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National Aeronautics and Space Administration
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PROTECTIVE COATING OF CARBON STEEL, STAINLESS STEEL, AND ALUMINUM ON LAUNCH STRUCTURES, FACILITIES, AND GROUND SUPPORT EQUIPMENT

MEASUREMENT SYSTEM IDENTIFICATION:
METRIC/SI (ENGLISH)

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DOCUMENT HISTORY LOG

Status	Document Revision	Approval Date	Description
Baseline		07-10-2001	Baseline Release.
Revision	A	01-21-2004	See changes below.

Foreword: Changed signature of W. Brian Keegan to Theron M. Bradley. Updated Table of Contents and KSC FORM 21-61ONS, Standardization Document Improvement Proposal.

General editorial/punctuation changes/corrections throughout document: put brackets inside parentheses and deleted “etc.” following “e.g.” Used non, free and proof as combining forms. Put a hyphen between Sherwin Williams. Changed Ameron International, P.C.G. to P.C.F.G. and web site to www.ameron.com. Changed Materials Science Division (LO-G) to Spaceport Technology Development Office (YA-C2).

Added paragraph 1.6, Environmental stewardship.

Paragraph 2.2: Changed MIL-C-24667A to MIL-PRF-24667A. Deleted MIL-T-81772.

Paragraph 2.3: Changed title of ASTM A653 to Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (**Galvannealed**) by the Hot-Dip Process and changed the ASTM address to 100 Barr Harbor Drive, West Conshohocken, PA 19482-2959. Changed the title of RP0188-88 to Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates. Changed the title of SSPC SP 5-94, Joint Surface Preparation Standard, to SSPC-SP 5-94/NACE No. 1, White Metal Blast Cleaning. Changed SSPC SP 10-94, Joint Surface Preparation Standard Near-White Blast Cleaning, to SSPC-SP 10-00/NACE No. 2, Near-White Blast Cleaning.

Paragraph 3: Deleted AISC, American Institute of Steel Construction; cfm, cubic feet per minute; GFE, Government-furnished equipment; and KHB, Kennedy handbook. Changed LO-G to YA-C2-T. Added ASME, American Society of Mechanical Engineers; CFR, Code of Federal Regulations; HAP, hazardous air pollutant; PDCA, Painting and Decorating Contractors of America; and YA-F, Labs and Testbed Division. Changed mega Pascal to megapascal.

Paragraph 4.1.2.4.e.2: Changed 235 to 239. Put parentheses around number listing.

Paragraph 4.1.4: Changed Materials and Chemical Analysis Laboratory to Spaceport Technology Development Office.

Paragraph 4.3.1: Added “and NASA policies” to the end of the last sentence.

Status	Document Revision	Approval Date	Description

Status	Document Revision	Approval Date	Description
Revision (Continued)	A	01-21-2004	See changes below.

4.4.1: Rewrote the first sentence. Added a sentence after the first sentence.

4.4.3.3 Added/environmental to safety/fire in the last sentence.

4.5.1: Added "An inorganic zinc coating used in a friction-type joint must be approved by the American Institute of Steel Construction (AISC)," after the fifth sentence.

Paragraph 5.7.5, end of the third sentence: Added "while considering the accuracy of the measurement instrument."

Appendix A, Section I: Changed zip code for Ameron International, P.C.F.G to 92821.
Appendix A, Section II: Added Dimetcote D-9HS SB; SB to Cathacoat 304V; Cathacoat 304H SB; and ZincClad IIHS SB to Coating Designations and Type. Added InterZinc 22HS, SB, International Paint, 6001 Antoine Drive, Houston, TX 77091, (713) 682-1711, www.international-pc.com.

Appendix B, Section II: Added (SB) to Primer (Type) D-21-9. Added D-9HS (SB) to Primer (Type) and PSX700(SB) to Topcoat (Type).

Appendix B, Section III: Added D-9HS (SB) and ZincClad IIHS (SB) to Primer (Type). Added InterZinc 22HS (SB), 181 (SB) (IOT), International Paint, 6001 Antoine Drive, Houston, TX 77091, (713) 682-1711, www.international-pc.com. Changed Topcoat (Type) 7551 P1 (SB) (IOT) to 5555.

Revision	B	03/18/2011	General Revision: Changes are not listed; reader must review complete document.

FOREWORD

This Standard is published by the National Aeronautics and Space Administration (NASA) to provide uniform engineering and technical requirements for processes, procedures, practices, and methods that have been endorsed as standard for NASA programs and projects, including requirements for selection, application, and design criteria of an item.

This Standard is approved for use by NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers.

This Standard was developed to ensure the inclusion of essential criteria in the coating of ground support equipment (GSE) and facilities used by or for NASA.

This Standard establishes practices for the protective coating of GSE and related facilities used by or for NASA programs and projects. This Standard is for the design of nonflight hardware used to support the operations of receiving, transportation, handling, assembly, inspection, test, checkout, service, and launch of space vehicles and payloads at NASA launch, landing, or retrieval sites. These criteria and practices may be used for items used at the manufacturing, development, and test sites upstream of the launch, landing, or retrieval sites.

The information provided herein is recommended for use in the preparation of written, individual coating specifications for specific projects for the prevention of corrosion through the use of protective coatings on facilities, space vehicle launch structures, and GSE in all environments.

Requests for information, corrections, or additions to this Standard should be submitted via "Feedback" in the NASA Standards and Technical Assistance Resource Tool at http://standards.nasa.gov.

Original Signed By: ***03/18/2011***

Michael G. Ryschkewitsch
NASA Chief Engineer

Approval Date

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1. SCOPE

1.1 Purpose

The purpose of this Standard is to establish requirements for the application of protective coatings to mitigate corrosion of exposed carbon steel, stainless steel, and aluminum.

This Standard provides a design standard for experienced corrosion control engineers for the development of specifications including requirements for materials, equipment, safety, procedures, and quality assurance inspections.

Refer to section 1.2 for the intended use of this Standard and surfaces to be coated according to this Standard. Refer to Appendices A, B, and C for listings of approved coating materials.

1.2 Applicability

This Standard is applicable to facilities, launch structures, ground support equipment (GSE), test facilities, and structures that are intended for use at all NASA locations world-wide.

This Standard is approved for use by NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers, and may be cited in contract, program, and other Agency documents as a technical requirement. This Standard may also apply to the Jet Propulsion Laboratory or to other contractors, grant recipients, or parties to agreements only to the extent specified or referenced in their contracts, grants, or agreements.

Requirements are numbered and indicated by the word “shall.” Explanatory or guidance text is indicated in italics beginning in section 4.

1.2.1 This Standard shall be used in the preparation of written, individual coating specifications for specific projects for the prevention of corrosion through the use of protective coatings on space vehicle launch structures, facilities, GSE, and test facilities and structures in the specific environments identified in section 1.4.

1.2.2 Due to the changing environmental considerations and different site conditions, new advances in corrosion technology, and a wide array of possible applications, this Standard shall not be used as a stand-alone specification that meets every contingency.

The appendices are considered to be an integral part of this Standard. Appendices A, B, C, and D shall be used for the preparation of all coating specifications.

1.3 Tailoring

Tailoring of this Standard for application to a specific program or project shall be formally documented as part of program or project requirements and approved by the Technical Authority.

1.4 Zones of Exposure

The following zones of exposure are established to define coating system requirements for surfaces located in specific environments. The zones of exposure shall be determined by the Design Engineer responsible for preparing the coating specification.

a. (1) Zone 1a. Surfaces that are directly impinged on by solid rocket booster (SRB) engine exhaust.

(2) Zone 1b. Surfaces that are indirectly impinged on by SRB exhaust.

(3) Zone 1c. Walking surfaces in Zones 1a and 1b.

b. Zone 2. Surfaces that are exposed to elevated temperatures (above 65 °C (above 150 °F)) and/or acid deposition from SRB exhaust with no exhaust impingement.

c. (1) Zone 3a. Surfaces, other than those located in Zones 1 or 2, that are exposed to acid deposition from SRB exhaust products.

(2) Zone 3b. Surfaces that are exposed to other types of chemical contamination (e.g., cooling towers, diesel exhaust stacks, acidic industrial environments, and water treatment facilities).

d. (1) Zone 4a. Surfaces not located in the launch environment but located in a neutral pH corrosive marine industrial environment or other chloride-containing environments.

