platt Zn/Al/Deft 0 VOC Topcoat          | 5H  | 2H  | -3 | SL STAIN | *Fail - C1<br>Pass - C3 |
|                    | 5                  | no primer/Ameron PSX 700                | F   | HB  | -1 | SL STAIN | *Fail - C1<br>Pass - C3 |
|                    | 6                  | Dimetcote 9HS/Ameron PSX 700            | F   | F   | 0  | NONE     | *Fail - C1<br>Pass - C3 |
|                    | 7                  | Devoe 304H/Ameron PSX 700               | 2B  | B   | +1 | SL STAIN | *Fail - C1<br>Pass - C3 |
|                    | 8                  | Morton Zinc Rich/Morton White           | 3H  | 2H  | -1 | SL STAIN | *Fail - C1<br>Pass - C3 |
|                    | 9                  | DuPont gray/DuPont White                | F   | F   | 0  | SL STAIN | *Fail - C1<br>Pass - C3 |
|                    | <b>Diesel Fuel</b> | 10                                      | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 2H  | F  | -2       | SL STAIN                |
|                    | 11                 | Aqua-Poxy 912/Deft 0 VOC Topcoat        | B   | 3B  | -2 | SL STAIN | Fail                    |

\*Coating failed when compared to C1, Passed when compared to C3

(Table 26. continued on next page)

**Table 26. Fluid Resistance Results (continued)**

|                                |   |   |     |     |      |                         |                          |
|--------------------------------|---|---|-----|-----|------|-------------------------|--------------------------|
| Hydraulic Fluid<br>MIL-H-83282 | C1  | MIL-P-53022B Ty II/MIL-C-46168D         | >6H | >6H | 0    | NONE                    | NA                       |
|                                | C3  | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H  | F   | -2   | NONE                    | NA                       |
|                                | 1   | MIL-P-53022/3M Applique                 | 6B  | <6B | -1   | NONE                    | Fail                     |
|                                | 2   | MIL-P-53022/Fluorogrip applique         | <6B | 6B  | +1   | NONE                    | Fail                     |
|                                | 3   | Platt 100% Zinc/Deft 0 VOC Topcoat      | >6H | 2H  | -4   | NONE                    | *Fail - C1<br>Pass - C3  |
|                                | 4   | Platt Zn/Al/Deft 0 VOC Topcoat          | 5H  | 3H  | -2   | NONE                    | Fail                     |
|                                | 5   | no primer/Ameron PSX 700                | F   | F   | 0    | NONE                    | *Fail - C1<br>Pass - C3  |
|                                | 6   | Dimetcote 9HS/Ameron PSX 700            | F   | >6H | +6   | NONE                    | **Pass - C1<br>Fail - C3 |
|                                | 7   | Devoe 304H/Ameron PSX 700               | 2B  | 2B  | 0    | NONE                    | Fail                     |
|                                | 8   | Morton Zinc Rich/Morton White           | 3H  | F   | -3   | NONE                    | *Fail - C1<br>Pass - C3  |
|                                | 9   | DuPont gray/DuPont White                | F   | F   | 0    | NONE                    | *Fail - C1<br>Pass - C3  |
| 10                             | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 2H                                      | F   | -2  | NONE | *Fail - C1<br>Pass - C3 |                          |
| 11                             | Aqua-Poxy 912/Deft 0 VOC Topcoat                      | B                                       | B   | 0   | NONE | *Fail - C1<br>Pass - C3 |                          |

\*Coating failed when compared to C1, Passed when compared to C3

\*\*Coating passed when compared to C1, failed when compared to C3

|                             |   |   |     |     |      |                         |                          |
|-----------------------------|---|---|-----|-----|------|-------------------------|--------------------------|
| Hydraulic Fluid<br>Sky-drol | C1  | MIL-P-53022B Ty II/MIL-C-46168D         | >6H | >6H | 0    | NONE                    | NA                       |
|                             | C3  | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H  | B   | -4   | NONE                    | NA                       |
|                             | 1   | MIL-P-53022/3M Applique                 | 6B  | <6B | -1   | NONE                    | Fail                     |
|                             | 2   | MIL-P-53022/Fluorogrip applique         | <6B | <6B | 0    | NONE                    | Fail                     |
|                             | 3   | Platt 100% Zinc/Deft 0 VOC Topcoat      | >6H | 3H  | -3   | NONE                    | Fail                     |
|                             | 4   | Platt Zn/Al/Deft 0 VOC Topcoat          | 5H  | 4H  | -1   | NONE                    | **Pass - C1<br>Fail - C3 |
|                             | 5   | no primer/Ameron PSX 700                | F   | 4B  | -5   | NONE                    | Fail                     |
|                             | 6   | Dimetcote 9HS/Ameron PSX 700            | F   | B   | -2   | NONE                    | *Fail - C1<br>Pass - C3  |
|                             | 7   | Devoe 304H/Ameron PSX 700               | 2B  | 5B  | -3   | NONE                    | Fail                     |
|                             | 8   | Morton Zinc Rich/Morton White           | 3H  | <6B | -10  | NONE                    | Fail                     |
|                             | 9   | DuPont gray/DuPont White                | F   | <6B | -7   | NONE                    | Fail                     |
| 10                          | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 2H                                      | F   | -2  | NONE | *Fail - C1<br>Pass - C3 |                          |
| 11                          | Aqua-Poxy 912/Deft 0 VOC Topcoat                      | B                                       | <6B | -5  | NONE | Fail                    |                          |

\*Coating failed when compared to C1, Passed when compared to C3

\*\*Coating passed when compared to C1, failed when compared to C3

(Table 26. continued on next page)

**Table 26. Fluid Resistance Results (continued)**

|                                 |   |   |     |     |      |                         |                         |
|---------------------------------|---|---|-----|-----|------|-------------------------|-------------------------|
| <b>Lube Oil<br/>MIL-L-23699</b> | C1  | MIL-P-53022B Ty II/MIL-C-46168D         | >6H | 5H  | -1   | NONE                    | NA                      |
|                                 | C3  | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H  | 2H  | 0    | NONE                    | NA                      |
|                                 | 1   | MIL-P-53022/3M Applique                 | 6B  | 6B  | 0    | NONE                    | Fail                    |
|                                 | 2   | MIL-P-53022/Fluorogrip applique         | <6B | <6B | 0    | NONE                    | Fail                    |
|                                 | 3   | Platt 100% Zinc/Deft 0 VOC Topcoat      | >6H | 2H  | -4   | NONE                    | *Fail - C1<br>Pass - C3 |
|                                 | 4   | Platt Zn/Al/Deft 0 VOC Topcoat          | 5H  | 3H  | -2   | NONE                    | Pass                    |
|                                 | 5   | no primer/Ameron PSX 700                | F   | F   | 0    | NONE                    | *Fail - C1<br>Pass - C3 |
|                                 | 6   | Dimetcote 9HS/Ameron PSX 700            | F   | F   | 0    | NONE                    | *Fail - C1<br>Pass - C3 |
|                                 | 7   | Devoe 304H/Ameron PSX 700               | 2B  | F   | +3   | NONE                    | *Fail - C1<br>Pass - C3 |
|                                 | 8   | Morton Zinc Rich/Morton White           | 3H  | F   | -3   | NONE                    | *Fail - C1<br>Pass - C3 |
|                                 | 9   | DuPont gray/DuPont White                | F   | F   | 0    | NONE                    | *Fail - C1<br>Pass - C3 |
| 10                              | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 2H                                      | F   | -2  | NONE | *Fail - C1<br>Pass - C3 |                         |
| 11                              | Aqua-Poxy 912/Deft 0 VOC Topcoat                      | B                                       | B   | 0   | NONE | Fail                    |                         |

\*Coating failed when compared to C1, Passed when compared to C3

|                                  |   |   |     |     |      |      |                         |
|----------------------------------|---|---|-----|-----|------|------|-------------------------|
| <b>Solvent<br/>PD-680, Ty II</b> | C1  | MIL-P-53022B Ty II/MIL-C-46168D         | >6H | 3H  | -3   | NONE | NA                      |
|                                  | C3  | MIL-P-53022B Ty II/MIL-PRF-85285C Ty II | 2H  | 2H  | 0    | NONE | NA                      |
|                                  | 1   | MIL-P-53022/3M Applique                 | 6B  | <6B | -1   | NONE | Fail                    |
|                                  | 2   | MIL-P-53022/Fluorogrip applique         | <6B | <6B | 0    | NONE | Fail                    |
|                                  | 3   | Platt 100% Zinc/Deft 0 VOC Topcoat      | >6H | 2H  | -4   | NONE | Pass                    |
|                                  | 4   | Platt Zn/Al/Deft 0 VOC Topcoat          | 5H  | 3H  | -2   | NONE | Pass                    |
|                                  | 5   | no primer/Ameron PSX 700                | F   | F   | 0    | NONE | *Fail - C1<br>Pass - C3 |
|                                  | 6   | Dimetcote 9HS/Ameron PSX 700            | F   | F   | 0    | NONE | *Fail - C1<br>Pass - C3 |
|                                  | 7   | Devoe 304H/Ameron PSX 700               | 2B  | B   | +1   | NONE | Fail                    |
|                                  | 8   | Morton Zinc Rich/Morton White           | 3H  | H   | -2   | NONE | Pass                    |
|                                  | 9   | DuPont gray/DuPont White                | F   | F   | 0    | NONE | *Fail - C1<br>Pass - C3 |
| 10                               | Deft Zinc Rich/Intermediate Primer/Deft 0 VOC Topcoat | 2H                                      | H   | -1  | NONE | Pass |                         |
| 11                               | Aqua-Poxy 912/Deft 0 VOC Topcoat                      | B                                       | B   | 0   | NONE | Fail |                         |

\*Coating failed when compared to C1, Passed when compared to C3

### Test Summary

The coating systems that performed best overall in this test are as follows: coating system 3, Platt Bros. 100% Zinc Metallizing Wire with Defthane Zero VOC Topcoat; coating system 4, Platt Bros. Zn/Alum 85/15 Metallizing Wire with Defthane Zero VOC Topcoat; and coating system 8, Morton Powdercoats.

