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

Joint Test Protocol
S-98-OC-010

For Validation of New Paint Coating Technologies for Seawater Ballast Tanks

October 2000

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PREFACE

This report was prepared by the Chief of Naval Operations Pollution Prevention Branch on behalf of, and under guidance provided by the Joint Group on Pollution Prevention (JG-PP) through the Joint Pollution Prevention Advisory Board (JPPAB). The structure, format, and depth of the report's technical content were determined by the JPPAB, Government contractors, and other Government technical representatives in response to the specific needs of this project.

Invaluable contributions to the creation of this report were provided by the organizations and groups listed below.

Naval Sea System Command
The Sherwin-Williams Company
Sigma Coatings
Naval Intermediate Maintenance Facility, Pacific Northwest (NAVIMFAC PACNORWEST)
Naval Research Laboratory
Marinetek Laboratory
WIWA Airless Spray Equipment
M. Rosenblatt & Son, Inc.
Corrosion Engineering Services
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1.0 INTRODUCTION

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

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

The focus of JG-PP is on original equipment manufacturer's (OEM 's) design, manufacturing, and re-manufacturing locations, with subsequent technology transfer to the Sustainment Community locations.

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

This Joint Test Protocol (JTP) documents the critical technical and performance requirements identified by project participants that an alternative must satisfy to be qualified for a particular application.

A subsequent Joint Test Report (JTR) will document the data and results of the testing and will be made available as a reference for future pollution prevention efforts by other Department of Defense (DOD) and commercial users to minimize duplication of effort.

For the Ballast Tank Coating Project, volatile organic compounds (VOCs) as found in various coating systems are identified as the target HazMat to be eliminated or reduced. VOCs are currently found in the painting systems for tank coatings, well deck overheads and topside exterior paints coverings, and represent a Class I compliance deficiency due to the severe impacts on the maintenance of Navy ships. The identified application of these paint systems is tank coverings, well deck overheads and topside exterior. The paint systems of concern are applied by brush/roller or via a plural paint spray system. Also, the tested versions of the coating system which will be covered by this JTP are considered to be high solids. The solid content of the subject paints is approximately 98 percent. The substrates are steel plates. Table 1, summarizes the target HazMat, process and material, application, current specifications, affected programs, and candidate parts/substrates.

Table 1.0. High Solids Low VOC Tank Coating Target HazMat Summary

Target HazMat	Current Process/ Material	Applications	Current Specifications	Affected Programs	Candidate Parts/ Substrates
VOCs (Ozone) HAPS – (Solvents and Heavy Metals)	Conventional Wet Spray Coating Brush Coating	Paint System	Mil-PRF-23236	**Navy** SEA 91 PEO MIW PEO EXP PEO SC PEO DD-21 PEO CV PEO SUBs **Army** TBD **Coast Guard** TBD **MSC** TBD **MARAD** TBD All Navy Ships, Larger Army Boats, Coast Guard Ships, and possibly MARAD and MSC	Paints will cover broad spectrum of areas including but not limited to Tanks, Well-Deck Overheads, and Topside Exterior Surfaces **REVISE: TYPE OF STEEL IS NOT IMPORTANT. PERTINENT ASPECTS INCLUDE SURFACE PROFILE, CLEANLINESS, TYPE OF BLASTING, SURFACE PREPARATION REQUIREMENTS.**

2.0 ENGINEERING AND TESTING REQUIREMENTS

All potential alternatives must meet the following performance requirements in order to qualify as a valid replacement for Paint Coating Systems, Fuel and Salt Water Ballast Tanks MIL-P-23236B.

A joint group led by JG-PP and consisting of technical representatives from NAVSEA 05M, the affected DOD Program Managers, representatives of the Sustainment Community, and other government technical representatives identified engineering, performance, and operational impact (supportability) requirements. These requirements were identified for Paint Coating System, Fuel and Salt Water Ballast Tanks which will comply with the latest national ambient air quality standards (NAAQS) revisions for O_3 - mainly by reduction of the VOCs. This group then reached consensus on tests with procedures, methodologies, and acceptance criteria to qualify alternatives against the critical technical and performance requirements.

