National Aeronautics and Space Administration (NASA)
Acquisition Pollution Prevention (AP2) Office

Joint Test Protocol

For Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel

FINAL
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January 31, 2005

Contract No. NAS10-03029
Task Nos. 1 and 6

Prepared by
International Trade Bridge (ITB), Inc.
Beavercreek, OH 45432

Submitted by
NASA Acquisition Pollution Prevention Office

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PREFACE

This report was prepared by International Trade Bridge, Inc. (ITB) through the National Aeronautics and Space Administration (NASA) Acquisition Pollution Prevention (AP2) Office under Contract Number NAS10-03029 Task Order Nos. 1 and 6. The structure, format, and depth of technical content of the report were determined by the NASA AP2 Office, Government contractors, and other Government technical representatives in response to the specific needs of this project.

The information contained in this plan is to be used in conjunction with NASA AP2 Office Field Test Plan entitled *Field Evaluations Test Plan For Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*; *Potential Alternatives Report for Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*; and *Cost Benefit Analysis for Alternative Low-Emission Surface Preparation/ Depainting Technologies for Structural Steel*, all of which were prepared by ITB.

The information contained in this report was leveraged from the Engineering and Technical Services for Joint Group on Pollution Prevention (JG-PP) Projects Joint Test Protocol entitled *Joint Test Protocol J-00-CR-017 for Validation of a Portable LASER System for Coating Removal*, dated February 5, 2001 (Revised October 12, 2001; Revised and Reformatted March 12, 2002), which was prepared by HQ AFMC/LGP-EV through the Joint Acquisition Sustainment Pollution Prevention Activity (JASPPA).

We wish to acknowledge the invaluable contributions provided by all the organizations involved in the creation of this document.

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1. INTRODUCTION

Headquarters National Aeronautics and Space Administration (NASA) chartered the Acquisition Pollution Prevention (AP2) Office to coordinate agency activities affecting pollution prevention issues identified during system and component acquisition and sustainment processes. The primary objectives of the AP2 Office 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 center cooperation and technology sharing.

NASA and Air Force Space Command (AFSPC) have similar missions and therefore similar facilities and structures in similar environments. Both are responsible for a number of facilities/structures with metallic structural and non-structural components in highly and moderately corrosive environments. Regardless of the corrosivity of the environment, all metals require periodic maintenance activity to guard against the insidious effects of corrosion and thus ensure that structures meet or exceed design or performance life. The standard practice for protecting metallic substrates in atmospheric environments is the application of an applied coating system. Applied coating systems work via a variety of methods (barrier, galvanic and/or inhibitor) and adhere to the substrate through a combination of chemical and physical bonds.

To achieve a substrate condition suitable for the application of a coating system, both new and old (in-situ) substrates must undergo some type of surface preparation and/or depainting operation to ensure adhesion of the new coating system. The level of cleanliness or anchor profile desired is typically a function of the type of coating to be applied and the specification being adhered to. In high performance environments, cleanliness and surface profile requirements for carbon steel (the dominant substrate for facilities, structures and equipment) dictates the use of abrasive media. Many of the abrasive media currently used across NASA and AFSPC installations generate large quantities of fugitive particulate emissions and waste. The high quantities of airborne dust and waste generated from these operations pose significant environmental concern. Efforts to contain emissions and the reduce quantity of waste generated have significant implications on project cost; this is often a deterrent to engaging in maintenance activities.

In response to recent technological developments and NASA's and AFSPC's need to undertake environmentally conscious corrosion prevention projects, a review of the industry needs to be undertaken to evaluate surface preparation technologies (materials and processes) for embrace. This project will identify, evaluate and approve alternative surface preparation technologies for use at NASA and AFSPC installations. Materials and processes will be evaluated with the goal of selecting those processes that will improve corrosion protection at critical systems, facilitate easier maintenance activity, extend maintenance cycles, eliminate flight hardware contamination and reduce the amount of hazardous waste generated.