### **4.3.7. High Temperature Resistance Test (NASA Requirement)**

#### Rationale

NASA requires this test for validation of alternative coating systems. The high temperature resistance test results are listed in Table 27.

#### Test Description

This procedure is used to determine the heat resistance of primers. Test coupons provided by NASA were coated on all sides with the primers of coating systems 6 and 7.

The film integrity and adhesion of the test coupons was measured in accordance with ASTM D 2197-98 (*Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion*, approved 1968, revised 1998) and ASTM D 4541-95e1 (*Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers*, approved 1993, revised 1995). The test coupons were then placed in an oven as specified in *Test Methodology*. At the completion of the test, the test coupons were removed from the oven allowed to cool to room temperature and the film integrity and adhesion was again measured.

#### Test Methodology

|   |   |
|---|---|
| <b>Parameters</b>                           | 24 hours at 750±5°F                       |
| <b>Coupons per Coating System</b>           | Provided by NASA                          |
| <b>Trials per Coupon</b>                    | One per coating per test coupon           |
| <b>Control Coupons Required for Testing</b> | None                                      |
| <b>Acceptance Criteria</b>                  | No change in film integrity and adhesion. |

**Table 27. High Temperature Resistance Test Results**

| <b>Manufacture Coating Panel #</b> | <b>Test #</b> | <b>Adhesion Before Heat (psi)</b> | <b>Adhesion After Heat (psi)</b> |
|------------------------------------|---------------|-----------------------------------|----------------------------------|
| Ameron                             | 1             | 490 (cohesive)                    | 1250 (90%coh,10%adh)             |
| D-9 HS                             | 2             | 650 (cohesive)                    | 1100 (cohesive)                  |
| # 1001                             | 3             | 600 (cohesive)                    | 600 (cohesive)                   |
| Devoe                              | 1             | 1250 (80%coh,20% adh)             | 1200 (10%coh,90%adh)             |
| 304 H                              | 2             | 1250 (60%coh,40%adh)              | 1000 (80%coh,20%adh)             |
| # 1973                             | 3             | 1000 (70%coh,30%adh)              | 1200 (80%coh,20%adh)             |

Test Summary

Results for this test, as reported by NASA, are that both primers tested passed this test according NASA-STD-5008.

## 5. SUMMARY OF ALTERNATIVES

### 5.1. Film Technology

#### 5.1.1. MIL-P-53022B, Type I with 3M Fluoropolymer Paint Replacement Product (Applique)

Table 28. CS1 Summary

| MIL-P- 53022B, Type I<br>3M Fluoropolymer (Applique) |       | Test Specimen |       |       |      |         |       |         |         |         |         |        |        |
|--|-------|---------------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
| Screening Test Requirements                          | Al-1a | Al-1b         | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| Ease of Application                                  | *     | *             | *     | *     | *    | *       | *     | *       | *       | Pass    | Pass    | *      | *      |
| Surface Appearance                                   | *     | *             | *     | *     | *    | *       | *     | *       | *       | Pass    | Pass    | *      | *      |
| Dry-to-Touch (Sanding)                               | *     | *             | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Cure Time (MEK Solvent Rub)                          | *     | *             | *     | *     | *    | *       | *     | *       | *       | Pass    | *       | *      | *      |

  

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
|                      | *       | *       | *       | *       |

  

| Common Test Requirements      | Al-1a | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|-------------------------------|-------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
| Removability                  | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | Pass   |
| Accelerated Weathering        | Fail  | Fail  | Fail  | Fail  | *    | *       | *     | *       | *       | Fail    | -       | *      | *      |
| Filiform Corrosion Resistance | Pass  | *     | *     | Pass  | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| X-Cut Adhesion                | Pass  | Pass  | Pass  | Fail  | *    | *       | *     | Fail    | Fail    | Fail    | Fail    | Fail   | *      |
| Mandrel Bend Flexibility      | *     | *     | *     | *     | Pass | *       | *     | *       | *       | *       | *       | *      | *      |
| Accelerated Storage Stability | Pass  | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

  

| Reparability | Procedure A | Procedure B |           | Procedure C |
|--------------|-------------|-------------|-----------|-------------|
|              | Control 1   | Control 2   | Control 3 |             |
|              | *           | Pass        | *         | Fail        |

  

| Extended Test Requirements         | Compared with: | Al-1a | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|------------------------------------|----------------|-------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
| 18-Month Marine Environment Test   |                |       |       |       |       |      |         |       |         |         |         |         |        |        |
| Cyclic Corrosion Resistance        | C1             | Pass  | **    | **    | **    | *    | **      | Pass  | Pass    | **      | Pass    | Fail    | Pass   | *      |
|                                    | C2             | **    | **    | **    | **    | **   | **      | **    | **      | **      | **      | **      | **     | **     |
|                                    | C3             | Pass  | **    | **    | **    | *    | **      | Pass  | Pass    | Pass    | Pass    | Fail    | Pass   | *      |
| SO2 Corrosion Resistance           |                | Pass  | Pass  | Fail  | Pass  | *    | Fail    | Fail  | Pass    | Fail    | Pass    | Fail    | *      | *      |
| B117 Salt Fog Corrosion Resistance |                | Pass  | Pass  | Fail  | Fail  | *    | Fail    | **    | **      | Fail    | Fail    | Fail    | *      | *      |
| High-Temperature Resistance        |                |       |       |       |       |      |         |       |         |         |         |         |        |        |

  

| Accelerated Weathering | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
|                        |          | Fail     |

  

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |                | Control 1       | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |
|                  | Control 3      | Fail            | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |

\*Not required to be tested

\*\*Not tested

-Coupons not tested due to overlapping test schedules

### 5.1.2. MIL-P-53022B, Type I with Fluorogrip, Grade E

Table 29. CS2 Summary

Primer MIL-P- 53022B, Type I

Topcoat Fluorogrip, Grade E

| Screening Test Requirements | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |
|-----------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| Ease of Application         | *             | *     | *     | *     | *    | *       | *     | *       | *       | Pass    | Pass    | *      | *      |
| Surface Appearance          | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | Fail    | *      | *      |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *       | *     | *       | *       | Pass    | *       | *      | *      |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
|                      | *       | *       | *       | *       |

| Common Test Requirements      | Al-1a        | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|-------------------------------|--------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                               | Removability | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Accelerated Weathering        | Fail         | Fail  | Fail  | Fail  | *    | *       | *     | *       | *       | Fail    | -       | *      | *      |
| Filiform Corrosion Resistance | Pass         | *     | *     | Pass  | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| X-Cut Adhesion                | Fail         | Pass  | Pass  | Pass  | *    | *       | *     | Pass    | Pass    | Pass    | Pass    | Pass   | *      |
| Mandrel Bend Flexibility      | *            | *     | *     | *     | Pass | *       | *     | *       | *       | *       | *       | *      | *      |
| Accelerated Storage Stability | Pass         | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

| Reparability | Procedure A | Control 1 | Procedure B Control 2 | Control 3 | Procedure C |
|--------------|-------------|-----------|-----------------------|-----------|-------------|
|              |             | *         | Pass                  | *         | Fail        |

| Extended Test Requirements         | Compared with:                   | Al-1a | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|------------------------------------|----------------------------------|-------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                                    | 18-Month Marine Environment Test |       |       |       |       |      |         |       |         |         |         |         |        |        |
| Cyclic Corrosion Resistance        | C1                               | Fail  | Fail  | Pass  | Fail  | *    | Fail    | Pass  | Pass    | **      | Pass    | Fail    | Fail   | *      |
|                                    | C2                               | **    | **    | **    | **    | *    | **      | **    | **      | **      | **      | **      | **     | **     |
|                                    | C3                               | Fail  | Fail  | Fail  | Pass  | *    | Fail    | Fail  | Pass    | Pass    | Pass    | Pass    | Fail   | *      |
| SO2 Corrosion Resistance           |                                  | Pass  | Pass  | Fail  | Pass  | *    | Pass    | Fail  | Fail    | Fail    | Pass    | Fail    | *      | *      |
| B117 Salt Fog Corrosion Resistance |                                  | Fail  | Pass  | Fail  | Fail  | *    | Pass    | Pass  | Fail    | Fail    | Fail    | Fail    | *      | *      |
| High-Temperature Resistance        |                                  |       |       |       |       |      |         |       |         |         |         |         |        |        |

| Accelerated Weathering | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
|                        |          | Fail     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |                | Control 1       | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |
|                  | Control 3      | Fail            | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |

\*Not required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

## 5.2. MWAS

### 5.2.1. Platt Bros. 100% Zinc Metallizing Wire with Defthane Zero VOC Topcoat

Table 30. CS3 Summary

Primer **Platt Bros. 100% Zinc Rich Coating**  
 Topcoat **Defthane Zero VOC Topcoat**

| Screening Test Requirements | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |
|-----------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| Ease of Application         | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | Fail    | *      | *      |
| Surface Appearance          | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | -       | *      | *      |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
|                      | *       | *       | *       | *       |

| Common Test Requirements      | Al-1a        | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|-------------------------------|--------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                               | Removability | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Accelerated Weathering        | -            | -     | -     | -     | *    | *       | *     | *       | *       | Pass    | -       | *      | *      |
| Fillform Corrosion Resistance | -            | *     | *     | -     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| X-Cut Adhesion                | -            | -     | -     | -     | *    | *       | *     | Pass    | -       | Pass    | -       | -      | *      |
| Mandrel Bend Flexibility      | *            | *     | *     | *     | *    | *       | *     | Fail    | *       | *       | *       | *      | *      |
| Accelerated Storage Stability | *            | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

| Reparability | Procedure A | Procedure B |           | Procedure C |
|--------------|-------------|-------------|-----------|-------------|
|              | Control 1   | Control 2   | Control 3 |             |
|              | *           | Pass        | *         | Fail        |

| Extended Test Requirements         | Compared with:                   | Al-1a | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|------------------------------------|----------------------------------|-------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                                    | 18-Month Marine Environment Test |       |       |       |       |      |         |       |         |         |         |         |        |        |
| Cyclic Corrosion Resistance        | C1                               | -     | -     | -     | -     | *    | -       | -     | Pass    | -       | Pass    | -       | -      | *      |
|                                    | C2                               | -     | -     | -     | -     | *    | -       | -     | -       | -       | -       | -       | -      | -      |
|                                    | C3                               | -     | -     | -     | -     | *    | -       | -     | Pass    | -       | Pass    | -       | -      | *      |
| SO2 Corrosion Resistance           |                                  | -     | -     | -     | -     | *    | -       | -     | Pass    | -       | Pass    | -       | *      | *      |
| B117 Salt Fog Corrosion Resistance |                                  | -     | -     | -     | -     | *    | -       | -     | -       | -       | Fail    | -       | *      | *      |
| High-Temperature Resistance        |                                  |       |       |       |       |      |         |       |         |         |         |         |        |        |

| Accelerated Weathering | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
|                        | Pass     | Pass     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  | Control 1      | Pass            | Fail      | Pass      | Fail        | Fail                          | Fail                      | Fail                   | Pass                      |
| Control 3        | Pass           | Pass            | Fail      | Pass      | Pass        | Fail                          | Pass                      | Pass                   |                           |

\*Not required to be tested

-Unable to test due to primer adhesion

## 5.2.2. Platt Bros. Zn/Alum 85/15 Metallizing Wire with Defthane Zero VOC Topcoat

Table 31. CS4 Summary

Primer **Platt Bros. Zn/Alum 85/15 Metallizing Wire**  
 Topcoat **Defthane Zero VOC Topcoat**

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |  |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|--|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |  |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |  |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | -     | *    | *    |  |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |  |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |  |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | *       | *       | *       | *       |

| Common Test Requirements      | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |  |
|-------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|--|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |  |
| Removability                  | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | Pass |  |
| Accelerated Weathering        | -             | -     | -     | -     | *    | *     | *     | *     | *     | Pass  | -     | *    | *    |  |
| Filiform Corrosion Resistance | -             | *     | *     | -     | *    | *     | *     | *     | *     | *     | *     | *    | *    |  |
| X-Cut Adhesion                | -             | -     | -     | -     | *    | *     | *     | Pass  | -     | Pass  | -     | -    | *    |  |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | *    | *     | *     | Fail  | *     | *     | *     | *    | *    |  |
| Accelerated Storage Stability | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |  |

| Reparability | Procedure A | Procedure B |           | Procedure C |
|--------------|-------------|-------------|-----------|-------------|
|              | Control 1   | Control 2   | Control 3 | Control 3   |
| Reparability | *           | Pass        | *         | Fail        |

| Extended Test Requirements         | Compared with: | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |  |
|------------------------------------|----------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|--|
|                                    |                | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |  |
| 18-Month Marine Environment Test   |                |               |       |       |       |      |       |       |       |       |       |       |      |      |  |
| Cyclic Corrosion Resistance        | C1             | -             | -     | -     | -     | *    | -     | -     | Pass  | -     | Pass  | -     | -    | *    |  |
|                                    | C2             | -             | -     | -     | -     | *    | -     | -     | -     | -     | -     | -     | -    | -    |  |
|                                    | C3             | -             | -     | -     | -     | *    | -     | -     | Pass  | -     | Pass  | -     | -    | *    |  |
| SO2 Corrosion Resistance           |                | -             | -     | -     | -     | *    | -     | -     | Pass  | -     | Pass  | -     | *    | *    |  |
| B117 Salt Fog Corrosion Resistance |                | -             | -     | -     | -     | *    | -     | -     | Fail  | -     | Fail  | -     | *    | *    |  |
| High-Temperature Resistance        |                |               |       |       |       |      |       |       |       |       |       |       |      |      |  |

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |                | Control 1       | Pass      | Fail      | Pass        | Fail                          | Fail                      | Pass                   | Pass                      |
| Control 3        | Pass           | Pass            | Pass      | Pass      | Fail        | Fail                          | Pass                      | Pass                   |                           |

\*Not required to be tested  
 -Unable to test due to primer adhesion

### 5.3. High Solids Coatings

#### 5.3.1. Ameron PSX 700 Siloxane Self Priming Topcoat

Table 32. CS5 Summary

Primer (no primer)  
Topcoat Ameron PSX 700 Siloxane Self Priming Topcoat

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |  |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|--|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |  |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |  |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |  |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | *     | *    | *    |  |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | *     | *    | *    |  |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | *       | *       | Fail    | Fail    |

| Common Test Requirements      | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |  |
|-------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|--|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |  |
| Removability                  | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | Pass |  |
| Accelerated Weathering        | Fail          | Fail  | Fail  | Fail  | *    | *     | *     | *     | *     | Fail  | -     | *    | *    |  |
| Filiform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    |  |
| X-Cut Adhesion                | Fail          | Fail  | Fail  | Fail  | *    | *     | *     | Pass  | Fail  | Pass  | Fail  | Fail | *    |  |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Fail | *     | *     | *     | *     | *     | *     | *    | *    |  |
| Accelerated Storage Stability | Fail          | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |  |

| Reparability | Procedure A | Procedure B |           | Procedure C |
|--------------|-------------|-------------|-----------|-------------|
|              |             | Control 1   | Control 2 | Control     |
| Reparability | *           | Pass        | *         | Pass        |

| Extended Test Requirements         | Compared with: | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |  |
|------------------------------------|----------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|--|
|                                    |                | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |  |
| 18-Month Marine Environment Test   |                |               |       |       |       |      |       |       |       |       |       |       |      |      |  |
| Cyclic Corrosion Resistance        | C1             | Fail          | Pass  | Pass  | Fail  | *    | Fail  | Pass  | Pass  | **    | **    | Fail  | Fail | *    |  |
|                                    | C2             | **            | **    | **    | **    | *    | **    | **    | **    | **    | **    | **    | **   | **   |  |
|                                    | C3             | Pass          | Pass  | Pass  | Pass  | *    | Fail  | Fail  | Pass  | Pass  | **    | Fail  | Fail | *    |  |
| SO2 Corrosion Resistance           |                | Fail          | Fail  | Fail  | Fail  | *    | Fail  | Fail  | Fail  | Fail  | Fail  | Fail  | *    | *    |  |
| B117 Salt Fog Corrosion Resistance |                | Pass          | Pass  | Pass  | Pass  | *    | Pass  | Pass  | Fail  | Fail  | Fail  | Fail  | *    | *    |  |
| High-Temperature Resistance        |                |               |       |       |       |      |       |       |       |       |       |       |      |      |  |

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |                | Control 1       | Control 3 | Control 1 | Control 3   | Control 1                     | Control 3                 | Control 1              | Control 3                 |
| Fluid Resistance | Control 1      | Pass            | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |
| Fluid Resistance | Control 3      | Pass            | Pass      | Fail      | Pass        | Pass                          | Fail                      | Pass                   | Pass                      |