Tests should be conducted in a manner that will eliminate duplication and maximize use of each test specimen. For example, where possible, more than one test should be performed on each specimen. The number and type of tests that can be run on any one specimen will be determined by the destructiveness of the test.

Tests in this JTP may involve the use of HazMats, operations, and equipment. This JTP does not address all safety issues associated with its use. It is the responsibility of each user of this JTP to establish appropriate environmental safety and health practices and to determine the applicability of regulatory limitations prior to its use.

The engineering requirements for which the tests in this JTP were chosen are the following:

- MIL-PRF-23236B and MIL-PRF-23236C (Proposed) – The ability of the coating(s) to resist salt water immersion (long term test) and the ability to demonstrate an average 70% edge coverage (short term test).

Table 2.0 provides the coatings classifications. Table 3.0 lists all engineering and test requirements identified by the JG-PP participants for validating alternative for High Solid Tank Coating. Table 4.0 lists the references used in this JTP, and Table 5.0 lists the common tests.

Note: Common tests are required by all affected programs while Extended tests are required by at least one of the programs, but not all. This listing includes acceptance criteria and the references, if any, used for developing the tests.

Table 2.0. Coatings Classifications

TYPE	Characteristics
Type I	General Use. May be used in areas where air pollution regulations do not apply
Type III	Limited solvent content for use where for use where air pollution regulations apply
Type IV	A coating system with a solvent content of 340 grams per liter of paint (2.8 pounds of solvent per gallon of paint) or 290 grams of solvent per liter of paint (2.4 pounds per gallon) for use where air pollution regulations apply
Class 1	A coating system where the first coat is a shop primer or pre construction primer
Class 2	A coating system with or without shop primer which will be used exclusively in dedicated seawater ballast tanks. No exposure to fuel , other hydro carbons, or fresh water is permitted.
Grade A	A coating system which is able to be stored, applied and cured at a temperature range of 20 to 50 degrees Fahrenheit (^{O}F)
Grade B	A coating system which is able to be stored, applied and cured at a temperature range of 51 to 100 degrees Fahrenheit (^{O}F)

Table 3.0. Common Test Requirements

Test	JTP Section	Application	Test Specimen	Acceptance Criteria	References
Materials	Table 5.0		COATING SYSTEM SAMPLE	Pigmented, formulated, and manufactured to produce product meeting the requirement of this JTP. Two component, chemically cured epoxy resins converted with amines, contain no crystalline silica, asbestos, lead, chromium or mercury.	
Solvents (Type III)	Table 5.0		Coating System Sample	General use coatings – 340g/L, or where modified.	National Ambient Air Quality Standards or Local Regulations ASTM D 2369
Color	**TABLE 5.0**		Coating System Sample	60-DEGREE SPECULAR GLOSS NOT LESS THAN 30 WITH EXCEPTION OF THE PRIME COAT. SUCCEEDING COATS AND STRIPE COATS SHALL BE OF CONTRASTING COLORS. TOPCOAT SHALL BE WHITE OR A VERY LIGHT PASTEL COLOR.	FED STD 141-4061 ASTM D 1729 ASTM E 308 ASTM D 156 ASTM D 523
Description	Table 5.0		Coating System Sample	At least two full coats as specified by the manufacturer, at a specified MDFT per coat for a total system thickness specified.	Manufactures Instructions
Pot life	3.1		1 L of finished Coating System Sample	Minimum pot life to be as per coating manufacturer's specifications of paint characteristics.	Contractors Instructions
Drying or Curing Time	Table 5.0		Coating System Sample	Not more than 24 hours between coats, ready for service in seven days	Manufactures Instructions FED-STD-141-4061
Flash Point	Table 5.0		Coating System Sample	No flash at lower than 38 C (100 F); preconstruction primers not flash lower than 20 C (68F)	ASTM-D-93