(2) Zone 4b. Surfaces located in neutral pH exterior environments in any geographical area.

(3) Zone 4c. Surfaces located in indoor environments that are not air-conditioned.

e. (1) Zone 5a. Surfaces located in a continuous indoor air-conditioned environment, such as an office or clean room, where both temperature and humidity are controlled more than 90 percent of the time.

(2) Zone 5b. Surfaces located in a low humidity, high ultraviolet environment, such as a high altitude, arid location.

f. (1) Zone 6a. Surfaces located underground or subject to intermittent or continuous immersion in aqueous environments.

(2) Zone 6b. Surfaces subject to exposure in a chemical/fuel storage environment. Based on the complexity of the liquid stored, this has to be engineered separately in compliance with all federal, state, and local environmental statutory requirements.

g. Zone 7. Surfaces under thermal insulation, such as chilled water, steam, and heated gas lines.

1.5 Method of Specifying Coating Requirements

a. Specifications referencing this Standard shall include the following:

(1) The type of surface to be coated.
(2) The zone of exposure.
(3) Surface preparation.
(4) Defined paint system.
(5) Coating thicknesses.
(6) The finish color required (when applicable).

These requirements should be assembled in a coating schedule for easy reference.

b. The coating specification shall contain the following key elements: scope, applicable documents, submittals, environmental protection, waste management, safety/personnel protection, materials, tools and equipment, environmental conditions, work schedule, surface preparation (including a listing of abrasive-sensitive hardware to be prepared or protected), coating schedule, coating mixing and application, quality control inspection, reporting, and final acceptance.

See Appendix D, Coating Specification Key Elements, for a recommended outline of a coating specification and Appendix E for a recommended coating schedule.

1.6 Environmental Stewardship and Health and Safety

a. Environmental, health, and safety impacts of processes and materials shall be taken into account when employing protective coating methods and techniques.

b. Alternative, environmentally friendly materials that do not contain hexavalent chromium, lead, cadmium, or hazardous air pollutants (HAPs), such as methyl ethyl ketone, toluene, and xylene, shall be considered when determining the correct coating method/technique for each protective coating application.

c. Alternative, less hazardous materials shall be considered when determining the correct coating method/technique for each protective coating application, to minimize risk in construction, use, and demolition.

d. Performance criteria defined in this Standard shall take precedent. Coatings containing hazardous materials may be harmful to human health and the environment.

2. APPLICABLE DOCUMENTS

2.1 General

The documents listed in this section contain provisions that constitute requirements of this Standard as cited in the text.

2.1.1 The latest issuances of cited documents shall apply unless specific versions are designated.

2.1.2 Non-use of specific versions as designated shall be approved by the responsible Technical Authority.

The applicable documents are accessible via the NASA Standards and Technical Assistance Resource Tool at http://standards.nasa.gov or may be obtained directly from the Standards Developing Organizations or other document distributors.

2.2 Government Documents

Department of Defense (DoD)

MIL-A-22262	Abrasive Blasting Media Ship Hull Blast Cleaning
MIL-P-85891	Plastic Media for Removal of Organic Coatings
MIL-PRF-24667	Coating System, Non-skid, for Roll, Spray, or Self-Adhering Application
QPL 22262	Qualified Products List (Military) of Products Qualified Under Detail Specification MIL-A-22262 Abrasive Blasting Media Ship Hull Blast Cleaning

Federal (FED)

29 CFR 1910.134	Respiratory Protection
FED-STD-595	Colors Used in Government Procurement

National Aeronautics and Space Administration (NASA)

KSC-SPEC-F-0006	Heat and Blast Protection Coating Materials and Application Methods, Specification for
KSC-STD-SF-0004	Ground Piping Systems Color Coding and Identification, Safety Standard for
NASA-STD-6001 (Latest version, including the interim (I) version)	Flammability, Offgassing, and Compatibility Requirements and Test Procedures

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

2.3 Non-Government Documents

American Society for Testing and Materials (ASTM)

ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D520	Standard Specification for Zinc Dust Pigment
ASTM D610	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	Standard Test Method for Evaluating Degree of Blistering of Paints

ASTM D1654	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4752	Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

Compressed Gas Association, Inc. (CGA)

CGA G-7.1	Commodity Specification for Air

NACE International

RP0198	The Control of Corrosion Under Thermal Insulation and Fireproofing Materials – A Systems Approach
RP0288	Inspection of Linings on Steel and Concrete
SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

National Sanitation Foundation (NSF)

NSF 61	Drinking Water System Components – Health Effects

The Society for Protective Coatings (SSPC)

SSPC-AB 1	Mineral and Slag Abrasives
SSPC-AB 2	Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB 3	Ferrous Metallic Abrasive
SSPC-PA 2	Measurement of Dry Coating Thickness With Magnetic Gages
SSPC-SP 1	Solvent Cleaning
SSPC-SP 3	Power Tool Cleaning
SSPC-SP 5/	White Metal Blast Cleaning

NACE No. 1	
SSPC-SP 10-/ NACE No. 2	Near-White Metal Blast Cleaning
SSPC-SP 11	Power Tool Cleaning to Bare Metal
SSPC-TU 4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates

2.4 Order of Precedence

This Standard establishes requirements for the application of protective coatings to prevent corrosion of exposed carbon steel, stainless steel, and aluminum but does not supersede nor waive established Agency requirements found in other documentation.

2.4.1 Conflicts between this Standard and other requirements documents shall be resolved by the responsible Technical Authority.

3. ACRONYMS AND DEFINITIONS

3.1 Acronyms and Abbreviations

° C	degree Celsius
° F	degree Fahrenheit
µg	microgram
µm	micrometer
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APL	Approved Products List
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CIP	Coating Inspector Program
cm	centimeter
DFT	dry film thickness
DoD	Department of Defense
FED	Federal
ft	foot
GSE	ground support equipment
GU	gloss units
HAP	hazardous air pollutant
hr	hour

in	inch
IOT	inorganic topcoat
kip	1,000 pounds-force
km	kilometer
kPa	kilopascal
KSC	John F. Kennedy Space Center
ksi	kip per square inch
LLC	Limited Liability Company
m	meter
mi	mile
mil	one thousandth of an inch
MIL	Military
mm	millimeter
MPa	megapascal
mph	miles per hour
NACE	NACE International, formerly known as National Association of Corrosion Engineers
NASA	National Aeronautics and Space Administration
NIOSH	National Institute of Occupational Safety and Health
No.	number
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
oz	ounce
PCB	polychlorinated biphenyl
PDCA	Painting and Decorating Contractors of America
pH	measure of acidity or alkalinity of a solution
PPE	personal protective equipment
PPG	Pittsburgh Paint and Glass
psi	pound per square inch
QPL	Qualified Products List
RH	relative humidity
SB	solvent-based
SRB	solid rocket booster
SSPC	The Society for Protective Coatings
STD	standard
TM	Technical Manual
TO	technical order
TSC	thermal spray coating
VOC	volatile organic content
WB	water-based
WFT	wet film thickness

3.2 Definitions

3.2.1 High-gloss finish is defined as a minimum of 85 gloss units (GUs) at a 60-degree angle.

3.2.2 Semigloss finish is defined as 60 GU to 85 GU at a 60-degree angle;

4. REQUIREMENTS

4.1 Materials

4.1.1 Abrasive-Blasting Aggregate

a. Blasting aggregates shall be approved materials in accordance with MIL-A-22262, Abrasive Blasting Media Ship Hull Blast Cleaning; or SSPC-AB 1, Mineral and Slag Abrasives, Type I or II, Class A; or steel grit in accordance with SSPC-AB 3, Ferrous Metallic Abrasive, Class 1.

b. Only materials approved in Qualified Products List (QPL) 22262, Qualified Products List: List of Products Qualified Under Military Specification MIL-A-22262, shall be used.

c. The abrasive grade selected shall produce the required surface profile and possess physical properties that are compatible with the requirements of this Standard.

d. The new steel grit shall be a neutral pH (6.0 to 8.0), rust-free and oil-free, dry, commercial-grade blasting grit with a hardness of 40 to 50 Rockwell C.

e. Recycled steel grit shall be in accordance with SSPC-AB 2, Cleanliness of Recycled Ferrous Metallic Abrasives.

f. The size shall be selected to produce the required anchor profile.