\*Not Required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

### 5.3.2. Dimetcote 9HS Zinc Rich Primer with Ameron PSX 700

Table 33. CS6 Summary

Primer **Dimetcote 9HS Zinc Rich Primer**  
 Topcoat **Ameron PSX 700 Siloxane Topcoat**

| Screening Test Requirements | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |
|-----------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| Ease of Application         | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | Fail    | *      | *      |
| Surface Appearance          | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | Fail    | *      | *      |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | *       | *      | *      |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *       | *     | *       | *       | Fail    | *       | *      | *      |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | Fail    | Fail    | Fail    | Fail    |

| Common Test Requirements      | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |
|-------------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| Removability                  | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | Pass   |
| Accelerated Weathering        | Pass          | Fail  | Pass  | Pass  | *    | *       | *     | *       | *       | Pass    | -       | *      | *      |
| Filiform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| X-Cut Adhesion                | Fail          | Fail  | Fail  | Fail  | *    | *       | *     | Pass    | Fail    | Fail    | Fail    | Fail   | *      |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Fail | *       | *     | *       | *       | *       | *       | *      | *      |
| Accelerated Storage Stability | Fail          | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

| Reparability | Procedure A |           | Procedure B |           | Procedure C |
|--------------|-------------|-----------|-------------|-----------|-------------|
|              | Control 1   | Control 2 | Control 3   | Control 3 | Control 3   |
| Reparability | *           | Pass      | Fail        | Fail      | Pass        |

| Extended Test Requirements         | Compared with | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |
|------------------------------------|---------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                                    |               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| 18-Month Marine Environment Test   |               |               |       |       |       |      |         |       |         |         |         |         |        |        |
| Cyclic Corrosion Resistance        | C1            | Pass          | Fail  | Pass  | Pass  | *    | Fail    | Pass  | Pass    | **      | Pass    | Pass    | Fail   | *      |
|                                    | C2            | **            | **    | **    | **    | *    | **      | **    | **      | **      | **      | **      | **     | **     |
|                                    | C3            | Pass          | Fail  | Pass  | Pass  | *    | Pass    | Fail  | Pass    | Pass    | Pass    | Pass    | Fail   | *      |
| SO2 Corrosion Resistance           |               | Fail          | Pass  | Pass  | Fail  | *    | Fail    | Fail  | Pass    | Fail    | Fail    | Fail    | *      | *      |
| B117 Salt Fog Corrosion Resistance |               | Fail          | Pass  | Fail  | **    | *    | **      | **    | **      | Pass    | Pass    | Fail    | *      | *      |
| High-Temperature Resistance        |               |               |       |       |       |      |         |       |         |         |         |         |        |        |

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

| Fluid Resistance | Control 1 | Control 3 | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|-----------|-----------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |           |           | Control 1      | Control 3       | Pass      | Fail      | Fail        | Fail                          | Fail                      | Pass                   | Fail                      |
| Control 3        | Control 3 | Control 3 | Pass           | Pass            | Pass      | Pass      | Fail        | Pass                          | Pass                      | Pass                   |                           |

\*Not Required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

### 5.3.3. Devoe 304H with Ameron PSX 700

**Table 34. CS7 Summary**

Primer **Devoe 304H**  
 Topcoat **Ameron PSX 700 Siloxane Topcoat**

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | *     | *    | *    |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | *     | *    | *    |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | Pass    | Pass    | Fail    | Fail    |

| Common Test Requirements      | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Removability                  | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | Pass |
| Accelerated Weathering        | Fail          | Fail  | Fail  | Fail  | *    | *     | *     | *     | *     | Pass  | -     | *    | *    |
| Fillform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| X-Cut Adhesion                | Fail          | Fail  | Fail  | Fail  | *    | *     | *     | Fail  | Fail  | Pass  | Fail  | Fail | *    |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Fail | *     | *     | *     | *     | *     | *     | *    | *    |
| Accelerated Storage Stability | Fail          | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |

| Reparability | Procedure A | Procedure B |           |           | Procedure C |
|--------------|-------------|-------------|-----------|-----------|-------------|
|              |             | Control 1   | Control 2 | Control 3 |             |
| Reparability | *           | Pass        | Fail      | Fail      | Fail        |

| Extended Test Requirements         | Compared with | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|------------------------------------|---------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                                    |               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| 18-Month Marine Environment Test   |               |               |       |       |       |      |       |       |       |       |       |       |      |      |
| Cyclic Corrosion Resistance        | C1            | Fail          | Fail  | **    | **    | *    | **    | **    | Pass  | **    | Pass  | Fail  | Fail | *    |
|                                    | C2            | **            | **    | **    | **    | *    | **    | **    | **    | **    | **    | **    | **   | **   |
|                                    | C3            | Fail          | Fail  | **    | **    | *    | **    | **    | Pass  | Pass  | Pass  | Pass  | Fail | *    |
| SO2 Corrosion Resistance           |               | Fail          | Fail  | Pass  | Fail  | *    | Fail  | Fail  | Pass  | Fail  | Pass  | Pass  | *    | *    |
| B117 Salt Fog Corrosion Resistance |               | Fail          | Fail  | Fail  | Fail  | *    | Fail  | Fail  | Fail  | Fail  | Fail  | Fail  | *    | *    |
| High-Temperature Resistance        |               |               |       |       |       |      |       |       |       |       |       |       |      |      |

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |                | Control 1       | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |
| Control 3        | Fail           | Pass            | Fail      | Pass      | Fail        | Fail                          | Pass                      | Fail                   |                           |

\*Not required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

## 5.4. Powder Coatings

### 5.4.1. Morton 13-7004 Corvel Zinc Rich Primer with Morton 30-1007 Corvel Clean White U 1578-1

Table 35. CS8 Summary

Primer **Morton 13-7004 Corvel Zinc Rich Primer**  
 Topcoat **Morton 30-1007 Corvel Clean White U 1578-1**

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | *     | *    | *    |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | *       | *       | *       | *       |

| Common Test Requirements      | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Removability                  | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | Pass |
| Accelerated Weathering        | Pass          | Pass  | Pass  | Pass  | *    | *     | *     | *     | *     | Pass  | -     | *    | *    |
| Filiform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| X-Cut Adhesion                | Pass          | Pass  | Pass  | Pass  | *    | *     | *     | Pass  | Pass  | Pass  | Pass  | Pass | *    |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Pass | *     | *     | *     | *     | *     | *     | *    | *    |
| Accelerated Storage Stability | Fail          | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |

| Reparability | Procedure A |           | Procedure B |           | Procedure C |
|--------------|-------------|-----------|-------------|-----------|-------------|
|              | Control 1   | Control 2 | Control 3   | Control 3 | Control 3   |
| Reparability | *           | Pass      | *           | Fail      | Fail        |

| Extended Test Requirements         | Compared with | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|------------------------------------|---------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                                    |               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| 18-Month Marine Environment Test   |               |               |       |       |       |      |       |       |       |       |       |       |      |      |
| Cyclic Corrosion Resistance        | C1            | Fail          | Fail  | Pass  | Fail  | *    | Fail  | Pass  | Pass  | **    | Pass  | Fail  | Fail | *    |
|                                    | C2            | **            | **    | **    | **    | *    | **    | **    | **    | **    | **    | **    | **   | **   |
|                                    | C3            | Pass          | Pass  | Pass  | Pass  | *    | Fail  | Pass  | Pass  | Pass  | Pass  | Fail  | Fail | *    |
| SO2 Corrosion Resistance           |               | Pass          | Pass  | Fail  | Pass  | *    | Fail  | Pass  | Pass  | Pass  | Pass  | Fail  | *    | *    |
| B117 Salt Fog Corrosion Resistance |               | Fail          | Pass  | Fail  | Fail  | *    | Pass  | Fail  | Fail  | Fail  | Fail  | Fail  | *    | *    |
| High-Temperature Resistance        |               |               |       |       |       |      |       |       |       |       |       |       |      |      |

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

| Fluid Resistance | Control 1        | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|------------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  | Fluid Resistance | Control 3       | Pass      | Fail      | Pass        | Fail                          | Fail                      | Fail                   | Fail                      |

\*Not required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

### 5.4.2. DuPont ELH503S5 Gray Morning with DuPont PFW510S9

**Table 36. CS9 Summary**

Primer **DuPont ELH503S5 Gray Morning**  
 Topcoat **DuPont PFW510S9 Sky White**

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | *     | *    | *    |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | *       | *       | *       | *       |

| Common Test Requirements      | Al-1a        | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
|-------------------------------|--------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                               | Removability | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| Accelerated Weathering        | Pass         | Pass  | Pass  | Pass  | *    | *     | *     | *     | *     | Pass  | -     | *    | *    |
| Filiform Corrosion Resistance | Pass         | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| X-Cut Adhesion                | Pass         | Pass  | Pass  | Pass  | *    | *     | *     | Pass  | Pass  | Pass  | Pass  | Pass | *    |
| Mandrel Bend Flexibility      | *            | *     | *     | *     | Fail | *     | *     | *     | *     | *     | *     | *    | *    |
| Accelerated Storage Stability | Fail         | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |

| Reparability | Procedure A | Procedure B |           | Procedure C |
|--------------|-------------|-------------|-----------|-------------|
|              |             | Control 1   | Control 2 |             |
| Reparability | *           | Pass        | *         | Pass        |

| Extended Test Requirements         | Compared with | Al-1a                            | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
|------------------------------------|---------------|----------------------------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                                    |               | 18-Month Marine Environment Test |       |       |       |      |       |       |       |       |       |       |      |      |
| Cyclic Corrosion Resistance        | C1            | Pass                             | Pass  | Pass  | Pass  | *    | Pass  | Pass  | Pass  | **    | Pass  | Fail  | Pass | *    |
|                                    | C2            | **                               | **    | **    | **    | *    | **    | **    | **    | **    | **    | **    | **   | **   |
|                                    | C3            | Pass                             | Pass  | Pass  | Pass  | *    | Pass  | Pass  | Pass  | Pass  | Pass  | Fail  | Pass | *    |
| SO2 Corrosion Resistance           |               | Pass                             | Pass  | Fail  | Pass  | *    | Pass  | Pass  | Pass  | Pass  | Pass  | Pass  | *    | *    |
| B117 Salt Fog Corrosion Resistance |               | Pass                             | Pass  | Pass  | Pass  | *    | Pass  | Fail  | Fail  | Fail  | Fail  | Fail  | *    | *    |
| High-Temperature Resistance        |               |                                  |       |       |       |      |       |       |       |       |       |       |      |      |