This Joint Test Protocol (JTP) contains the critical requirements and tests necessary to qualify alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel Applications. These tests were derived from engineering, performance, and operational impact (supportability) requirements defined by a consensus of NASA and Air Force Space Command (AFSPC) participants.

The Field Test Plan (FTP), entitled *Joint Test Protocol for Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*, prepared by ITB, defines the field evaluation and testing requirements for validating alternative surface preparation/depainting technologies and supplements the JTP. The field evaluations will be performed at Stennis Space Center, Mississippi, under the oversight of the Project Engineer. Additional field evaluations may be performed at other NASA centers or AFSPC facilities.

The Potential Alternatives Report (PAR) entitled *Potential Alternatives Report Plan for Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*, prepared by ITB, provides technical analyses of identified alternatives to the current surface preparation/depainting technologies, criteria used to select alternatives for further analysis, and a list of those alternatives recommended for testing.

The Cost Benefit Analysis (CBA) entitled *Cost Benefit Analysis for Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*, prepared by ITB, evaluates investments in environmental technologies that address compliance and pollution prevention issues. The CBA quantifies the estimated capital and process costs of coating removal alternatives, Return-on-Investments, and cost savings relative to the current coating removal process to determine if implementation of the candidate alternatives is economically justified.

A Joint Test Report (JTR) will document the results of the testing as well as any test modifications made during the execution of the testing. The JTR will be made available as a reference for future pollution prevention endeavors by other NASA centers, the Department of Defense (DoD) and commercial users to minimize duplication of effort. Users of this JTP should check the project's JTR for additional test details or minor modifications that may have been necessary in the execution of the testing. The technical stakeholders will have agreed upon test procedures modifications documented in the JTR.

The current coating removal processes identified herein are for polyurethane, epoxy and other paint systems applied by conventional wet-spray processes. Table 1 summarizes the target HazMats; processes and materials; applications; affected programs, and candidate substrates.

Table 1-1 Target HazMat Summary					
Target HazMat	**Current Process**	**Applications**	**Current Specifications**	**Affected Programs**	**Candidate Parts/Substrates**
Airborne particulates and contaminated particulate matter	Dry Abrasive Blasting	Maintenance of Test Stands, Ground Support Equipment, Shuttle Support Structures, Launch Pads, Towers and general structures.	SSPC-SP-5; SSPC-SP-10	Ground Support and Facilities Maintenance	A36 Carbon Steel; Aluminum Alloy 6061

2. ENGINEERING, PERFORMANCE, AND TESTING REQUIREMENTS

A joint group led by the AP2 Office and consisting of technical representatives from NASA centers and AFSPC reached technical consensus on engineering, performance, and testing requirements for alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel Applications. The joint group defined critical tests with procedures, methodologies, and acceptance criteria to qualify alternatives against these technical requirements.

The objective of this project is to qualify candidate alternative low-emission surface preparation/depainting technologies for structural steel applications under the specifications for the standard AFSPC and NASA systems. This project will compare surface preparation/depainting performance of the proposed alternatives to existing surface preparation/depainting systems or standards.

Field evaluations demonstrate comparative field performance of candidate surface preparation/depainting technologies when applied on operating structures and is perhaps one of the most critical screening tests. It is expected that the field demonstration will serve to eliminate several variables and provide concrete evidence of the cost and environmental impact of alternatives. Information gathered from this field trial is critical for local environmental, safety, and occupational health (ESOH) personnel along with technical stakeholders to be able to make educated decisions on process standardization and what further capital and testing under this JTP is warranted.

Once the JTP test criterion is approved, testing will be performed in a manner that will optimize the use of each test panel. For example, where practical, more than one type of test will be performed on the coated test panels. The number and types of tests performed on a given panel will be determined by the destructive-nature of the tests in question.

All coating removal technology candidates will be evaluated on approved AFSPC coating systems and NASA coating systems listed in the approved product list in accordance with NASA-STD-5008. Qualified personnel will perform all surface preparation and coating applications in accordance with best-standard practice to the appropriate coating technical documentation. Relevant process information will be documented at the time the test specimens are prepared. The coating removal process will follow all manufacturers' instructions.