For paint removal or cleaning of aluminum, stainless steel, and fiberglass, plastic media in accordance with MIL-P-85891, Plastic Media for Removal of Organic Coatings, may be used as an alternate.

g. Only aggregates that are free of crystalline silica shall be selected for use at NASA, unless exemptions to this policy are coordinated with the local Occupational Health Office.

h. Blasting aggregate for abrasion-sensitive hardware (such as bellows, gimbal joints, and other thin-walled components) shall be materials that do not change the surface profile.

i. Blasting operations shall not produce holes, cause distortion, remove metal, or cause thinning of the substrate.

4.1.2 Protective Coatings, Thinners, and Cleaners

The following paragraphs establish minimum requirements for each generic type of protective coating specified in this Standard. See section 4.4.3.1 for coating intercoat compatibility requirements.

a. All coatings shall possess physical properties and handling characteristics that are compatible with the application requirements of this Standard.

b. All coatings shall be self-curing.

c. Thinners and cleaners for each coating shall be procured from the manufacturer of the coating.

d. Procurement awards for coatings to be supplied according to this Standard shall be made only for those products in the Approved Products List (APL).

e. Application characteristics shall be judged acceptable prior to beach exposure testing.

f. Protective coatings shall be compatible with fluids expected in the areas to the extent required to prevent fire, explosion, or damage to facility, hardware, and GSE. All coating materials, when used in areas where exposure to hypergolic propellants could occur, shall be compatible with the propellants in accordance with the latest version of NASA-STD-6001, Flammability, Offgassing, and Compatibility Requirements and Test Procedures, including the interim (I) version.

Interested parties should be aware of this requirement and are urged to arrange for testing of their product so that they may be eligible for award of contracts or orders for coatings to be supplied in accordance with this Standard. To arrange for product testing and the testing criteria, manufacturers must contact the Engineering Directorate, NASA, John F. Kennedy Space (KSC) Center, FL 32899 or contact the Corrosion Technology Laboratory at http://corrosion.ksc.nasa.gov.

4.1.2.1 Inorganic Zinc Coatings

Inorganic zinc coatings that have been approved are listed in Appendix A, Approved Products List for Inorganic Zinc Coatings.

To be listed, a coating shall meet the following minimum requirements:

a. Self-curing, multiple-component.

b. Dry-temperature resistance to 400 °C (750 °F) for 24 hours.

c. Minimum shelf life of 6 months, when stored in accordance with manufacturer's instructions.

d. Minimum of 83 percent zinc by weight in the applied dry film.

e. Contain Type III zinc dust pigment in accordance with ASTM D520, Standard Specification for Zinc Dust Pigment, and be asbestos-free, polychlorinated biphenyl (PCB)-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

f. Attain a rating of not less than 9 in accordance with ASTM D610, Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces; and ASTM D1654, Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments, when applied to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(1) 18 months for initial acceptance.
(2) 5 years for final acceptance.

g. Application characteristics shall be judged acceptable prior to beach testing.

4.1.2.2 Primer and/or Intermediate Coatings

These coatings are listed in Appendix B, Approved Products List for Topcoat Systems.

4.1.2.2.1 Inhibitive Polyamide Epoxy Coatings

Polyamide epoxy coatings shall conform to the following minimum requirements:

a. Polyamide-cured.

b. Rust-inhibitive.

c. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

d. Suitable as a primer for carbon steel, galvanized steel, and aluminum.

e. Suitable as an intermediate coat between an inorganic zinc primer and an aliphatic polyurethane finish coat.

f. Meet the compatibility requirements of section 4.4.3.1.

g. Contain a minimum of 40 percent solids by volume.

4.1.2.2.2 Noninhibitive Polyamide Epoxy Coatings

Polyamide epoxy coatings shall conform to the following minimum requirements:

a. Polyamide-cured.

b. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

c. Suitable as an intermediate coat between inorganic zinc primer and an aliphatic polyurethane finish coat.

d. Meet the compatibility requirements of section 4.4.3.1.

e. Contain a minimum of 40 percent solids by volume.

f. Not to be used as a primer on carbon steel.

4.1.2.2.3 Water-Reducible Intermediate Coatings

Water-reducible intermediate coatings shall conform to the following minimum requirements:

a. Self-curing, one or two packages, water reducible.

b. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

c. Suitable as an intermediate coat between inorganic zinc primers and water-reducible topcoats.

d. Meet the compatibility requirements of section 4.4.3.1.

e. Contain a minimum of 30 percent solids by volume.

f. Not to be used as a primer on steel.

4.1.2.3 Finish Coatings

4.1.2.3.1 Aliphatic Polyurethane Coatings

Aliphatic polyurethane coatings shall conform to the following minimum requirements:

a. Catalyst isocyanate cured.

b. High-gloss finish (minimum 85 gloss units (GUs) at a 60-degree angle).

c. Retain gloss and color upon prolonged exterior exposure.

d. Suitable as an exterior finish coat over an inorganic zinc primer with a polyamide epoxy intermediate coat.

e. Meet the compatibility requirements of section 4.4.3.1.

f. Contain a minimum of 44 percent solids by volume.

g. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

h. Attain a numerical rating of not less than 8 in accordance with ASTM D610 and ASTM D1654 and a numerical rating of not less than 9F in accordance with ASTM D714, Standard Test Method for Evaluating Degree of Blistering of Paints, when applied as a system to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(1) 18 months for initial acceptance.
(2) 5 years for final acceptance.

4.1.2.3.2 Water-Reducible Topcoats

Water-reducible topcoats shall conform to the following minimum requirements:

a. Self-curing, one or two packages, water-reducible.

b. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

c. Retain gloss and color upon prolonged exterior exposure.

d. Semi-gloss or high-gloss finish. (Semigloss is defined as 60 GU to 85 GU at a 60-degree angle; high gloss is defined as a minimum 85 GU at a 60-degree angle.)

e. Meet the compatibility requirements of section 4.4.3.1.

f. Attain a numerical rating of not less than 8 in accordance with ASTM D610 and ASTM D1654 and a numerical rating of not less than 9F in accordance with ASTM D714, when applied as a system to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(1) 18 months for initial acceptance.
(2) 5 years for final acceptance.

4.1.2.3.3 Inorganic Topcoats (IOTs)

IOTs shall conform to the following minimum requirements:

a. Dry-temperature resistance to 400 °C (750 °F) for 24 hours.

b. Suitable as a topcoat for inorganic zinc and galvanized steel in high-temperature environments.

c. Listed as an approved coating system (see Appendix B).

d. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

e. Attain a rating of not less than 9 in accordance with ASTM D610 and ASTM D1654 when applied to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(1) 18 months for initial acceptance.
(2) 5 years for final acceptance.

4.1.2.3.4 Polysiloxane Topcoats

Polysiloxane topcoats shall conform to the following minimum requirements:

a. Suitable as a finish coat for exterior exposure.

b. Contain a minimum of 44 percent solids by volume.

c. High-gloss finish (minimum 85 GU at a 60-degree angle).

d. Retain gloss and color on prolonged outdoor exposure.

e. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

f. Listed as an approved coating system (see Appendix B).

g. Attain a numerical rating of not less than 8 in accordance with ASTM D610 and ASTM D1654 and a numerical rating of not less than 9F in accordance with ASTM D714 when

applied as a system to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(1) 18 months for initial acceptance.
(2) 5 years for final acceptance.

4.1.2.4 Epoxy Mastic Coatings

Epoxy mastic coatings shall conform to the following minimum requirements:

a. Specifically intended for use over mechanically cleaned steel.

b. Contain a minimum of 80 percent solids by volume.

c. Two-component, catalyst-cured, aluminum-pigmented.

d. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

Examples of epoxy mastic coating that currently meet these requirements include:

(1) Ameron Amerlock 400 AL.
(2) Devoe Bar Rust 239.
(3) PPG Pittguard DTR.
(4) Sherwin-Williams Epolon Mastic.