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |      |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|------|
|                  |                | Control 1       | Pass      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      | Fail |
|                  |                | Control 3       | Pass      | Pass      | Pass        |                               | Pass                      | Fail                   | Pass                      | Pass |

\*Not required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

## 5.5. Waterborne Coatings

### 5.5.1. Deft 44-GY-16 with Deft 44-W-7 and Defthane Zero VOC Topcoat

Table 37. CS10 Summary

Primer **Deft 44-GY-16 Zinc Rich Primer/Deft 44-W-7 Intermediate Primer**  
 Topcoat **Defthane Zero VOC Topcoat**

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | *     | *    | *    |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | *     | *    | *    |

  

| Pot Life (Viscosity) | Primer  |         | Intermediate Primer |         | Topcoat |         |
|----------------------|---------|---------|---------------------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1             | Batch 2 | Batch 1 | Batch 2 |
| Pot Life (Viscosity) | Fail    | *       | Pass                | *       | Pass    | *       |

  

| Common Test Requirements      | Al-1a        | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
|-------------------------------|--------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                               | Removability | *     | *     | *     | *    | *     | *     | *     | *     | *     | Pass  | -    | *    |
| Accelerated Weathering        | Pass         | Pass  | Pass  | Pass  | *    | *     | *     | *     | *     | Pass  | *     | *    | *    |
| Filiform Corrosion Resistance | Pass         | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| X-Cut Adhesion                | Pass         | Fail  | Fail  | Fail  | *    | *     | *     | Pass  | Fail  | Pass  | Pass  | Fail | *    |
| Mandel Bend Flexibility       | *            | *     | *     | *     | Pass | *     | *     | *     | *     | *     | *     | *    | *    |
| Accelerated Storage Stability | Fail         | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |

  

| Reparability | Procedure A | Procedure B |           |           | Procedure C |
|--------------|-------------|-------------|-----------|-----------|-------------|
|              | Control 1   | Control 2   | Control 3 | Control 3 | Control 3   |
| Reparability | *           | Pass        | *         | Pass      | Pass        |

  

| Extended Test Requirements         | Compared with | Al-1a                            | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
|------------------------------------|---------------|----------------------------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                                    |               | 18-Month Marine Environment Test |       |       |       |      |       |       |       |       |       |       |      |      |
| Cyclic Corrosion Resistance        | C1            | Pass                             | Pass  | Pass  | Pass  | *    | Fail  | Pass  | Pass  | **    | Pass  | Fail  | Fail | *    |
|                                    | C2            | **                               | **    | **    | **    | *    | **    | **    | **    | **    | **    | **    | **   | **   |
|                                    | C3            | Pass                             | Pass  | Pass  | Pass  | Pass | Fail  | Pass  | Pass  | Pass  | Pass  | Pass  | Fail | *    |
| SO2 Corrosion Resistance           |               | Pass                             | Pass  | Pass  | Pass  | *    | Fail  | Fail  | Pass  | Fail  | Pass  | Fail  | *    | *    |
| B117 Salt Fog Corrosion Resistance |               | Pass                             | Pass  | Pass  | Fail  | *    | Fail  | Fail  | Fail  | Fail  |       | Fail  | *    | *    |
| High-Temperature Resistance        |               |                                  |       |       |       |      |       |       |       |       |       |       |      |      |

  

| Accelerated Weathering | 1000 hrs               | 1500 hrs |
|------------------------|------------------------|----------|
|                        | Accelerated Weathering | Pass     |

  

| Fluid Resistance | Compared with:   | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|------------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  | Fluid Resistance | Control 1       | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |
|                  | Control 3        | Fail            | Pass      | Pass      | Pass        | Pass                          | Pass                      | Pass                   | Pass                      |

\*Not required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

## 5.5.2. Aqua-Poxy 912 with Defthane Zero VOC Topcoat

Table 38. CS11 Summary

Primer **Aqua-Poxy 912**  
 Topcoat **Defthane Zero VOC Topcoat**

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | Pass  | *    | *    |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | Fail  | Fail  | *    | *    |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | *     | *    | *    |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | *     | *    | *    |

| Pot Life (Viscosity) | Primer  |         | Topcoat |         |
|----------------------|---------|---------|---------|---------|
|                      | Batch 1 | Batch 2 | Batch 1 | Batch 2 |
|                      | Pass    | *       | Pass    | *       |

| Common Test Requirements      | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|-------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| Removability                  | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | Pass |
| Accelerated Weathering        | Pass          | Pass  | Pass  | Pass  | *    | *     | *     | *     | *     | Pass  | -     | *    | *    |
| Filiform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    |
| X-Cut Adhesion                | Pass          | Pass  | Fail  | Pass  | *    | *     | *     | Pass  | Pass  | Pass  | Pass  | Pass | *    |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Pass | *     | *     | *     | *     | *     | *     | *    | *    |
| Accelerated Storage Stability | Fail          | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    |

| Reparability | Procedure A | Procedure B |           | Procedure C |
|--------------|-------------|-------------|-----------|-------------|
|              |             | Control 1   | Control 2 | Control 3   |
|              | *           | Pass        | *         | Pass        |

| Extended Test Requirements         | Compared with | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |
|------------------------------------|---------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|
|                                    |               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |
| 18-Month Marine Environment Test   |               |               |       |       |       |      |       |       |       |       |       |       |      |      |
| Cyclic Corrosion Resistance        | C1            | Pass          | Pass  | Pass  | Pass  | *    | Pass  | Pass  | Pass  | **    | Pass  | Fail  | Pass | *    |
|                                    | C2            | **            | **    | **    | **    | *    | **    | **    | **    | **    | **    | **    | **   | **   |
|                                    | C3            | Pass          | Pass  | Pass  | Pass  | *    | Pass  | Pass  | Pass  | Pass  | Pass  | Pass  | Pass | *    |
| SO2 Corrosion Resistance           |               | Pass          | Fail  | Fail  | Pass  | *    | Fail  | Fail  | Pass  | Fail  | Pass  | Fail  | *    | *    |
| B117 Salt Fog Corrosion Resistance |               | **            | Fail  | Fail  | Pass  | *    | Pass  | Fail  | Fail  | Fail  | Fail  | Fail  | *    | *    |
| High-Temperature Resistance        |               |               |       |       |       |      |       |       |       |       |       |       |      |      |

| Accelerated Weathering | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
|                        | Pass     | Pass     |

| Fluid Resistance | Compared with: | Distilled Water | Fuel JP-5 | Fuel JP-8 | Diesel Fuel | Hydraulic Fluid (MIL-H-83282) | Hydraulic Fluid (SKYDROL) | Lube Oil (MIL-L-23699) | Solvent (PD-680, Type II) |
|------------------|----------------|-----------------|-----------|-----------|-------------|-------------------------------|---------------------------|------------------------|---------------------------|
|                  |                | Control 1       | Fail      | Fail      | Fail        | Fail                          | Fail                      | Fail                   | Fail                      |
| Control 3        | Fail           | Pass            | Pass      | Fail      | Pass        | Fail                          | Fail                      | Fail                   |                           |

\*Not required to be tested

\*\*Not Tested

-Coupons not tested due to overlapping test schedules

## 5.6. Control Coatings

### 5.6.1. Army: MIL-P-53022B, Type II with MIL-C-46168D

Table 39. C1 Summary

Primer MIL-P- 53022B, Type II  
Topcoat MIL-C-46168D

| Screening Test Requirements | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |  |
|-----------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|--|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |  |
| Ease of Application         | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Surface Appearance          | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Pot Life (Viscosity)        | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *       | *     | *       | *       | Pass    | *       | *      | *      |  |

| Common Test Requirements      | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |  |
|-------------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|--|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |  |
| Removability                  | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | Pass   |  |
| Accelerated Weathering        | Pass          | Pass  | Pass  | Pass  | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Filiform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| X-Cut Adhesion                | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Fail | *       | *     | *       | *       | *       | *       | *      | *      |  |
| Accelerated Storage Stability | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |

|              | Procedure A |           | Procedure B |   | Procedure C |
|--------------|-------------|-----------|-------------|---|-------------|
|              | Control 1   | Control 2 | Control 3   |   |             |
| Reparability | Fail        | *         | *           | * | *           |

| Extended Test Requirements         | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |  |
|------------------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|--|
|                                    | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al - 3a | Al-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |  |
| 18-Month Marine Environment Test   |               |       |       |       |      |         |       |         |         |         |         |        |        |  |
| Cyclic Corrosion Resistance        | -             | -     | -     | -     | -    | -       | -     | -       | -       | -       | -       | -      | -      |  |
| SO2 Corrosion Resistance           | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |  |
| B117 Salt Fog Corrosion Resistance | *             | *     | *     | *     | *    | *       | *     | *       | Fail    | *       | *       | *      | *      |  |
| Fluid Resistance                   | -             | -     | -     | -     | -    | -       | -     | -       | -       | -       | -       | -      | -      |  |
| High-Temperature Resistance        |               |       |       |       |      |         |       |         |         |         |         |        |        |  |

|                        | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
| Accelerated Weathering | Fail     | Fail     |