> **Note:** Tests specified in this JTP may involve the use of hazardous materials, operations, and equipment. This JTP does not address all safety issues associated with its implementation. It is the responsibility of each user of this JTP to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to its use.

The objective of this project is to qualify the candidate processes under the specifications for the standard system. This project will compare coating removal performance of the proposed alternatives to existing coating removal systems or standards. Tables 2-1 and 2-2 summarize the test requirements for validating alternative surface preparation/depainting technologies against existing approved coating removal systems.

Table 2-1 lists field evaluations that are intended to compare the performance of candidate test surface preparation/depainting technologies with current surface preparation/depainting systems when applied in an operational environment. Coating removal evaluators will complete a written evaluation and documentation checklists to organize and quantify the observations of coating removal technologies' performances under actual operating conditions. These tests are further defined in the FTP.

Table 2-2 lists the common tests required by participating centers. Candidate coating removal technologies will be submitted to these common tests for a more comprehensive evaluation.

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

Table 2-1 Field Evaluation Engineering, Performance, and Testing Requirements for Alternative Low-Emission Surface Preparation/Depainting Technologies				
Test	**Test Plan Section**	**Test Specimen**	**Acceptance Criteria**	**Test Methodology References**
Ease of Use	3.2.1.	Field	To be assessed by field applicator	None
Coating Strip Rate	3.2.2.	Field	Performs as well as or better than baseline process	None
SSPC Surface Cleaning Level	3.2.3.	Field	Concurrence that technology meets agreed upon cleaning level using visual determination using SSPC Surface cards at 10X magnification	SSPC-SP-10/ NACE-NO. 2
Surface Profile/ Roughness	3.2.4.	Field	Concurrence that technology meets agreed upon surface profile using visual determination	NACE-STD-RP0287
Waste Generation	3.2.5.	Field	Less than current abrasive blasting techniques	None
Particulate Generation	3.2.6.	Field	Less than current abrasive blasting techniques	None
Coating Removal Damage Appraisal	3.2.7.	Field	No warping/denting or metal erosion observable at 10X magnification	None

Table 2-2 Common Engineering, Performance, and Testing Requirements for Alternative Low-Emission Surface Preparation/Depainting Technologies				
Test	**JTP Section**	**Test Specimen**	**Acceptance Criteria**	**Test Methodology References**
SSPC Surface Cleaning Level	3.2.1.	Coupon	Concurrence that technology meets agreed upon cleaning level using visual determination using SSPC Surface cards at 10X magnification	SSPC-SP-10/ NACE-NO. 2
Surface Profile/ Roughness	3.2.2.	Coupon	Concurrence that technology meets agreed upon surface profile using visual determination	NACE-STD-RP0287
Waste Generation	3.2.3.	Coupon	Less than current abrasive blasting techniques	None
Particulate Generation	3.2.4.	Coupon	Less than current abrasive blasting techniques	None
Coating Removal Damage Appraisal	3.2.5.	Coupon	No warping/denting or metal erosion observable at 10X magnification	None
Coating Adhesion	3.2.6.	Coupon	Candidate process performs equal to or better than baseline process	ASTM D 4541

3. TEST DESCRIPTIONS

Tests identified in Table 2-2 are further defined in this section to include the test specimens/panel description and test methodology. Any unique equipment or instrumentation requirements, data reporting, and analysis procedures are included. The test methodology lists the major parameters, test specimen descriptions, number of trials per specimen and acceptance criteria.

Due to the limitations currently placed on units within the field, coating preparation is a key evaluation element of this project. Where applicable, the coating of coupons will be documented using the "Coating System Application Evaluation and Inspection Report" (Appendix A) based on the Application Record Sheet in NASA-STD-5008, or an equivalent form. For each test requiring coupons, a minimum of six (6) coupons shall be prepared; those with the best coating as determined by the technician shall be used in accordance with the number of coupons required for each test as specified in the *Test Methodology*. Unless otherwise required by a specific test, all coupons will be prepared as follows:

The varying grades of abrasive blasting will be evaluated after coupons have been blasted, then divided into the appropriate level of preparation prior to coating.