Test	JTP Section	Application	Test Specimen	Acceptance Criteria	References
Application Characteristics	Table 5.0		Coating System Sample	Readily applied by brush and spray, reasonable leveling without sagging at the recommended MDFT.	FED-STD 141-4321.2 FED-STD 141 4331.1 Manufactures Instructions
Immersion Resistance	3.2		150 x 300x 3mm Steel Plates	No pinhole rusting, loss of adhesion between coats of the substrate or blisters larger than 1.5 millimeters (mm) (1/16 inch) in diameter.	Contractors Instructions
Adhesion	3.4		150 x 300x 3mm Steel Plates	Adhesion of the recoated area at least 50 % of the originally applied and immersed coating system	ASTM D 3359
Service Performance	Table 5.0		Coating System Sample	Protection against corrosion with a total of 1% max touch-up for minimum of 3 years	
Condition in Container	Table 5.0		Coating System Sample	Readily broken up with a paddle or mechanical stirring device, not increase more than one third in viscosity, addition of maximum of 5 % solvent (not to exceed VOC limits); increase more than 1/5 in time of dry, nor show and objectionable properties for at least one year	FED-STD-141-3011.2
Toxicity	3.8		Coating System Sample	No adverse effect on the health on the personnel when properly used	Naval Medical Command
Edge Retention	3.9		Coating System Sample, 90 Al alloy section	Coating system maintains 70% coverage over angled edge as compared to DFT of flat surface of the structural aluminum angle section.	MIL-P-23236
Identification Characteristics	Table 5.0			See Table 4.0	

Table 4.0. Reference Documents

Reference Document	Title	Date	JTP Test	JTP Section	Applicable Section(s) of Reference Document
TT-N-95	Naphtha; Aliphatic	Notice of Validation 11/05/91	D 1296	Table 5.0	
TT-T-548	Toluene, Technical	Notice of Cancellation 9/9/97 Replaced by A-A-59107 Toluene, Technical, 9/9/97	D 1296	Table 5.0	
PPP-P-1892	Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of	Notice of Cancellation 11/21/97 No Replacement			
FED-STD-141	Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing	Change No. 1 12/10/93	Brushing Properties Test Method #4321.2 Spraying Properties Test Method # 4331.1	3.6 3.7	
FED-STD-313	Material Safety Data Sheets Preparation and the Submission of	Change No. 1 3/21/00			
D 93	Standard test Methods for Flash point by Pensky – Martens Closed Tester (DoD adopted)	D93-1999B 7/10/99	Supercedes FTMS No. 141 # 4293	Table 5.0	
D 522	Standard Test Method for Elongation of Attached Organic Coatings with Conical Mandrel Apparatus (DoD adopted)	D 522A-1993 9/15/93	Supercedes FTMS No. 141 # 6222	Table 5.0	

Reference Document	Title	Date	JTP Test	JTP Section	Applicable Section(s) of Reference Document
D 523	Standard Test Method for Specular Gloss (DoD Adopted)	D 523-1983 (R99) 3/31/89		Table 5.0	
D 562	Standard Test Method for Consistency of Paints Using the Stormer Viscometer (DoD Adopted)	D 562-1981(R97)e1 10/30/81	Supercedes FTMS No. 141 # 4281	Table 5.0	
D 846	Standard Specification for ten-Degree Xylene (DoD Adopted)	D 846-84 03/30/84			
D 1208	Standard Test Methods for Common Properties of Certain Pigments (DoD Adopted)	D 1208-1996 10/26/84	Supercedes FTMS No. 141 # 5261	Table 5.0	
D 1210	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems (DoD Adopted)	D 1210-1996 9/19/96		Table 5.0	
D 1296	Standard Test Method for Odor of Volatile Solvents and Dilutents (DoD Adopted)	D 1296-1993 (R96) 06/22/90	Supercedes FTMS No. 141 # 4401	Table 5.0	
D 1475	Standard Test Method for Density of Paint, Varnish, Lacquer, and Related Products (DoD Adopted)	D 1475-1998 10/10/98	Supercedes FTMS No. 141 # 4184	Table 5.0	
D 1729	Standard Practice for Visual Evaluation of Color Differences of opaque Materials (DoD Adopted)	D 1729-1996 2/12/90	Supercedes FTMS No. 141 # 4249	Table 5.0	