4.1.2.5 Coal Tar Epoxy

a. Coal tar epoxy coating shall be a two-component, high-build epoxy of low volatile organic content (VOC).

b. The coal tar epoxy shall contain, at a minimum, 65 percent solids by volume.

c. The coal tar epoxy shall produce a one-coat thickness of 405 µm to 510 µm (16 mil to 20 mil) per coat dry film thickness (DFT).

Examples of coal tar epoxies that currently meet these requirements include the following:

a. Sherwin-Williams Hi-Mil Sher-Tar.
b. Made Well 1103.
c. Devoe Devtar 247.

4.1.2.6 Potable Water Epoxy

All coatings for potable water immersion service shall be three-coat epoxy systems that are certified by NSF Standard 61, Drinking Water System Components – Health Effects.

Some NSF-approved products include:

a. Ameron Amercoat 395.
b. Devoe Bar Rust 233.
c. Sherwin-Williams Potable Water Epoxy.

4.1.2.7 Nonskid Coating

Approved nonskid coatings shall conform to MIL-PRF-24667, Coating System, Non-skid, for Roll, Spray, or Self-Adhering Application, Type 1, Composition G, as supplied by American Safety Technologies, Inc., 565 Eagle Rock Avenue, Roseland, NJ 07068, telephone (800) 631-7841 (< www.astantislip.com >), or an approved equivalent (Primer MS 7C, Topcoat MS 400G, Color Topping MS-200).

4.1.3 Sealants/Caulking

a. Sealants shall be self-curing, single-component, polysulfide rubber or polyurethane material only, conforming to ASTM C920, Standard Specification for Elastomeric Joint Sealants, Type S, Grade NS, Class 25, use NT, A, and O.

b. If not topcoated, the caulking shall match the color of the joint surface being caulked.

c. If caulking is to be used in a clean-room environment, an approved material with low offgassing characteristics, in accordance with the latest version of NASA-STD-6001, including the interim (I) version, shall be selected.

4.1.4 Chip-Free Clean-Room Paint

Paint systems for metal substrates in clean-rooms may be required to pass tests for adhesion, offgassing, flammability, vacuum outgassing, and hypergolic compatibility. Offgassing, flammability, and hypergolic compatibility testing shall be in accordance with the latest version of NASA-STD-6001, including the interim (I) version, Supplemental Test Procedure A.7.

4.2 Equipment

4.2.1 Compressed Air

a. The compressed air system shall be capable of delivering a continuous nozzle pressure to achieve the required surface cleanliness and profile, typically 620 kPa (90 psi) minimum to each blast nozzle in operation.

The required air capacity depends upon the configuration of the abrasive system used. The air system should comply with the instructions and recommendations of the manufacturer of the abrasive-blasting system.

b. The compressed air system shall be equipped with oil and moisture separators to ensure only clean, dry air is provided to the service outlet.

c. The compressed air system shall comply with Occupational Safety and Health Administration (OSHA), American National Standards Institute (ANSI), and National Institute of Occupational Safety and Health (NIOSH) configurations.

d. Air distribution manifolds shall conform to American Society of Mechanical Engineers (ASME) standards.

4.2.2 Abrasive-Blasting System

a. The abrasive-blasting system shall comply with OSHA, ANSI, and NIOSH configurations consisting of, but not limited to, the following:

(1) A remote-controlled welded pressure pot conforming to ASME standards.
(2) The required length of blast hose.
(3) A venturi nozzle.
(4) A respiratory air-line filter.
(5) A blast hood approved by the Mine Safety and Health Administration/NIOSH with the required length of air hose.

b. The blasting system shall be designed to produce the specified cleanliness level and profile when coupled with the available compressed air supply.

4.2.3 Coating Application System

The coating application equipment shall be an airless spray system, conventional spray system, or other approved equipment in accordance with the coating manufacturer's recommendations and section 4.4.3.6.

4.2.4 Respiratory Protection

Respiratory protection shall be in accordance with 29 CFR 1910.134, Respiratory Protection, and Center respiratory protection requirements.

4.3 Safety and Health Requirements

a. Necessary precautions, in accordance with OSHA regulations, manufacturers' recommendations, and industry standards, shall be taken to ensure the safety and health of personnel performing the work required by this Standard and personnel who may be affected by such work.

Some of the materials handled in accordance with this document are combustible, or toxic, or both.

b. The Contractor shall provide equipment as required for safe and healthful application and instruction to the users regarding the hazards and proper handling and disposal procedures to prevent injury or illness.

c. The Contractor shall provide safe access to all areas for the coating inspector.

d. The Contractor shall submit a written safety and health plan that includes a Hazard Communication Program, a Respiratory Protection Program, and a Hearing Conservation Program that conforms to OSHA requirements and industry standards.

e. Where the contractor is required to remove surface coatings that contain PCB, lead, chromium, mercury, or cadmium, or other regulated materials, the Contractor shall include specific provisions in the safety and health plan for complying with all Federal, State, Local, and NASA Center specific requirements.

4.3.1 Environmental Requirements

The operations described in this Standard have the potential to impact the environment.

a. All local, state, and federal environmental regulations, as well as theNASA Center's environmental policies, shall be followed.

b. Questions regarding these regulations and policies shall be directed to the local environmental management organization.

4.3.2 Personal Protective Equipment (PPE)

a. When engineering controls cannot be implemented to protect workers, then PPE and/or administrative controls shall be used.

b. Where required, PPE shall be used in accordance with all federal, state, NASA, and Center requirements.

c. Both the supervisors and the workers shall be properly instructed, trained, and certified in the selection, use, and maintenance of PPE.

4.4 General Requirements

4.4.1 Applicator Qualifications

a. To ensure the highest quality of workmanship, only coating applicators who have worked in the painting trade sufficiently long enough to master the use of all applicable tools and materials shall be assigned to perform the work described herein.

The applicator's proficiency and ability to attain the required quality of workmanship for the specified coating system can be verified by testing and qualification in accordance with ASTM D4228, Standard Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces.

b. In addition, the coating applicators shall provide written evidence of having successfully completed a comprehensive training program, such as Painting and Decorating Contractors of America (PDCA)/NACE/SSPC Industrial Painters Training, or equivalent.

c. The Contractor shall provide all painting personnel an orientation on the proper mixing and application of the coatings specified, particularly inorganic zinc coatings.

d. Topics in the orientation of proper mixing and application of the specified coatings (particularly for inorganic zinc coatings) shall include specification requirements, material application characteristics, and inspection criteria.

e. The mixing or application of coatings shall be performed only by personnel who have received training.

f. The Contractor shall prepare representative sample areas that meet specification requirements.

4.4.2 Preparation of Surfaces

a. All surfaces to be coated shall be clean, dry, and free from oil, grease, dirt, dust, corrosion, peeling paint, caulking, weld spatter, and any other surface contaminants.

b. All surfaces that cannot be accessed after fabrication, erection, or installation shall be prepared and coated while accessible.

c. Surface preparation and coating operations shall be sequenced, so that freshly applied coatings will not be contaminated by dust or foreign matter.

d. All equipment and adjacent surfaces not to be coated shall be protected from surface preparation operations.

e. Working mechanisms shall be protected against intrusion of the abrasive.

f. All surfaces shall be degreased, as required, before subsequent surface preparation procedures or the application of protective coatings, or both.

g. The following sections provide the surface preparation techniques that shall be used when specified in section 4.5.

4.4.2.1 Cleaning and Degreasing

a. Degreasing shall be by solvent cleaning, detergent washing, or steam cleaning in accordance with SSPC-SP 1, Solvent Cleaning.

b. This degreasing procedure shall be followed when cleaning carbon steel, galvanized steel, stainless steel, or aluminum.

c. Selection of solvents shall be in accordance with use requirements and applicable federal, state, and NASA environmental policies.

d. Chlorofluorocarbon solvents shall not be used.

e. Water washing, using clean potable water, shall be done when high levels of chloride (>5 µg/cm^2) or other undesirable contaminants are found on the surfaces.

f. Water washing shall be accomplished using standard industrial pressure cleaners with a pressure-versus-volume output balance that will ensure thorough and productive cleaning.

g. All water washing or pressure cleaning operations shall comply with all Federal, State, Local and NASA Center environmental requirements.

h. The cleaned surface shall be free of loose coatings, chlorides, dirt, dust, mildew, grinding/welding/cutting debris, and visible contaminants.

i. The surface shall be clean and dry prior to the abrasive-blasting operations and application of coatings.