\*Not required to be tested

-Results used to determine the acceptance of alternatives

5.6.2. NASA: Devoc CATHACOAT 304K with DEVRAN 201 and DEVTHANE 369

Table 40. C2 Summary

Primer CATHACOAT 304 K / DEVRAN 201  
 Topcoat Devoc Aliphatic Urethane DEVTHANE 369

| Screening Test Requirements | Test Specimen |       |       |       |      |         |       |         |         |         |         |        |        |
|-----------------------------|---------------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
|                             | AI-1a         | AI-1b | AI-1c | AI-1d | AI-2 | AI - 3a | AI-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
| Ease of Application         | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Surface Appearance          | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Pot Life (Viscosity)        | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

| Common Test Requirements      | AI-1a | AI-1b | AI-1c | AI-1d | AI-2 | AI - 3a | AI-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|-------------------------------|-------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
| Removability                  | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | Pass   |
| Accelerated Weathering        | *     | *     | *     | *     | *    | *       | *     | *       | *       | Pass    | Pass    | *      | *      |
| Filiform Corrosion Resistance | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| X-Cut Adhesion                | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| Mandrel Bend Flexibility      | *     | *     | *     | *     | Fail | *       | *     | Fail    | *       | *       | *       | *      | *      |
| Accelerated Storage Stability | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |

|  | Procedure A  | Control 1 | Procedure B Control 2 | Control 3 | Procedure C |
|--|--------------|-----------|-----------------------|-----------|-------------|
|  | Reparability | Pass      | *                     | *         | *           |

| Extended Test Requirements         | AI-1a | AI-1b | AI-1c | AI-1d | AI-2 | AI - 3a | AI-3b | St - 1a | St - 1b | St - 2a | St - 2b | St - 3 | St - 6 |
|------------------------------------|-------|-------|-------|-------|------|---------|-------|---------|---------|---------|---------|--------|--------|
| 18-Month Marine Environment Test   |       |       |       |       |      |         |       |         |         |         |         |        |        |
| Cyclic Corrosion Resistance        | -     | -     | -     | -     | -    | -       | -     | -       | -       | -       | -       | -      | -      |
| SO2 Corrosion Resistance           | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| B117 Salt Fog Corrosion Resistance | *     | *     | *     | *     | *    | *       | *     | Fail    | Fail    | Fail    | Fail    | *      | *      |
| Fluid Resistance                   | *     | *     | *     | *     | *    | *       | *     | *       | *       | *       | *       | *      | *      |
| High-Temperature Resistance        |       |       |       |       |      |         |       |         |         |         |         |        |        |

|                        | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
| Accelerated Weathering | Pass     | Pass     |

\*Not required to be tested

-Results used to determine the acceptance of alternatives

5.6.3. Air Force, Navy, USMC: MIL-P-53022B, Type II with MIL-PRF-85285C, Type II

Table 41. C3 Summary

Primer MIL-P-53022B, Type II  
 Topcoat MIL-PRF-85285C Type II

| Screening Test Requirements | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |   |
|-----------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|---|
|                             | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |   |
| Ease of Application         | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | * |
| Surface Appearance          | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | * |
| Pot Life (Viscosity)        | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | * |
| Dry-to-Touch (Sanding)      | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | * |
| Cure Time (MEK Solvent Rub) | *             | *     | *     | *     | *    | *     | *     | *     | *     | Pass  | *     | *    | *    | * |

| Common Test Requirements      | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |      |
|-------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|------|
|                               | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |      |
| Removability                  | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | Pass |
| Accelerated Weathering        | Pass          | Pass  | Pass  | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    | *    |
| Filiform Corrosion Resistance | Pass          | *     | *     | Pass  | *    | *     | *     | *     | *     | *     | *     | *    | *    | *    |
| X-Cut Adhesion                | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | *    |
| Mandrel Bend Flexibility      | *             | *     | *     | *     | Pass | *     | *     | Pass  | *     | *     | *     | *    | *    | *    |
| Accelerated Storage Stability | *             | *     | *     | *     | *    | *     | *     | *     | *     | *     | *     | *    | *    | *    |

|              | Procedure A |           | Procedure B |           | Procedure C |           |
|--------------|-------------|-----------|-------------|-----------|-------------|-----------|
|              | Control 1   | Control 2 | Control 3   | Control 3 | Control 3   | Control 3 |
| Reparability | Pass        | *         | *           | *         | *           | *         |

| Extended Test Requirements         | Test Specimen |       |       |       |      |       |       |       |       |       |       |      |      |   |
|------------------------------------|---------------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|------|---|
|                                    | Al-1a         | Al-1b | Al-1c | Al-1d | Al-2 | Al-3a | Al-3b | St-1a | St-1b | St-2a | St-2b | St-3 | St-6 |   |
| 18-Month Marine Environment Test   |               |       |       |       |      |       |       |       |       |       |       |      |      |   |
| Cyclic Corrosion Resistance        | -             | -     | -     | -     | -    | -     | -     | -     | -     | -     | -     | -    | -    | - |
| SO2 Corrosion Resistance           | Pass          | Fail  | Fail  | Pass  | *    | Fail  | Pass  | Pass  | Pass  | Pass  | Fail  | *    | *    |   |
| B117 Salt Fog Corrosion Resistance | Pass          | Pass  | Fail  | Pass  | *    | Pass  | Fail  | Fail  | Fail  | Fail  | -     | *    | *    |   |
| Fluid Resistance                   | -             | -     | -     | -     | -    | -     | -     | -     | -     | -     | -     | -    | -    | - |
| High-Temperature Resistance        |               |       |       |       |      |       |       |       |       |       |       |      |      |   |

|                        | 1000 hrs | 1500 hrs |
|------------------------|----------|----------|
| Accelerated Weathering | Pass     | Pass     |

\*Not required to be tested

-Results used to determine the acceptance of alternatives

## 6. SUMMARY AND RECOMMENDATIONS

A quick reference table was formed to give a very general overview of the performance of the alternative coating systems. In tests where multiple substrates were tested, the alternative coating system received a "Pass" if it performed well on more than 50% of the substrate tested. For more in depth information on the performance of a coating system or test please refer to the summary of that particular coating system or to the test description previously enclosed.

The project technical representatives met on June 12-13, 2001 to determine the alternatives that would continue testing in the field evaluations. It was decided by eleven technical representatives from the U.S. AF, U.S. Navy, and NASA that the following coating systems would be evaluated in field testing: Coating system 8, Morton 13-7004 Corvel Zinc Rich Primer with Morton 30-1007 Corvel Clean White U 1578-1; Coating system 9, DuPont ELH503S5 Gray Morning with DuPont PFW510S9 Sky White; Coating system 10, Deft 44-GY-16 Zinc Rich Primer with Deft 44-W-7 Intermediate Primer and Defthane Zero VOC Topcoat; and Coating system 11, Aqua-Poxy 912 with Defthane Zero VOC Topcoat. These coatings systems were selected due to the number of tests each coating passed in comparison with all other coating systems tested, please refer to Table 42, and also due to the ease in which each coating could be implemented. All in attendance at the June 12-13 meeting were in agreement of the field-testing of these coating systems.

These coating systems were applied to pieces of Support Equipment and placed in field environments at the following four locations.

- Cape Canaveral Air Force Station, Florida
- Patrick Air Force Base, Florida
- Naval Air Station Brunswick, Maine
- Naval Station Everett, Washington

The coating systems were evaluated every three months with final evaluations taking place in June 2003. The results of the field evaluations will be documented in a separate field evaluation report, which will be posted on the JG-PP Web site when final. Interim field evaluation reports are available on the JG-PP Web site.