Test panels will be 12" X 12" long and of a suitable thickness. Test coupons must be stored in a controlled environment of 70°F and 50% Relative Humidity (RH) and packaged coupons will be packaged in moisture barrier material with a desiccant package to be used to further reduce humidity within the package. Test specimens must be painted or coated within 24 hours of surface preparation. Each test will be performed on identical test specimens prepared with the AFSPC and NASA standard coating systems as controls.

Each liquid coating system will be prepared and applied in accordance with the appropriate specification and manufacturer guidelines. The coating system may be applied in one or more coats to achieve the specified dry film thickness. Application should be conducted at a minimum temperature of 70°F and 50% ± 10% relative humidity (RH) unless otherwise specified. To ensure uniform coating thickness, coating applications shall be conducted per American Society for Testing and Materials (ASTM) D 823 (*Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels*, revised 1995).

Unless otherwise specified, a topcoat is applied over the primer. The topcoat must be applied over the primer within the manufacturer's recommended time. The topcoat should be applied to the total dry film thickness specified. Unless otherwise specified, all panels shall be artificially aged for 7 days at room temperature followed by 7 days at 150° ± 5°F.

Users of this JTP should check the project's JTR, if available, for additional test details or minor modifications that may have been necessary in the execution of testing. The technical stakeholders will have agreed upon any testing procedure modifications.

Table 3-1 contains a listing of substrate types that will be used for testing and their test specimen code.

Table 3-1 Test Specimen Codes and Substrate Descriptions

Test Specimen Code	Substrate Description
RA36	Rusted Carbon Steel 12 inch x 12 inch x 3/16 inch panels fabricated from ASTM A36 hot rolled carbon steel; rusted per SSPC-VIS-1, Condition B or C.
CA36	Coated Carbon Steel 12 inch x 12 inch x 3/16 inch panels fabricated from ASTM A36 hot rolled carbon steel; primed, intermediate coated (if required), and topcoated. Coatings applied per the coating manufacturer specifications.
AL	Aluminum Alloy 6061-T6 12 inch x 12 inch x 3/16 inch; cleaned to provide a water-break-free surface; no conversion coating or other pretreatment; primed and topcoated. Coatings applied per the coating manufacturer specifications

3.1. Field Evaluation Engineering, Performance, and Testing Requirements

The NASA AP2 document, *Field Evaluations Test Plan for Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*, prepared by ITB, contains information on the field evaluations, listed in Table 2-1, for candidate coating removal technologies. These tests demonstrate comparative field performance of candidate coating removal technologies with currently used coating removal systems. The field evaluations will be performed in conjunction with the laboratory testing.

3.2. Common Engineering, Performance, and Testing Requirements

The common engineering, performance, and testing requirements of candidate alternative coating removal technologies listed in Table 2-2 are further defined in this section to include the test description, rationale, and test methodology. The *Test Methodology* lists the major parameters and acceptance (pass/fail) criteria. Any *Unique Equipment or Instrumentation* requirements and *Data Analysis and Reporting Criteria* are also included.

3.2.1. SSPC Surface Cleaning Level

Test Description

This test shall be performed in accordance with SSPC-SP-10/NACE-No. 2 (*Near-White Blast Cleaning*, issued 2000).

Rationale

SSPC–SP-10 is the industry standard for surface preparation of carbon steel for application of most coating systems and particularly inorganic zinc primers. A suitable alternative depainting technology shall be capable of achieving a surface cleanliness level equal to SP-10 per visual inspection.

Test Methodology

Table 3-2 Test Methodology for SSPC Surface Cleaning Level	
Parameters	Per SSPC-SP-10/NACE-No. 2
Coupons Per System	Three (3) of each test substrate
Trials Per Test Coupon	One (1)
Control Coupons Required For Testing	None
Acceptance Criteria	Concurrence that technology meets agreed upon cleaning level using visual determination using SSPC Surface cards at 10X magnification

Unique Equipment or Instrumentation

- 10X optical magnifier

Data Analysis and Reporting

- Engineering evaluation substantiated by written description on the "Coating System Application Evaluation and Inspection Report" (Appendix A), or an equivalent form, and photographs.