4.4.2.2 Abrasive Blasting

a. The abrasive-blasting aggregate shall be clean and dry and conform to section 4.1.1.

b. The abrasive-blasting system shall conform to section 4.2.2.

c. Abrasive blasting shall be in accordance with the applicable paragraphs in section 4.5.

d. Abrasive residues shall be removed from the surface, leaving it clean and dry before the coatings are applied.

e. All particulate emissions generated during abrasive-blasting operations shall be contained.

f. The containment system shall be designed to comply with all applicable federal, state, and local regulations as well as all NASA policies.

g. Exemptions to the requirement in "f" shall be coordinated with the local environmental management office.

h. The aggregate used to prepare abrasive-sensitive hardware such as bellows, gimbal joints, and other thin-walled components shall be carefully identified and selected.

4.4.2.3 Mechanical Cleaning Methods

Mechanical methods shall be in accordance with the applicable paragraph in section 4.5.

4.4.3 Application of Coatings

a. All prepared surfaces shall be coated within 6 hours after surface preparation and before corrosion or recontamination occurs. As an exception, surfaces prepared under temperature and humidity control may be coated after 6 hours but only after inspection of the surface preparation confirms that the cleanliness level has met the specified standards.

b. Any surface that shows corrosion or contamination, regardless of the length of time after preparation, shall be prepared again.

c. The application and handling characteristics of all coatings will vary. To obtain optimum performance, adequate written instructions from the manufacturer are essential and shall be closely followed in conjunction with the requirements defined herein.

d. The manufacturer's written recommendations for thinning, mixing, handling, and applying the product shall be strictly followed.

e. All coatings shall be thoroughly worked into all joints, crevices, and open spaces.

f. All newly coated surfaces shall be protected from damage.

g. All equipment and adjacent surfaces not to be coated shall be protected from overspray and splattered coatings.

h. Particulate emissions shall be contained during all spray-painting operations.

i. The containment system shall be designed to comply with all federal, state, and local regulations as well as all NASA policies.

j. Exemptions to this requirement shall be coordinated with the local environmental management organization.

4.4.3.1 Coating Systems

a. Coating systems for specified uses and substrates shall be as defined in section 4.5 and conform to section 4.1.2.

b. All thinners and cleaners shall be products of the coating manufacturer, except as defined in section 4.1.2.7.

c. To ensure intercoat compatibility, coating systems consisting of more than one coat shall be products of the same manufacturer.

d. Continuity of the coating manufacturer's system shall be maintained for the duration of an individual project.

4.4.3.2 Colors

a. Inorganic zinc coatings shall be pigmented so that there is a definite contrast between the coating and the dull gray appearance of the blasted steel surface during the coating application.

b. Color coding for fluid system piping shall be in accordance with KSC-STD-SF-0004, Ground Piping Systems Color Coding and Identification, Safety Standard for.

c. Finish coat colors shall be in accordance with the following FED-STD-595, Colors Used in Government Procurement, color numbers using pigments free of PCB, lead, chromium, and cadmium:

(1) White, No. 17925.
(2) Blue, No. 15102 (safety).
(3) Yellow, No. 13538 (standard).
(4) Yellow, No. 13655 (safety).

(5) Red, No. 11136.
(6) Red, No. 11105 (safety).
(7) Black, No. 17038.
(8) Green, No. 14110 (safety).
(9) Gray, No. 16187 (safety).
(10) Brown, No. 10080 (safety).
(11) Gray, No. 16473 (standard).

4.4.3.3 Storage of Coating Materials

a. Coating materials and thinners shall be stored in their original containers with the manufacturer's name, product identification, shelf life, and batch number.

b. Coating materials, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to sparks, flame, direct sunlight, extreme heat, or rainfall.

c. The manufacturer's written instructions for storage limitations shall be followed.

d. Tarpaulins shall not be used as the sole means of covering coating materials for storage.

e. Material Safety Data Sheets for coating materials and thinners shall be maintained or made accessible to users in the area.

f. The Contractor shall submit a written plan for approval for storage of coating materials for coordination with the local safety/fire/environmental organization.

4.4.3.4 Mixing and Application Instructions

a. Coating materials shall be thoroughly mixed prior to application with a mechanical mixing instrument that will not induce air into the coating, such as a Jiffy Mixer, manufactured by the Jiffy Mixer Company (< www.jiffymixer.com >), Inc., Riverside, CA, or an approved equivalent.

b. The mixer shall be powered by an air motor or an explosion-proof electric motor.

c. All mixing operations shall be performed over an impervious surface with provisions to prevent runoff to grade of any spilled material.

d. The mixed coating material shall be strained through a 30-mesh to 60-mesh screen prior to application.

e. Thinning shall be for viscosity control only.

f. If thinner is required, the amount recommended by the manufacturer of the thinner shall be used.

g. The material shall be agitated as required during application to maintain a uniform suspension of solids.

h. Continuous rapid agitation shall be avoided.

i. Spray equipment shall be adjusted to produce an even, wet coat with minimum overspray.

j. The conventional pressure pot, when used, shall be kept at approximately the same level or above the spray gun, so that the material is delivered properly.

k. Coatings shall be applied in even, parallel passes, overlapping 50 percent.

4.4.3.5 Weather Conditions

a. No coating shall be applied when contamination from any source (i.e., rainfall) is imminent or when the temperature or humidity is outside limits recommended by the coating manufacturer.

b. To prevent condensation during application, the surface temperature shall be at least 3 °C (5 °F) above the dew point and rising.

c. Spray application methods shall not be used when wind speed exceeds 25 km/hr (15 mph) in the area where the coating is being applied.

d. Limitations against using certain coatings under specific relative humidity (RH) are as follows:

(1) Solvent-based inorganic zinc coatings, polysiloxane topcoats, and IOTs shall not be applied in conditions with <40 percent RH.

(2) Water-based inorganic zinc coatings shall not be applied in conditions with <40 percent or >80 percent RH.

4.4.3.6 Methods of Application

a. Coatings shall be applied with airless or conventional spray equipment, or both, according to section 4.2.3.

b. Application with brushes shall be permitted for minor touchup of spray applications and stripe coats of inorganic zinc.

Organic midcoats and topcoats may be applied using a brush, roller, or spray device as applicable.

4.4.3.7 Coating Finish

a. Each coat of material applied shall be free of runs, sags, blisters, bubbles, and mud-cracking; variations in color, gloss, and texture; holidays (missed areas); excessive film buildup; foreign contaminants; dry overspray; etc.

b. Special care shall be taken to ensure complete coverage and proper thickness on welds, corners, crevices, sharp edges, bolts, nuts, and rivets.

c. Each coat of applied material shall be rendered clean, dry, and free from surface contaminants before another coating is applied.

4.4.3.8 Touchup of Welds and Damaged Coatings

a. Field welds and damaged coatings shall be touched up in accordance with section 4.5.8.

b. The coating shall be applied in accordance with sections 4.4.3.4 and 4.4.3.6.

c. Touchup and repair shall be accomplished promptly after the damage or welding has occurred.

4.4.3.9 Coating, Drying, and Curing

a. The coating manufacturer's recommended drying and curing times for handling, recoating, and topcoating shall be followed.

b. The coating manufacturer's recommendations shall be followed to test the coating for proper curing.

c. Proper curing of solvent-based inorganic zinc-rich coatings shall be verified by ASTM D4752, Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub, prior to further coating.

d. Water-based inorganic zinc-rich coatings shall be verified for curing in accordance with the same procedure, but water is to be substituted as the solvent.

Note: The curing time of solvent-based inorganic zinc coatings can be accelerated by rinsing or spraying the coating with potable fresh water after an initial overnight drying. The number and frequency of rinse cycles can vary with environmental conditions. Check with the material manufacturer for recommended procedures.