**Table 42. Overall Summary**

|                        |                                     | Coating System      | 1                    | 2                    | 3                                      | 4   | 5              | 6              | 7              | 8                                       | 9                            | 10                         | 11                        | Control 1                 | Control 2                               | Control 3                 |
|------------------------|-------------------------------------|---------------------|----------------------|----------------------|--|---|----------------|----------------|----------------|---|------------------------------|----------------------------|---------------------------|---------------------------|---|---------------------------|
|                        |                                     | Primer              | MIL-P-53022B, Type I | MIL-P-53022B, Type I | Platt Bros. 100% Zinc Metallizing Wire | Platt Bros. Zn/ Alum 85/15 Metallizing Wire | None           | Dimetcote 9HS  | Devoe 304 H    | Morton 13-7004 Corvel Zinc Rich Primer  | DuPont ELH503S5 Gray Morning | Deft 44-GY-16, Deft 44-W-7 | Aqua-Poxy 912             | MIL-P-53022B, Type II     | Devoe CATHAC COAT 304K with DEVTRAN 201 | MIL-P-53022B, Type II     |
|                        |                                     | Topcoat             | 3M Applique          | Fluorogrip, Grade E  | Defthane Zero VOC Topcoat              | Defthane Zero VOC Topcoat                   | Ameron PSX 700 | Ameron PSX 700 | Ameron PSX 700 | Morton 30-1007 Corvel Clean White White | DuPont PFW510S9 Sky White    | Defthane Zero VOC Topcoat  | Defthane Zero VOC Topcoat | MIL-C-46168D              | DEVTHANE 369                            | MIL-PRF-85285C, Type II   |
| <b>JTR Section</b>     | <b>Test</b>                         | <b>Performed By</b> |                      |                      |  |   |                |                |                |   |                              |                            |                           |                           |   |                           |
| <b>Screening Tests</b> |                                     |                     |                      |                      |  |   |                |                |                |   |                              |                            |                           |                           |   |                           |
| 4.1.1                  | Ease of Application                 | CTC                 | Pass                 | Pass                 | Fail                                   | Fail  | Fail           | Fail           | Fail           | Fail                                    | Fail                         | Pass                       | Pass                      | Exempt from Testing       | Exempt from Testing                     | Exempt from Testing       |
| 4.1.2                  | Surface Appearance                  | CTC                 | Pass                 | Fail                 | Fail                                   | Fail  | Fail           | Fail           | Fail           | Fail                                    | Fail                         | Fail                       | Fail                      | Exempt from Testing       | Exempt from Testing                     | Exempt from Testing       |
| 4.1.3                  | Pot Life (Viscosity)                | CTC                 | NA                   | NA                   | NA                                     | NA  | Fail           | Fail           | Fail           | NA                                      | NA                           | Fail                       | Fail                      | Exempt from Testing       | Exempt from Testing                     | Exempt from Testing       |
| 4.1.4                  | Dry-to-Touch                        | CTC                 | NA                   | NA                   | NA                                     | NA  | Pass           | Fail           | Fail           | NA                                      | NA                           | Fail                       | Pass                      | Exempt from Testing       | Exempt from Testing                     | Exempt from Testing       |
| 4.1.5                  | Cure Time (MEK Solvent Rub)         | CTC                 | Pass                 | Pass                 | NA                                     | NA  | Pass           | Fail           | Fail           | Fail                                    | Fail                         | Pass                       | Pass                      | Pass                      | Exempt from Testing                     | Pass                      |
| <b>Common Tests</b>    |                                     |                     |                      |                      |  |   |                |                |                |   |                              |                            |                           |                           |   |                           |
| 4.2.1                  | Removability                        | CTC                 | Pass                 | Pass                 | Pass                                   | Pass  | Pass           | Pass           | Pass           | Pass                                    | Pass                         | Pass                       | Pass                      | Pass                      | Pass                                    | Pass                      |
| 4.2.2                  | Reparability                        | CTC                 | Fail                 | Fail                 | Fail                                   | Fail  | Pass           | Fail           | Fail           | Fail                                    | Pass                         | Pass                       | Pass                      | Fail                      | Pass                                    | Pass                      |
| 4.2.3                  | Accelerated Weathering              | CTIO                | Fail                 | Fail                 | Pass                                   | Pass  | Fail           | Pass           | Fail           | Pass                                    | Pass                         | Pass                       | Pass                      | Pass                      | Pass                                    | Pass                      |
| 4.2.4                  | Filiform Corrosion Resistance       | CTC                 | Pass                 | Pass                 | NA                                     | NA  | Pass           | Pass           | Pass           | Pass                                    | Pass                         | Pass                       | Pass                      | Pass                      | Exempt from Testing                     | Pass                      |
| 4.2.5                  | X-Cut Adhesion by Tape Test         | CTC                 | Fail                 | Pass                 | Pass                                   | Pass  | Fail           | Fail           | Fail           | Pass                                    | Pass                         | Fail                       | Pass                      | Exempt from Testing       | Exempt from Testing                     | Exempt from Testing       |
| 4.2.6                  | Mandrel Bend Flexibility            | CTC                 | Pass                 | Pass                 | Fail                                   | Fail  | Fail           | Fail           | Fail           | Pass                                    | Fail                         | Pass                       | Pass                      | Fail                      | Fail                                    | Pass                      |
| 4.2.7                  | Accelerated Storage Stability       | CTC                 | Pass                 | Pass                 | NA                                     | NA  | Fail           | Fail           | Fail           | Fail                                    | Fail                         | Fail                       | Fail                      | Exempt from Testing       | Exempt from Testing                     | Exempt from Testing       |
| <b>Extended Tests</b>  |                                     |                     |                      |                      |  |   |                |                |                |   |                              |                            |                           |                           |   |                           |
| 4.3.1                  | 18-Month Marine Environment Test    | NASA                | NA                   | NA                   | NA                                     | NA  | NA             | NA             | NA             | NA                                      | NA                           | NA                         | NA                        | NA                        | NA                                      | NA                        |
| 4.3.2                  | Cyclic Corrosion Resistance         | CTIO                | Pass                 | Fail                 | Pass                                   | Pass  | Pass           | Pass           | Fail           | Pass                                    | Pass                         | Pass                       | Pass                      | Results used as reference | Results used as reference               | Results used as reference |
| 4.3.3                  | SO2 Corrosion Resistance            | NAWCAD              | Pass                 | Fail                 | Pass                                   | Pass  | Fail           | Fail           | Fail           | Pass                                    | Pass                         | Pass                       | Fail                      | Exempt from Testing       | Exempt from Testing                     | Pass                      |
| 4.3.4                  | B 117 Salt Fog Corrosion Resistance | CTIO                | Fail                 | Fail                 | Fail                                   | Fail  | Pass           | Fail           | Fail           | Fail                                    | Fail                         | Fail                       | Fail                      | Exempt from Testing       | Exempt from Testing                     | Fail                      |
| 4.3.5                  | Accelerated Weathering              | CTIO                | Fail                 | Fail                 | Pass                                   | Pass  | Pass           | Pass           | Pass           | Pass                                    | Pass                         | Pass                       | Pass                      | Exempt from Testing       | Exempt from Testing                     | Pass                      |
| 4.3.6                  | Fluid Resistance                    | NAWCAD              | Fail                 | Fail                 | Pass                                   | Pass  | Fail           | Pass           | Fail           | Pass                                    | Fail                         | Pass                       | Fail                      | Results used as reference | Exempt from Testing                     | Results used as reference |
| 4.3.7                  | High Temperature Resistance         | NASA                | NA                   | NA                   | NA                                     | NA  | NA             | NA             | NA             | NA                                      | NA                           | NA                         | NA                        | NA                        | NA                                      | NA                        |
|                        | Number of Screening Tests Passed    |                     | 3/3                  | 2/3                  | 0/2                                    | 0/2   | 2/5            | 0/5            | 0/5            | 0/3                                     | 0/3                          | 2/5                        | 3/5                       | 1/1                       | 0/0                                     | 1/1                       |
|                        | Number of Common Tests Passed       |                     | 4/7                  | 5/7                  | 3/5                                    | 3/5   | 3/7            | 3/7            | 2/7            | 5/7                                     | 5/7                          | 5/7                        | 6/7                       | 3/5                       | 3/4                                     | 5/5                       |

(Table 42. continued on next page)

**Table 42. Overall Summary (continued)**

|                                  | Coating System | 1                    | 2                    | 3                                      | 4   | 5              | 6              | 7              | 8                                       | 9                            | 10                         | 11                        | Control 1             | Control 2                            | Control 3               |
|----------------------------------|----------------|----------------------|----------------------|--|---|----------------|----------------|----------------|---|------------------------------|----------------------------|---------------------------|-----------------------|--------------------------------------|-------------------------|
|                                  | <b>Primer</b>  | MIL-P-53022B, Type I | MIL-P-53022B, Type I | Platt Bros. 100% Zinc Metallizing Wire | Platt Bros. Zn/ Alum 85/15 Metallizing Wire | None           | Dimetcote 9HS  | Devoe 304 H    | Morton 13-7004 Corvel Zinc Rich Primer  | DuPont ELH503S5 Gray Morning | Deft 44-GY-16, Deft 44-W-7 | Aqua-Poxy 912             | MIL-P-53022B, Type II | Devoe CATHACOAT 304K with DEVRAN 201 | MIL-P-53022B, Type II   |
|                                  | <b>Topcoat</b> | 3M Applique          | Fluorogrip, Grade E  | Defthane Zero VOC Topcoat              | Defthane Zero VOC Topcoat                   | Ameron PSX 700 | Ameron PSX 700 | Ameron PSX 700 | Morton 30-1007 Corvel Clean White White | DuPont PFW510S9 Sky White    | Defthane Zero VOC Topcoat  | Defthane Zero VOC Topcoat | MIL-C-46168D          | DEVTHANE 369                         | MIL-PRF-85285C, Type II |
| Number of Extended Tests Passed  |                | 2/5                  | 0/5                  | 4/5                                    | 4/5   | 3/5            | 3/5            | 1/5            | 4/5                                     | 3/5                          | 4/5                        | 2/5                       | 0/0                   | 0/0                                  | 0/0                     |
| Percentage of Total Tests Passed |                | 60%                  | 47%                  | 58%                                    | 58%   | 47%            | 35%            | 18%            | 60%                                     | 53%                          | 65%                        | 65%                       | 67%                   | 75%                                  | 100%                    |