Reference Document	Title	Date	JTP Test	JTP Section	Applicable Section(s) of Reference Document
D 2196	Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer (DoD Adopted)	D 2196-1999 4/10/99		Table 5.0	
D 2369	Standard Test Method for Volatile Content of Coatings (DoD Adopted)	D 2369-1998 11/10/98	Supercedes FTMS No. 141 # 4041	Table 5.0	
D 3359	Standard Method for Measuring Adhesion by Tape Test (DoD Adopted)	D 3359-1997 11/10/97	Adhesion	3.4	
D 3828	Standard Test Methods for Flash Point by Small Scale Closed Tester (DoD Adopted)	D 3828-1998 11/10/98		Table 5.0	
E 308	Standard Method for Computing the Colors of Objects by Using the CIE System (DoD Adopted)	E 308-1999 6/10/99		Table 5.0	
F 718	Shipbuilders and Marine Paints and Coatings; Product/Procedure Data Sheet (DoD Adopted)	F			
	National Ambient Air Quality Standards (NAAQS)				

Table 5.0. Test Procedures

Characteristics	Requirements	Test Paragraph	Applicable Federal Standard Test Method FED-STD-141	Applicable ASTM Test	Quality Conformance	Qualification
Chemical nature$_1$	Table 3*		----	-----	---	X
Volatiles$_1$	Table 3*		----	D 2369	X	X
Nonvolatile vehicle	Table 3*		----	-----	X	X
Viscosity	Table 3*		----	(Krebs-Stormer D 562 or Brookfield D 2196)	X	X
Mass per L (gallon)$_1$	Table 3*		----	D 1475	X	X
Fineness of grind	Table 3*		----	D 1210	X	X
Flash Point$_1$	100^{o}F		----	D 3828	X	X
Odor	Table 3*		----	D 1296	X	X
Color$_1$	Pastel		----	------	---	---
Quality Conformance	Table 3*			D 1729	X	---
Qualification	Table 3*			E 308	---	X
Specular Gloss$_1$	Topcoat > 30		----	D 523	X	X
Drying (curing) time$_1$	24 hr. max.		4061	------	X	X
Flexibility	Table 3*		----	D 522	X	X

Characteristics	Requirements	Test Paragraph	Applicable Federal Standard Test Method FED-STD-141	Applicable ASTM Test	Quality Conformance	Qualification
Application	Table 3*		4321.2 and 4331.1	------	---	X
Immersion resistance	No corrosion No blistering		----	------	---	X
Resistance to fuel and water	No corrosion No blistering		----	------	---	X
Condition in container$_1$	Maintain viscosity		3011	------	X	X
Ash	Table 3*		----	D 1208	X	X
Pot Life$_1$	4 hours		----	-------	X	X
Service performance	3 years		----	-------	---	X
Shop primer	1 year		-----	-------	----	X

* Table 3 requirements established by manufacturer become requirements for a particular product.

3.0 TEST DESCRIPTIONS

The test described in this section includes explanations of unique methodologies, equipment, instrumentation and data analysis. Test methodologies include the type of samples, the number of test runs, testing parameters and conditions, and acceptance criteria. Tests identified in Table 4.0 are further defined below to include test description, rationale, and methodology. Also included, as needed, are any major or unique equipment, and data reporting and analysis procedures. Test methodology includes the definition of test parameters, test specimens, number of trials per specimen, any experimental control specimens required, and acceptance (pass/fail) criteria.