3.2.2. Surface Profile/Roughness

Test Description

This test serves to evaluate substrate damage as a result of using the coating removal technology. Surface roughness shall be measured in accordance with NACE-STD-RP0287 (*Field Measurements of Surface Profile of Abrasive Blast Cleaned steel Surfaces Using a Replica Tape*, revised 2002). Any surface abnormalities shall be noted and photographed.

Rationale

Due to the potential for substrate damage posed by any coatings removal process, preliminary appraisal must be made to estimate the magnitude of this potential.

Test Methodology

Strip specimen and clean if necessary to remove stripping residues. Measure the surface roughness. A minimum of five readings shall be performed along different directions and different places in the panel. Record each of the readings.

Table 3-3 Test Methodology for Surface Profile/Roughness	
Parameters	Per NACE-STD-RP0287
Coupons Per System	Three (3) of each test substrate
Evaluations Per Test Coupon	Two (2)—One (1) prior to testing and one (1) after removal cycle
Control Coupons Required For Testing	None
Acceptance Criteria	Concurrence that technology meets agreed upon surface profile using visual determination

Unique Equipment or Instrumentation

- Per NACE-STD-RP0287

Data Analysis

- Engineering evaluation substantiated by written description on the "Coating System Application Evaluation and Inspection Report" (Appendix A), or an equivalent form, and photographs.

3.2.3. Waste Generation

Test Description

This test will assess the waste streams generated by the process. Assessment will include the waste quantity, determination of regulated wastes, and waste stream containment.

Rationale

Generation of regulated wastes and waste quantity are cost factors to consider in selection of depainting technologies. Additionally, waste stream containment and the ability of the

selected method to control visible emissions will determine the requirement of containment structures that require cost consideration.

Test Methodology

- Waste Quantity—Contain and collect wastes generated during depainting of the test structure. Determine mass and volume of the collected waste.
- Fugitive Emissions—A subjective evaluation of fugitive emissions, both particulate and liquid runoff.
- Regulated Wastes—Collect bulk sample of contained wastes for analysis per 40 CFR Part 261.

Table 3-4 Test Methodology for Waste Generation	
Parameters	Regulated waste—EPA regulatory criteria (40 CFR Part 261); Fugitive Emissions - TBD
Coupons Per System	Three (3) of each test substrate
Trials Per Test Coupon	One (1)
Control Coupons Required For Testing	Three (3) of each test substrate
Acceptance Criteria	Analysis of waste generation rate, visible emissions control, chemical analysis of bulk waste, and cost comparable to baseline process

Unique Equipment or Instrumentation

- None

Data Analysis and Reporting

- EPA test results.
- Fugitive emissions report.
- Bulk waste quantification measurement on the "Coating System Application Evaluation and Inspection Report" (Appendix A), or an equivalent form, and photographs.

3.2.4. Particulate Generation

Test Description

This will provide a baseline assessment of employee exposure to aerosols generated during the depainting process. A baseline exposure assessment will be conducted to identify typical employee exposures to depainting media of all phases (preparation, depainting, clean-up).

Personnel dosimetry monitoring and area monitoring will be used to characterize exposure levels.

Rationale

This test will be used to determine if typical employee exposures to air contaminants generated during depainting operations comply with the Threshold Limit Values (TLVs) Time-Weighted Average (TWA) exposure levels published by the American Conference of Governmental Industrial Hygienists (ACGIH). Test results will confirm use of recommended personal protective equipment and identify possible exposure hazards.

Test Methodology

Measurement of air contaminant levels may be determined using either real-time monitoring devices or sample collection methods requiring subsequent laboratory analysis. (Actual test methods are TBD pending MSDS review.) Laboratory analysis of collected media will be by a laboratory certified by the ACGIH.