## 7. REFERENCED DOCUMENTS

**Table 43. Referenced Documents**

| <b>Reference Document</b> | <b>Title</b>  | <b>Date</b>                      | <b>Applicable Section of Referenced Document</b> | <b>JTP Test</b>                          | <b>JTR Section</b> |
|---------------------------|---|----------------------------------|--|--|--------------------|
| ASTM D 523-89 (1999)      | Standard Test Method for Specular Gloss   | March 31, 1989; Reaffirmed 1999  | All  | Surface Appearance                       | 4.1.2              |
|                           |   |                                  |  | Removability                             | 4.2.1              |
|                           |   |                                  |  | Reparability                             | 4.2.2              |
|                           |   |                                  |  | Accelerated Weathering (Common Test)     | 4.2.3              |
|                           |   |                                  |  | Accelerated Weathering (Extended Test)   | 4.3.5              |
| ASTM D 522-93a            | Standard Test Method for Mandrel Bend Test of Attached Organic Coatings                               | September 15, 1993               | Test Method B                                    | Mandrel Bend Flexibility                 | 4.2.6              |
| ASTM D 610-95             | Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces                       | September 15, 1995               | All  | 18-Month Marine Environment Test         | 4.3.1              |
| ASTM D 1200-94 (1999)     | Standard Test Method for Viscosity by Ford Viscosity Cup  | August 15, 1994; Reaffirmed 1999 | All  | Pot Life                                 | 4.1.3              |
| ASTM D 1654-92            | Standard Test Method of Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments | October 15, 1992                 | Test Procedure A                                 | SO <sub>2</sub> Corrosion Resistance     | 4.3.3              |
|                           |   |                                  |  | B-117 Salt Fog Corrosion Resistance Test | 4.3.4              |
| ASTM D 2197-98            | Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion                              | 1968; Revised 1998               | All  | High-Temperature Resistance              | 4.3.7              |

(Table 43. continued on next page)

**Table 43. Referenced Documents (continued)**

| <b>Reference Document</b> | <b>Title</b>   | <b>Date</b>                        | <b>Applicable Section of Referenced Document</b> | <b>JTP Test</b>               | <b>JTR Section</b> |
|---------------------------|--|------------------------------------|--|-------------------------------|--------------------|
| ASTM D 2244-93            | Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates               | September 15, 1993                 | All  | Surface Appearance            | 4.1.2              |
|                           |  |                                    |  | Removability                  | 4.2.1              |
|                           |  |                                    |  | Reparability                  | 4.2.2              |
|                           |  |                                    |  | Accelerated Weathering        | 4.2.3, 4.3.5       |
| ASTM D 2803-93            | Standard Guide for Testing Filiform Corrosion Resistance of Organic Coatings on Metal                                  | May 15, 1993                       | Test Procedure C                                 | Filiform Corrosion Resistance | 4.2.4              |
| ASTM D 3359-97            | Standard Test Method for Measuring Adhesion by Tape Test   | December 10, 1995; Reapproved 1997 | Test Method A                                    | X-Cut Adhesion By Tape Test   | 4.2.5              |
| ASTM D 3363-00            | Standard Test Method for Film Hardness by Pencil Test  | November 15, 1992                  | All  | Fluid Resistance              | 4.3.6              |
| ASTM D 4541-95e1          | Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers                                 | February 15, 1995                  | All  | High-temperature Resistance   | 4.3.7              |
| ASTM D 4752-98            | Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub       | 1998                               | All  | Cure Time                     | 4.1.5              |
| ASTM D 5139-90 (1996)     | Standard Specification for Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants | Approved 1990; Reaffirmed 1996     | All  | Panel Preparation             | 2                  |

(Table 43. continued on next page)

**Table 43. Referenced Documents (continued)**

| <b>Reference Document</b>   | <b>Title</b>   | <b>Date</b>  | <b>Applicable Section of Referenced Document</b> | <b>JTP Test</b>                      | <b>JTR Section</b>  |
|---|--|--|--|--------------------------------------|---|
| ASTM F 22-65 (1998)   | Standard Test Method for Hydrophobic Surface Films by the Water-Break Test   | Reapproved 1998  | All  | Panel Preparation                    | Table 2-1 Coupon (test Specimen) codes and substrate descriptions |
| ASTM G 26-96  | Standard Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials | January 1, 1996  | Test Method 1                                    | Removability                         | 4.2.1   |
|   |  |  |  | Accelerated Weathering               | 4.2.3, 4.3.5  |
| ASTM G 85-98  | Standard Practice for Modified Salt Spray (Fog) Testing  | April 10, 1998   | Annex A4   | SO <sub>2</sub> Corrosion Resistance | 4.3.3   |
| FED-STD-595B  | Colors used in Government Procurement  | December 15, 1989; Change Notice 1, dated January 11, 1994 | All  | Surface Appearance                   | 4.1.2   |
| GM 9540P  | Standard Practice for Modified Salt Spray (Fog) Testing  | December 1997  | All  | Cyclic Corrosion Resistance          | 4.3.2   |
| JTP Environmental Security Technology Certification Program (ESTCP) | Validation of Alternatives to Topcoats Containing Volatile Organic Compounds (VOCs) for Military Aerospace Applications                | October 30, 1998 (Draft)                                   | All  | Reference Data                       | 1   |

(Table 43. continued on next page)

**Table 43. Referenced Documents (continued)**

| <b>Reference Document</b>                   | <b>Title</b>  | <b>Date</b>   | <b>Applicable Section of Referenced Document</b> | <b>JTP Test</b>               | <b>JTR Section</b>  |
|---|---|---|--|-------------------------------|---|
| JTP LM-P-1-1                                | Validation of Alternatives to High VOC Topcoats and Primers   | June 16, 1997 (Rev. November 19, 1998)                                  | All  | Reference Data                | 1   |
| JTP MD-P-1-1                                | Validation of Alternatives to Chromate-Containing Primer Coatings for Aircraft Exterior Mold Line Skins   | December 23, 1997   | All  | Reference Data                | 1   |
| JTP TI-P-1-1<br>MIL-A-8625F<br>MIL-P-53022B | Alternatives to High VOC Primers and Topcoats containing: MEK, Toluene, and Xylene Anodic Coatings for Aluminum and Aluminum Alloys Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free | June 20, 1996 (Rev. May 11, 1998)<br>September 10, 1993<br>June 1, 1988 | All<br>Type II – Sulfuric Acid Anodize<br>All    | Reference Data                | 1   |
|   |   |   |  | Panel Preparation             | Table 2-1 Coupon (Test Specimen) Codes and Substrate Descriptions |
|   |   |   |  | Cure Time                     | 4.1.5   |
|   |   |   |  | Removability                  | 4.2.1   |
|   |   |   |  | Reparability                  | 4.2.2   |
|   |   |   |  | Accelerated Weathering        | 4.2.3, 4.3.5  |
|   |   |   |  | Filiform Corrosion Resistance | 4.2.4   |
|   |   |   |  | Mandrel Bend Flexibility      | 4.2.6   |
|   |   |   |  | Cyclic Corrosion Resistance   | 4.3.2   |
| SO2 Corrosion Resistance                    | 4.3.3   |   |  |                               |   |

*(Table 43. continued on next page)*

**Table 43. Referenced Documents (continued)**

| <b>Reference Document</b> | <b>Title</b>                       | <b>Date</b>    | <b>Applicable Section of Referenced Document</b> | <b>JTP Test</b>                    | <b>JTR Section</b> |
|---------------------------|------------------------------------|----------------|--|------------------------------------|--------------------|
| MIL-PRF-85285C            | Coating, Polyurethane, High Solids | April 30, 1997 | All  | B117 Salt Fog Corrosion Resistance | 4.3.4              |
|                           |                                    |                |  | Fluid Resistance                   | 4.3.6              |
|                           |                                    |                |  | Cure Time                          | 4.1.5              |
|                           |                                    |                |  | Removability                       | 4.2.1              |
|                           |                                    |                |  | Reparability                       | 4.2.2              |
|                           |                                    |                |  | Accelerated Weathering             | 4.2.3, 4.3.5       |
|                           |                                    |                |  | Filiform Corrosion Resistance      | 4.2.4              |
|                           |                                    |                |  | Mandrel Bend Flexibility           | 4.2.6              |
|                           |                                    |                |  | Cyclic Corrosion Resistance        | 4.3.2              |
|                           |                                    |                |  | SO2 Corrosion Resistance           | 4.3.3              |
| None                      | Subjective Evaluations             | Not Applicable | Not Applicable                                   | B117 Salt Fog Corrosion Resistance | 4.3.4              |
|                           |                                    |                |  | Fluid Resistance                   | 4.3.6              |

*(Table 43. continued on next page)*

**Table 43. Referenced Documents (continued)**

| <b>Reference Document</b> | <b>Title</b>  | <b>Date</b>    | <b>Applicable Section of Referenced Document</b> | <b>JTP Test</b>  | <b>JTR Section</b>          |
|---------------------------|---|----------------|--|--|-----------------------------|
| SSPC SP-1                 | Steel Structures Painting Manual, Systems and Specifications, Vol. 2, Solvent Cleaning                  | September 1991 | All  | Ease of Application<br>Dry-to-touch<br>Test Coupon preparation | 4.1.1<br>4.1.4<br>Table 2-1 |
| SSPC SP-10                | Steel Structures Painting Manual, Systems and Specifications, Vol. 2, Near-White Blast Cleaning         |                |  |  |                             |
| SSPC SP-11                | Steel Structures Painting Manual, Systems and Specifications, Vol. 2, Power Tool Cleaning to Bare Metal | September 1991 | All  | Ease of Application<br>Dry-to-touch<br>Test Coupon preparation | 4.1.1<br>4.1.4<br>Table 2-1 |

**APPENDIX A**  
**Photographs from Removability Testing**

**APPENDIX B**  
**Photographs from Reparability Testing**

**APPENDIX C**  
**Previous Report on 18-Month Marine Environment Testing (Supplied by NASA)**

**APPENDIX D**  
**Photographs From Cyclic Corrosion Resistance and B117 Salt Fog Corrosion Resistance**  
**Testing (Supplied by CTIO)**