4.4.4 Sealing/Caulking

a. The perimeter of all faying surfaces, joints open less than 13 mm (0.5 in), and skip-welded joints shall be completely sealed.

b. The sealant shall be a self-curing, single-component, polysulfide rubber or polyurethane type, conforming to section 4.1.3.

c. The sealant shall be applied to the joint with a caulking gun after the inorganic zinc primer has been applied on carbon steel.

d. For topcoated zinc primers, caulking shall be applied after the intermediate coat of epoxy.

e. For coatings on stainless steel, galvanized steel, and aluminum, caulking shall be applied before application of the topcoat.

f. The bead shall have a smooth and uniform finish and be cured (tacky to the touch) before the topcoat is applied.

4.5 Specific Requirements

4.5.1 Protection of Carbon Steel

a. Carbon steel surfaces shall be protected from atmospheric corrosion through the application of zinc coatings (inorganic zinc coating and/or hot-dip galvanizing and/or metallizing) as defined herein.

b. New steel components, such as stair treads, grating, handrails, pipes, and hardware (nuts, bolts, and fasteners), shall be hot-dip galvanized in accordance with section 4.5.1.2.1, as applicable.

c. All other carbon steel surfaces that are exposed to the atmosphere shall be coated with inorganic zinc conforming to section 4.1.2 in accordance with section 4.4.3, hot-dip-galvanized (zinc-coated) in accordance with section 4.5.1.2.1, or metallized in accordance with section 4.5.1.3.
The zinc coatings may require topcoating with additional protective coatings as specified; but in neutral pH atmospheres, testing has proven zinc without topcoating to have superior performance.

d. Carbon steel faying surfaces that are a part of all friction-type and electrical grounding joints shall be abrasive-blasted and coated with 100 µm to 150 µm (4 mil to 6 mil) of inorganic zinc only, in accordance with section 4.5.1.1.4, prior to installation.

e. An inorganic zinc coating used in a friction-type joint shall be approved by the American Institute of Steel Construction (AISC).

f. The recommended coating application sequence for carbon steel shall be to first abrasive blast the steel and then to prime it with inorganic zinc before installation or erection.

g. Further topcoating, if required, shall be done after all welding, grinding, or drilling has been completed, and after areas damaged by these procedures have been properly repaired with inorganic zinc.

4.5.1.1 Protection with Inorganic Zinc

4.5.1.1.1 Pre-Cleaning of Carbon Steel

Carbon steel surfaces shall be cleaned and degreased in accordance with SSPC-SP 1 followed by power tool cleaning in accordance with SSPC-SP 3, Power Tool Cleaning, to remove weld spatter, weld slag, laminations, sharp edges, and other surface defects prior to abrasive blasting or power tool cleaning to bare metal.

4.5.1.1.2 Power Tool Cleaning of Carbon Steel

a. Carbon steel shall be cleaned to bare metal, using power tools, in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal, when a roughened, clean, bare metal surface is required but abrasive blasting is not feasible or permissible.

b. The surface anchor profile of the surface cleaned with the power tool shall be 40 µm to 75 µm (1.5 mil to 3.0 mil).

c. All rust shall be completely removed from pits and depressions.

4.5.1.1.3 Abrasive Blasting of Carbon Steel

a. Carbon steel shall be abrasive-blasted to a minimum cleanliness of near-white metal, in accordance with SSPC-SP 10/NACE No. 2, Near-White Metal Blast Cleaning, with aggregate conforming to the requirements in section 4.1.1.

b. The anchor profile of the blasted surface shall be 40 µm to 75 µm (1.5 mil to 3.0 mil), measured in accordance with ASTM D4417, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.

c. All rust shall be completely removed from pits and depressions.

4.5.1.1.4 Stripe Coat Application

Stripe coating with inorganic zinc shall be applied to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure complete coverage prior to subsequent applications of inorganic zinc.

4.5.1.1.5 Application of Inorganic Zinc Coatings

a. Inorganic zinc coatings shall be applied to a DFT of 100 µm (4.0 mil) minimum to 150 µm (6.0 mil) maximum when they will be left without a topcoat or when IOT or ablative coating is applied.

b. When the zinc coatings are to be topcoated with organic topcoats, the DFT shall be reduced to 65 µm (2.5 mil) minimum to 100 µm (4.0 mil) maximum.

c. The proper DFT for the inorganic zinc coating shall be obtained in a single application, which may consist of multiple passes, while the coating is still wet (including the application of a stripe coat).

4.5.1.1.6 Topcoat Systems for Inorganic Zinc Coatings

a. The following topcoat systems shall be applied over the inorganic zinc coatings as required for each zone of exposure described in section 1.4.

b. Topcoats shall be applied at the DFT recommended by the manufacturer or as specified in the section that follows.

c. The film thickness of the topcoats shall be sufficient to ensure uniform coverage and color.

(1) Zones 1a and 1b. Inorganic zinc coatings may be left without a topcoat; however, for maximum protection, the inorganic zinc coating should be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006, Heat and Blast Protection Coating Materials, Specification for.

(2) Zone 1c. Inorganic zinc coatings shall be left without a topcoat.

(3) Zone 2. An IOT conforming to section 4.1.2.3.3 shall be applied at a DFT of 75 µm to 125 µm (3 mil to 5 mil).

As an alternate, surfaces may be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006.

(4) Zones 3a and 3b.

A. An intermediate/tie coat and a finish coat conforming to section 4.1.2 shall be applied in accordance with section 4.4.3.

B. As an alternate, an IOT conforming to section 4.1.2.3.3 or a polysiloxane finish coat conforming to section 4.1.2.3.4 shall be applied at the manufacturer's recommended DFT).

C. The DFT shall be sufficient to completely hide the inorganic zinc primer.

(5) Zones 4a, 4b, and 4c. *No topcoats are required, except as needed for color coding, safety purposes, identification, or special conditions.*

When required for color coding, safety purposes, identification, or special conditions, topcoats shall be in accordance with section 4.4.3.2.

(6) Zone 5a and 5b. Inorganic *zinc coating is suggested but not required. As an alternate, an inhibitive epoxy primer and a polyurethane finish coat conforming to section 4.1.2 at the manufacturer's recommended thickness may be used.*

(7) Zone 6. The coating system shall be as specified in sections 4.5.4 and 4.5.5.

(8) Zone 7. The coating system shall be as specified in NACE International RP0198, The Control of Corrosion Under Thermal Insulation and Fireproofing Materials – A Systems Approach.

4.5.1.2 Protection by Galvanizing

4.5.1.2.1 Galvanizing

a. Galvanizing (zinc coating) shall be accomplished after fabrication by the hot-dip process conforming to ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; and ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

b. Galvanizing weight for steel sheet without further coating protection shall meet the standards of ASTM A653, with a galvanizing weight of G165.

c. All lower galvanizing weights for steel sheet shall be further protected with coatings except for Zone 5a & 5b exposures.

d. In accordance with this Standard, the galvanneal process shall not be used for the coating of steel sheet.

e. Steel components with an ultimate tensile strength above 900 MPa (130 ksi) or hardness above Rockwell C Hardness 28 shall not be galvanized due to potential hydrogen embrittlement.

4.5.1.2.2 Surface Preparation for Galvanizing

CAUTION: *Some galvanized configurations are susceptible to distortion when they are abrasive-blasted.*

a. Special care shall be taken to prevent any metal distortion by reducing blast nozzle pressure and increasing the working distance from the nozzle to the surface.

b. In some cases, such as in the surface preparation of light-gage sheet steel, these precautions may not be sufficient to prevent distortion; and alternate procedures, such as abrading or mechanical cleaning, shall be used to remove corrosion or roughen the surface.

c. Galvanized surfaces shall be abrasive-blasted with fine-grade abrasives conforming to the requirements in section 4.1.1 to remove corrosion and old coatings or roughen new surfaces.

d. The blasted surface shall be free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

e. Galvanized surfaces to be further topcoated shall be prepared by degreasing in accordance with section 4.4.2.1 before any additional surface preparation.

f. After degreasing, abrasive blasting or mechanical cleaning shall be performed as required by the zone of exposure, as defined in section 4.5.1.2.3.

g. If galvanized steel is prepared for the application of coatings by abrasive blasting, it shall be lightly brush-blasted with fine-grade abrasive at a lower pressure to provide a corrosion-free and uniform, slightly roughened surface.

h. Care shall be taken not to completely remove the galvanized finish.

i. The zinc coatings shall be maintained or rendered clean, dry, and free from contaminants before topcoat systems are applied.

j. Field repair of damaged galvanized surfaces shall be accomplished in accordance with ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings, using inorganic zinc coatings.

k. Galvanized steel that is to be mechanically cleaned shall be cleaned in accordance with SSPC-SP 3 using abrasive discs/sheets, or other approved methods.

l. All corrosion and foreign matter shall be completely removed and the entire surface slightly roughened.