Unless otherwise specified, each test should be performed in accordance with Table 4.0. The temperatures at which the tests are conducted are specified in the applicable test methodology. For reduced temperature materials, the test shall be conducted at the low end of the temperature range.

Panel Preparation: Test panels shall be prepared to SSPC-SP-10 abrasive blast criteria with a surface profile of 2-4 mils. Surface chloride and conductivity tests shall be performed in accordance with NAVSEA SWI 009-32, paragraph 3.7.2. Test plates of the nature and size specified in the applicable test method shall be coated in accordance with the contractor's application instructions. The individual coatings shall be mixed in accordance with the contractors mixing instruction.

Actual execution of the tests may vary from that described in this JTP. Any deviations will be justified by the technical stakeholders, and documented and discussed in the project's JTR. Therefore, users of this document should check the JTR for modifications that may have been necessary in the execution of testing.

3.1 POT LIFE TEST

Test Description

The purpose of this test is to determine the minimum pot life of two-component tank coating systems.

The coating system shall be mixed from the components, in accordance with the contractor's instructions, in a container so as to result in approximately 1 L of finished material. For routine testing, ambient conditions above 21C and 50% relative humidity shall be satisfactory. For referee tests, 21 +/- 3C and 80+/- 10 percent relative humidity shall prevail. The time between mixing and the loss of adequate brushing and spraying properties shall be determined. Report up to a 48-hour period the actual temperature, humidity, and the time of loss of adequate brushing and spraying properties. For the reduced temperature coatings' systems, pot life shall be determined at the lower end of the temperature range or as directed by the paint manufacturer.

Rationale: To provide the applicator with an estimated time within which a two-

component coating will still be usable and meet brush and spray requirements. Two-component high solids coatings with an extremely short pot life should still be reported to allow the applicator to decide which product is suitable and will be used for touch-up applications.

Test Methodology: Determine viscosity every 30 minutes for coatings with solids less than 75% and every 10 minutes when solids are greater than 76%.

Parameters	Specimen and Product Temperature
Number and Type of Specimens per Candidate Alternative	Three to ensure proper mixing and agitation to eliminate hot spots.
Trials per Specimen *(if needed)*	One
Experimental Control Specimens	N/A
Acceptance Criteria	Upper viscosity limit stays below that reported on manufacturer's data sheet. Verify by comparing results to 3.6 and 3.7 of this test protocol.

Major or Unique Equipment: None

Data Reporting and Analysis: Report viscosity vs. time and loss of brush/spray properties.

3.2 IMMERSION RESISTANCE

Test Description

The purpose of this test is to determine the immersion resistance characteristics of the coating system in seawater.

The coating systems shall be mixed and applied in accordance with the contractor's instructions and consonant with the requirements for immersion resistance in Table 3.0 in order to completely coat two 150 by 300 by 3mm blasted hot rolled mild steel plates. The blast pattern shall approximate 0.08 mm (3-mils) depth for coating systems of at least 0.13-mm (5-mils) thickness and 0.04-mm (1.5-mils) for systems less than 0.13-mm (5-mils) thick, have completely removed all mill scale, rust and rough edges, and be similar to the average areas encountered in blasted tanks prepared to surface profile SSPC-SP10 as defined by the Steel Structures Painting Council before coating. Unless otherwise specified, 24 hours dry time shall be allowed between coats and 1 week at 21C or equivalent between the last coat and first immersion.

The coated panels shall be subjected to 50 cycles (or to prior failure) of the following test cycle. Test cycle for evaluating tank coatings applies to class 2 coatings. The cycle comprises three operations carried out in the order specified:

(1) Salt water immersion for 1 week: immerse panels totally for 1 week in 3 percent salt water solution comprised of commercial table salt dissolved in distilled water, at a temperature of 27 +/- 6C. Natural seawater with salinity of 33-35 ppm chloride is acceptable. Remove panels from test and allow to dry for 2 days.
(2) Hot seawater immersion for 2 hours: this operation is intended to simulate conditions encountered in the use of tank cleaning equipment. Following drying period, immerse panels totally in hot, synthetic seawater for 2 hours at 80C (175F).