Table 3-5 Test Methodology for Particulate Generation	
Parameters	TLV TWA exposure levels published by the ACGIH; Baseline hazard assessment with sample collection for laboratory analysis or real time measurement
Coupons Per System	Three (3) of each test substrate
Trials Per Test Coupon	One (1)
Control Coupons Required For Testing	Three (3) of each test substrate
Acceptance Criteria	PPE is appropriate for measured exposure levels and comparable to baseline process; Particulate generation less than baseline process

Unique Equipment or Instrumentation

- TBD

Data Analysis and Reporting

- Report to include observations of field test set-up; description of procedures and work practices. Description of test methods and sample analysis. Table of monitoring results with comparison to applicable OSHA Permissible Exposure Levels (PEL) and TLV-TWAs. Findings on PPE effectiveness and discussion of possible exposure hazards and their relation to observed procedures and work practices. Photographic documentation of procedures and work practices.

- Quantification of particulate generation on the "Coating System Application Evaluation and Inspection Report" (Appendix A), or an equivalent form, and photographs.

3.2.5. Coating Removal Damage Appraisal

Test Description

The following tests serve to evaluate preliminary substrate damage as a result of using the alternate coating removal technologies. Test materials/substrates shall be examined for Warping/Denting and Metal/Composite Erosion. Observations for substrate damage shall be made immediately following the coating removal process. Any surface abnormalities shall be noted and photographed.

Rationale

Due to the potential for substrate damage posed by any coatings removal process, a preliminary appraisal must be made to estimate the magnitude of this potential.

Warping/Denting

As applicable, examine all metallic substrate materials after application of the de-paint process for any indications of warping and/or denting. Warping will be seen as a curling of the test panel. Denting will be most easily observed on the rear surface, or the surface opposite to that to which the de-paint process is applied. This is expected to be an engineering evaluation and shall be substantiated by a brief written description supported by photographic documentation of the substrate surface following application of the de-painting process. This evaluation shall be conducted after each of four removal cycles.

Metal/Composite Erosion

Document any tendency for a de-paint process to remove or erode metallic. Any pitting or apparent abrasion of surface should be considered potential substrate erosion. These types of assessments may be made under magnification by comparison of stripped versus "as received" materials. Provide a brief written description and photographic documentation of the substrate surface following the application of the de-painting process. Examine for surface cracking, pitting, or roughening. This evaluation shall be conducted after each of the four removal cycles.

Test Methodology

Table 3-6 Test Methodology for Coating Removal Damage Appraisal	
Parameters	10X magnification of stripped surface for warping/denting; metal/composite erosion
Coupons Per System	Three (3) of each test substrate

Table 3-6 Test Methodology for Coating Removal Damage Appraisal	
Evaluations Per Test Coupon	Two (2)—One (1) prior to testing and one (1) after removal cycle; examine the entire surface of the coupon
Control Coupons Required For Testing	None
Acceptance Criteria	No warping/denting or metal/composite erosion observable at 10X magnification.

Note: Control panels will not be created. Rather, tests before and after will be accomplished.

Unique Equipment or Instrumentation

- 10X Magnifier

Data Analysis and Reporting

- Engineering evaluation substantiated by written description on the "Coating System Application Evaluation and Inspection Report" (Appendix A), or an equivalent form, and photographs.

3.2.6 Coating Adhesion

Test Description

This test evaluates the pull-off strength (commonly referred to as adhesion) of a coating. The test determines either the greatest perpendicular force (in tension) that a surface area can bear before a plug of material is detached, or whether the surface of the material remains intact at a prescribed force.

This test method uses a class of apparatus known as portable pull-off adhesion testers. They are capable of applying a concentric load and counter load to a single surface so that coatings can be tested even though only one side is accessible. Measurements are limited by the strength of adhesion bonds between the loading fixture and the specimen surface or the cohesive strengths of the adhesive, coating layers, and substrate.

Perform this test in accordance with ASTM D 4541 (*Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers*, approved 2002). The test shall be performed immediately after coating cure and again after six (6)-months beach exposure.

Rationale

Surface preparation can greatly affect the adhesion of coatings. Participants agreed that adhesion following surface preparation is a critical performance requirement.