4.5.1.2.3 Coating Systems for Galvanizing

a. Zones 1a and 1b. Galvanized surfaces may be left without a topcoat; however, for maximum protection, the galvanized coating shall be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006.

b. Zone 1c. Galvanized surfaces shall be left without a topcoat.

c. Zone 2. After brush-blasting, an IOT conforming to section 4.1.2.3.3 shall be applied at a DFT of 75 µm to 125 µm (3 mil to 5 mil).

As an alternate, surfaces may be topcoated with a heat-resistant coating material, such as a silicone ablative coating material in accordance with KSC-SPEC-F-0006.

d. Zones 3a and 3b. After brush-blasting, primer/tiecoat and finish coat conforming to section 4.1.2 shall be applied in accordance with manufacturer's recommended thicknesses.

(1) As an alternate, an IOT conforming to section 4.1.2.3.3 or a polysiloxane finish coat conforming to section 4.1.2.3.4 shall be applied at the manufacturer's recommended DFT.

(2) The DFT shall be sufficient to completely hide the galvanized coating.

e. Zones 4a, 4b, and 4c. *No topcoats are required for galvanizing weights meeting or exceeding ASTM A123, ASTM A153, and ASTM A653, with a galvanizing weight of G165.*

(1) When steel sheet is galvanized less than ASTM A653, with a galvanizing weight of G165, further coating in accordance with Zone 3 shall be required.

(2) As an alternate to topcoats, steel sheet shall be degreased, brush-blasted, and an inorganic zinc primer conforming to section 4.1.2.1 applied to a DFT of 50 µm to 75 µm (2 mil to 3 mil).

f. Zone 5a and 5b. *No topcoats are required, except for when needed for color coding, safety purposes, identification, or special conditions.*

(1) When topcoats are required for color coding, safety purposes, identification, or special conditions, the surface shall be degreased and an epoxy primer applied at the manufacturer's recommended DFT.

(3) Within 24 hours, a polyurethane finish coat conforming to section 4.1.2 shall be applied at the manufacturer's recommended DFT.

(4) As an alternate, a polysiloxane topcoat conforming to section 4.1.2.3.4 shall be applied at the manufacturer's recommended DFT.

(4) The DFT shall be sufficient to completely hide the galvanized coating.

g. Zone 6. The coating system shall be as specified in sections 4.5.4 and 4.5.5.

h. Zone 7. The coating system shall be as specified in NACE International RP0198 .

4.5.1.3 Protection with Metallizing

4.5.1.3.1 Pre-Preparation of Carbon Steel

Carbon steel surfaces shall be cleaned and degreased in accordance with SSPC-SP 1 followed by power tool cleaning in accordance with SSPC-SP 3 to remove weld spatter, weld slag, laminations, sharp edges, and other surface defects prior to abrasive blasting or power-tool cleaning to bare metal.

4.5.1.3.2 Abrasive Blasting of Carbon Steel

a. At a minimum, carbon steel shall be abrasive-blasted to near-white metal (SSPC-SP 10/NACE No. 2) with aggregate conforming to the requirements in section 4.1.1.

b. The anchor profile of the blasted surface shall be 62.5 µm to 75 µm (2.5 mil to 3 mil).

c. All rust shall be completely removed from pits and depressions.

4.5.1.3.3 Application of Metallized Coatings

a. Metal wire to be used with the arc spray metallizing equipment shall be pure zinc, 90-10 zinc-aluminum, 85-15 zinc-aluminum alloys, 53-56 aluminum-magnesium, or pure magnesium .

b. Metallized zinc coatings shall be applied to a DFT of 200 µm (8 mil) minimum to 375 µm (15 mil) maximum, depending on the intended service environment.

4.5.1.3.4 Topcoat Systems for Metallized Zinc Coatings

a. Topcoat systems shall be applied over the metallized zinc coatings as required for each zone of exposure described in section 1.1.

b. The coating materials shall be selected from Appendix C, Approved Products List for Metallized (TSC) Systems.

c. Topcoats shall be applied at the DFT recommended by the manufacturer or as specified in requirement "d" that follows.

d. The film thickness of the topcoats shall be sufficient to ensure uniform coverage and color.

(1) Zones 1a and 1b. Metallized coatings may be left without a topcoat; however, for maximum protection, the metallized coating shall be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006.

(2) Zone 1c. Metallized coatings shall be left without a topcoat.

(3) Zone 2. An IOT conforming to section 4.1.2.3.3 shall be at a DFT of 75 µm to 125 µm (3 mil to 5 mil).

As an alternate, surfaces may be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006.

(4) Zone 3. An intermediate/tie coat and a finish coat conforming to section 4.1.2 shall be applied in accordance with section 4.4.3.

A. As an alternate, an IOT conforming to section 4.1.2.3 shall be applied at a DFT of 75 µm to 125 µm (3 mil to 5 mil), or a polysiloxane finish coat conforming to section 4.1.2.3.4 shall be applied at the manufacturer's recommended DFT.

B. The DFT shall be sufficient to completely hide the metallized coating.

(5) Zones 4a, 4b, and 4c. *No topcoats are required, except as needed for color coding, safety purposes, identification, or special conditions.*

When topcoats are required for color coding, safety purposes, identification, or special conditions, topcoats shall be in accordance with section 4.4.3.2.

(6) Zone 5a and 5b. A *metallized coating is suggested but not required. As an alternate, an inhibitive epoxy primer and a polyurethane finish coat conforming to section 4.1.2 may be applied at the manufacturer's recommended thickness.*

(7) Zone 6. The coating system shall be as specified in sections 4.5.4 and 4.5.5.

(8) Zone 7. The coating system shall be as specified in NACE International RP0198.

4.5.2 Protection of Aluminum

Aluminum shall be protected from corrosion by the use of protective coatings as defined herein. Certain alloys may require coatings in specific environments as specified in section 4.5.2.2

4.5.2.1 Surface Preparation of Aluminum

CAUTION: *Some aluminum configurations are susceptible to distortion and/or destruction when they are abrasive-blasted.*

a. Special care shall be taken to ensure against any metal damage by the choice of abrasive aggregate and by reducing blast nozzle pressure and increasing the working distance from the nozzle to the surface as necessary.

b. In some cases, such as in the surface preparation of light-gage sheet, these precautions may not be sufficient to prevent distortion; and an alternate procedure, such as abrading or mechanical cleaning, shall be used to remove corrosion or roughen the surface.

c. Aluminum surfaces shall be abrasive-blasted with fine-grade abrasive materials conforming to the requirements in section 4.1.1 to remove corrosion and old coatings or roughen new surfaces.

d. The blasted surface shall be free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

e. Aluminum shall be prepared by degreasing and abrasive blasting or mechanical cleaning, as required by the condition and configuration of the surface.

f. Abrasive blasting shall be used whenever possible using nonmetallic abrasives specified in section 4.1.1.

g. Mechanical cleaning shall be used only when abrasive blasting is impractical, would damage the structure or component, or is prohibited in the area where the work is being performed.

h. Aluminum shall be mechanically cleaned in accordance with SSPC-SP 3 using abrasive discs/sheets, or other approved methods.

i. All corrosion and foreign matter shall be completely removed and the entire surface slightly roughened.

j. Anodized or chemical-conversion-coated aluminum surfaces shall not be mechanically cleaned.

k. In accordance with section 4.1.1, plastic media or an approved equivalent shall be used for abrasive blasting of bellows, gimbal joints, and other thin-walled, abrasion-sensitive components.