Note: Operations (1) and (2) constitute one complete test cycle. This cycle is repeated and coating deterioration reported after each complete cycle. If coating is still satisfactory after 25 cycles, wipe lightly with a soft cloth and fresh water, allow 48 hours to thoroughly dry and recoat the central upper third of one side of each panel, masking the portion from the edge to 13-mm (1/2-inch) inward, with one coat of the finish coating of the coating systems (or primer and finish coat if appropriate). Allow 1 week dry time and complete immersion test with 25 additional test cycles. On the recoated area, adhesion is determined in accordance with ASTM D 3359 of the added coating less than half the adhesion between the original coats shall be considered failure. Inspect for conformance to Table 3.0 Adhesion.

Rationale: To verify with real time testing that the coating will resist immersion in seawater as per the manufacturer's claim.

Test Methodology: Test method cited in Section 3.2 (a) is acceptable.

Parameters	Application and cure time/temperature
Number and Type of Specimens per Candidate Alternative	Run test on triplicate panels.
Trials per Specimen *(if needed)*	One
Experimental Control Specimens	None
Acceptance Criteria	See Note in 3.2 (a) above

Major or Unique Equipment: None

Data Reporting and Analysis: Visual and narrative for each inspection– analysis is pass/fail.

3.3 RECOATABILITY

Test Description
The purpose of this test is to determine the recoatability of the coating system by itself after 24 hours drying time.

Recoatability for qualification of the coating systems shall be determined as specified in Section 3.2. For quality conformance in connection with acceptance of individual lots, after 24 hours dry time, the panel prepared in accordance with Section 3.0 shall be recoated on one side with the finish coat of the coating systems (or primer and finish coat if appropriate), allowed 72 hours dry time and then immersed as specified in seawater for 168 hours, examined, and reported.
Rationale: To ensure all coats in the system can be used to repair themselves.

Test Methodology: Use above procedure.

Parameters	Dry time, temperature, exposure time
Number and Type of Specimens per Candidate Alternative	Run in triplicate.
Trials per Specimen *(if needed)*	One
Experimental Control Specimens	None
Acceptance Criteria	No film failure, loss of hardness, wrinkling, or other defects.

Major or Unique Equipment: None

Data Reporting and Analysis: Report any film defects of overcoated area.

3.4 ADHESION

Test Description
The purpose of this test is to determine the adhesion of the coating system to the substrate.

A separate panel similar to the panel tested under Section 3.2 shall be prepared observing the dry times of 3.2. Adhesion of each coat shall be determined in accordance with ASTM D 3359 just before application of the next coat and of the coating systems just before the time of immersion of the panel specified in Section 3.3. After the immersion periods for the panel specified in Section 3.3, the adhesion between the immersed and the retained panel shall be compared.

Rationale: To ensure optimum adhesion of a newly applied coating system.

Test Methodology: Test method above and that of 3.2 and 3.3 are acceptable.

Parameters	Cure time, temperature, exposure time
Number and Type of Specimens per Candidate Alternative	Run in triplicate

Trials per Specimen *(if needed)*	Five sets of three per panel to eliminate point-to-point anomalies, three measurements within a 3" circle are performed, then averaged. Five averages are then reported.
Experimental Control Specimens	MIL-P-24441, Type IV, F150/151
Acceptance Criteria	Minimum 70% adhesion retention

Major or Unique Equipment: None

Data Reporting and Analysis: Report adhesion values and compare to standard.

3.5 VOLATILE ORGANIC CONTENT

Test Description
Volatile organic content shall be determined by EPA method 24.

Rationale: Ensure compliance with VOC regulations.