Test Methodology

Table 3-7 Test Methodology for Coating Adhesion	
Parameters	ASTM D 4541; three data points for each coupon; immediately after coating cure and then again after 6-months beach exposure.
Coupons Per Coating System	Two (2) of each substrate (one for initial and one for 6-month exposure)
Trials Per Coupon	Three (3)
Control Coupons Required For Testing	Two (2) of each substrate (one for initial and one for 6-month exposure)
Acceptance Criteria	Candidate process performs equal to or better than baseline process

Unique Equipment and Instrumentation

- Patti adhesion tester or equivalent

Data Analysis

- Record the strength at which adhesion fails on the "Coating System Application Evaluation and Inspection Report" (Appendix A), or an equivalent form; there should be three (3) data points for each coupon.
- One color photograph of a coupon prepared with each candidate process shall be taken before the test. One color photograph of each tested coupon and the dolly shall be taken after the test.

4. REFERENCE DOCUMENTS

The documents in Table 4-1 were referenced in the development of this JTP. In addition, this report was leveraged from the Engineering and Technical Services for Joint Group on Pollution Prevention (JG-PP) Projects Joint Test Protocol entitled *Joint Test Protocol J-00-CR-017 for Validation of a Portable LASER System for Coating Removal*, dated February 5, 2001 (Revised October 12, 2001; Revised and Reformatted March 12, 2002), which was prepared by HQ AFMC/LGP-EV through the Joint Acquisition Sustainment Pollution Prevention Activity (JASPPA) and the NASA AP2 document entitled *Field Evaluations Test Plan for Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Structural Steel*, prepared by ITB.

Table 4-1 Summarized Test and Evaluation Reference Listing

Reference Document	Title	Date	JTP Test	JTP Section
ASTM D 823	*Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels*	Revised 1995	Test Descriptions	3.
ASTM D 4541	*Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers*	Approved 2002	Coating Adhesion	3.2.6.
NACE-STD-RP0287	*Method for Conducting Coating (Paint) Panel Evaluation Testing In Atmospheric Exposures*	Revised 2004	Surface Profile/ Roughness	3.2.2.
SSPC-SP-10/ NACE-NO. 2	*Near-White Blast Cleaning*	Issued 2000	SSPC Surface Cleaning Level	3.2.1.
SSPC-VIS-1	*Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*	Revised 1989	Test Descriptions	3.

Appendix A

Coating System Application Evaluation and Inspection Report

COATING SYSTEM APPLICATION EVALUATION AND INSPECTION REPORT*

DATE	PROJECT REF. NO.	PAGE	OF
PROJECT NAME		LOCATION	
INSPECTION ORGANIZATION		INSPECTOR	
PRODUCT MANUFACTURER / NAME		COUPON	

1. DESCRIPTION OF ITEMS AND/OR AREAS

2. DESCRIPTION OF WORK PERFORMED / REMARKS

3. ENVIRONMENTAL CONDITIONS

TIME	:	:	:	:	:	:
AIR TEMP °F						
RELATIVE HUMIDITY	%	%	%	%	%	%

REMARKS

4. PRE-WORK SURFACE CONDITIONS / SURFACE PREPARATION

5. COATING APPLICATION

METHOD OF APPLICATION	START TIME	STOP TIME
	APPROXIMATE SQ. FT. COATED	
EQUIPMENT DESCRIPTION	GALS COATING APPLIED	
	WET FILM THICKNESS (AVG)	MILS

POT LIFE—Technician Evaluation and attach records of viscosity readings

EASE OF USE—Technician Evaluation

REMARKS

6. POST CURE INSPECTION

DRY FILM THICKNESS (AVG) MILS (See Attached Documentation)

SURFACE APPEARANCE WITH UNAIDED EYE—Technician Evaluation

SURFACE APPEARANCE WITH 10X MAGNIFICATION—Technician Evaluation

GLOSS READING (per ASTM D 523)	COLOR READING (per ASTM D 2244)

REMARKS

INSPECTOR'S SIGNATURE DATE

*Based on Application Record Sheet in NASA-STD-5008