Test Methodology: 40 CFR, Ch. 1, Part 60, Appendix A, Method 24.

Parameters	See Method 24
Number and Type of Specimens per Candidate Alternative	Must evaluate each different coating of the system.
Trials per Specimen *(if needed)*	Three
Experimental Control Specimens	None
Acceptance Criteria	Meet VOC 340 g/L

Major or Unique Equipment: See Method 24 of above test methodology.

Data Reporting and Analysis: Report VOC contents and compare to regulated level.

3.6 BRUSHING PROPERTIES

Test Description
The purpose of this test is to determine the ability of the coating system to be applied by brush.

Coatings shall be prepared according to the manufacturer's directions. Coatings shall be applied without further reduction in accordance with method 4321.2 of FED-STD-141 and observed for compliance with in accordance with Table 3.0.

Rationale: To ensure applicability by brush (within pot life).

Test Methodology: Federal Standard 141, Method 4321.2

Parameters	See test methodology
Number and Type of Specimens per Candidate Alternative	One
Trials per Specimen *(if needed)*	One
Experimental Control Specimens	None
Acceptance Criteria	Pass the Federal Standard requirements

Major or Unique Equipment: None

Data Reporting and Analysis: Compare to above test method standards.

3.7 SPRAYING PROPERTIES

Test Description
The purpose of this test is to determine the ability of the coating system to be applied with a plural component paint applicator.

Prepare the coating according to the manufacturer's directions. Without further reduction, spray on a sandblasted steel panel to the recommended wet film thickness. Observe for spraying properties in accordance with method 4331.1 of FED-STD-141 and in accordance with Table 3.0.

Rationale: To ensure sprayability for production purposes (within pot life).

Test Methodology: Federal Standard 141, Method 4331.1

Parameters	See test methodology
Number and Type of Specimens per Candidate Alternative	One
Trials per Specimen *(if needed)*	One
Experimental Control Specimens	None
Acceptance Criteria	See test methodology

Major or Unique Equipment: None

Data Reporting and Analysis: Compare to test method standards.

3.8 TOXICITY

Test Description
The purpose of this test is to conduct toxicological reviews to evaluate the safety of the coating system.

The contractor shall have the toxicological formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use.

Rationale: To ensure worker health and safety during application and future removal.

Test Methodology: N/A

Parameters	Various TCLP limits as established in 40 CFR
Number and Type of Specimens per Candidate Alternative	One
Trials per Specimen (if needed)	One
Experimental Control Specimens	N/A
Acceptance Criteria	Meet TCLP limits

Major or Unique Equipment: N/A

Data Reporting and Analysis: N/A

3.9 EDGE RETENTION

Test Description
The purpose of this test is to evaluate the performance of the edge-retention characteristics of the coating system.

An aluminum alloy 6061 structural angle (90) section shall be used for testing and evaluation of the edge-retention properties of a specific coating system. Preparation of the sample shall consist of sample machining, grit blasting, and solvent cleaning. The topcoat of the coating system shall be applied to both sides of the unprimed angled aluminum specimen, then on the middle edge. WFT measurements shall be performed after application to ensure compliance with the thickness protocol. Specimen shall cure for 72 hours. The specimen will then be cut into ½ - inch segments, and the DFT shall be measured on each segment's side and edge. Edge retention is defined as the percentage of the DFT of the edge compared to the DFT of the flat sides. Any specimen with less than 50% retention constitutes a failure. The average of three specimens shall not be less than 70% to pass.

Rationale: To ensure adequate edge retention of a coating system in order to prevent premature coating failure at edges, corners, and welds of structures.

Test Methodology: MIL-P-23236, Edge Retention Test

Parameters	See Test Methodology

Number and Type of Specimens per Candidate Alternative	One
Trials per Specimen *(if needed)*	One
Experimental Control Specimens	N/A
Acceptance Criteria	See Test Methodology

Major or Unique Equipment: None

Data Reporting and Analysis: Compare to above test method standards.