4.5.2.2 Protective Coatings

Note: *Aluminum surfaces require special coatings if used underwater. See section 4.5.4 for coatings for underwater use.*

The following protective coatings shall be applied to aluminum surfaces as required for each zone of exposure described in section 1.4:

a. Zones 1, 2, and 3. The following coatings shall be used to protect aluminum in the launch environment. To facilitate washdown of SRB residue on critical hardware, an inhibited polyamide epoxy coating and aliphatic polyurethane topcoat may be used as well as other coatings such as polysiloxane, IOTs, and silicone ablative.

b. Zones 4 and 5. *No protective coatings are required except as needed for color coding, safety purposes, identification, or special conditions for normal atmospheric service of 1000-, 5000-, and 6000-series alloys.* Aluminum that is located within 3.5 km (2 mi) of the coastline or subject to chemical exposure shall be fully coated according to section 4.5.2.2.a.

c. Zone 6. The coating system shall be as specified in sections 4.5.4 and 4.5.5.

d. Zone 7. The coating system shall be as specified in NACE International RP0198.

4.5.3 Protection of Stainless Steel

Type 300 series stainless steels shall be protected from corrosion by the use of protective coatings as defined in section 4.5.3.2. Certain highly alloyed stainless steels, such as AL6XN or 254 SMO, do not require protective coatings for corrosion protection.

Note: *Thin-walled 300-series stainless-steel tubing is subject to pitting corrosion failure in outdoor marine environments.For exterior installations, this tubing shall be degreased, prepared with a stainless-steel wire wheel or equivalent, and coated in accordance with section 4.5.3.2.*

4.5.3.1 Surface Preparation of Stainless Steel

a. Stainless steel shall be prepared by degreasing in accordance with SSPC-SP 1 and abrasive blasting or mechanical cleaning.

b. Abrasive blasting shall be used whenever possible, using nonmetallic abrasives specified in 4.1.1.

c. As an alternative, stainless steel shall be mechanically cleaned in accordance with SSPC-SP 3 using abrasive discs/sanding sheets or other approved methods.

d. All corrosion and foreign matter shall be completely removed and the entire surface slightly roughened.

CAUTION: *Some stainless steel configurations are susceptible to distortion and/or destruction, when they are abrasive-blasted.*

e. Special care shall be taken to ensure against any metal damage by choice of abrasive aggregate and by reducing the blast nozzle pressure and increasing the working distance from the nozzle to the surface as necessary.

f. In some cases, such as in the surface preparation of light-gage sheet, these precautions may not be sufficient to prevent distortion; and an alternate procedure, such as abrading or mechanical cleaning, shall be used to remove corrosion or roughen the surface.

g. Stainless steel surfaces shall be abrasive-blasted with fine-grade abrasive conforming to the requirements in section 4.1.1 to remove corrosion and old coatings or roughen new surfaces.

h. The blasted surface shall be free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

4.5.3.2 Protective Coating

Zones 1, 2, and 3. For 300 series stainless steels, an inhibited polyamide epoxy primer and aliphatic polyurethane topcoat shall be used. *Other coatings such as polysiloxane and silicone ablative may be substituted as topcoats.*

b. Zones 4 and 5. For special conditions, stainless steel shall be brush-blasted and coated with inhibitive epoxy primer to a DFT of 50 µm to 75 µm (2 mil to 3 mil) followed by a finish coat that provides a DFT of 50 µm to 75 µm (2 mil to 3 mil).

c. Zone 6. The coating system shall be as specified in sections 4.5.4 and 4.5.5.

d. Zone 7. The coating system shall be as specified in NACE International RP0198 .

4.5.4 Underground, Submerged, or Continuously Wetted Surfaces

a. Surfaces that will be underground, submerged, or continuously wetted shall be prepared in accordance with SSPC-SP 5/NACE No.1, White Metal Blast Cleaning, with a profile of 75 µm to 100 µm (3 mil to 4 mil) and coated with coal tar epoxy conforming to section 4.1.2.5.

b. Coal tar epoxy coatings shall not be used for surfaces that will be in contact with potable water.

c. The coating shall be applied to a minimum DFT of 410 µm (16.0 mil) and checked for missed areas or pinholes with a properly calibrated holiday detector in accordance with NACE International SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

d. Cathodic protection requirements shall be coordinated with the application of this coating.

4.5.5 Coating Systems for Potable Water Immersion Service

a. All surface preparation for carbon steel shall be in accordance with SSPC-SP 5/NACE No. 1, with a surface profile of 75 µm to 100 µm (3 mil to 4 mil).

b. All coatings for potable water service shall be selected from section 4.1.2.6.

c. All potable water coating systems shall be inspected in accordance with standard recommended practices in NACE International RP0288, Inspection of Lining on Steel and Concrete, and with SP0188.

4.5.6 Provision for Nonskid Surfaces

Where a nonskid surface is required for walkways, decks, or other such surfaces, a nonskid coating conforming to section 4.1.2.7 shall be applied as follows:

a. Carbon steel. Coatings shall be applied directly over the zinc coating (inorganic zinc, galvanizing, or metallizing) and follow surface preparation instructions defined for topcoating in section 4.5.1.

b. Aluminum and stainless steel. Coatings shall be applied directly over these surfaces after surface preparation following instructions defined for topcoating in sections 4.5.2 and 4.5.3.

4.5.7 Coating Systems for Metallic Surfaces Under Thermal Insulation

Coating systems for carbon steel and stainless steel surfaces under thermal insulation and cementitious fireproofing shall be as specified in NACE International RP0198.

4.5.8 Repair of Applied Coatings

a. Newly applied coatings shall be repaired in accordance with table 1, Repair of Applied Coatings.

Table 1—Repair of Applied Coatings

Existing Coating	Repair Coating
Inorganic zinc	
Zones[1] 1 and 4	Inorganic zinc/epoxy mastic for small area touchup
Zone 2	Inorganic zinc/inorganic topcoat
Zones 3 and 5	Epoxy mastic/polyurethane/polysiloxane system for small area touchup
Galvanized steel	
Zones 1 and 4	Inorganic zinc/epoxy mastic for small area touchup
Zone 2	Inorganic zinc/inorganic topcoat
Zones 3 and 5	Epoxy mastic/polyurethane/polysiloxane system for small area touchup
Inorganic topcoat	
All zones	Inorganic zinc/inorganic topcoat
Epoxy/Polyurethane[2]	
Zones 3, 4, and 5	Epoxy/polyurethane system/polysiloxane

Existing Coating	Repair Coating
Water-reducible	
Zones 3, 4, and 5	Water-reducible intermediate/finish
Coal tar epoxy	
Zone 6	Coal tar epoxy
[1] Zones are defined in section 1.4. [2] When this coating is replaced with inorganic zinc, complete removal of the existing coating is required.	

b. Surfaces shall be prepared by washing with water and using mechanical methods in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal, to remove corrosion, weld slag, and to “feather back” coating edges.

c. Touchup and repair shall be accomplished promptly after the damage has occurred.

d. Touchup and repair of shop-applied coatings shall be accomplished using coatings from the same manufacturer as those applied in the shop.

4.5.9 Maintenance of Existing Coatings

a. Each support contractor responsible for maintaining facilities or GSE shall develop a Coating Maintenance Plan that includes the following key elements:

(1) Record keeping.

(2) Routine inspection of facilities.

(3) Coating repair criteria.

(4) Coating systems.

(5) Equipment requirements.

(6) Procedures.

(7) Training and certification.

(8) In-process inspection.

(9) Worker protection.

(10) Environmental compliance.

b. All operations shall be in strict accordance with section 4.3.3.

5. QUALITY ASSURANCE PROVISIONS

5.1 Responsibility for Inspection

5.1.1 The coating contractor/applicator shall:

a. Provide continuous quality control of all work to ensure complete conformance to the project specifications as defined in section 5.2.

b. Submit a project-specific quality control coating inspection plan to the Contracting Officer for approval.

c. Provide the NASA assigned coatings inspector with safe access to the work.

5.1.2 The NASA assigned coatings inspector shall be a NACE Certified Level III inspector under the NACE International Coating Inspector Program (CIP). (The CIP is provided by NACE International, Education Department, 1440 South Creek Drive, Houston, TX 77084-4906, < www.nace.org >.). Inspection of the surface preparation and coating application processes shall be performed by the NASA-assigned coatings inspector as follows:

a. Perform all of the in-process inspections required by this Standard and the project specifications.

b. Witness, inspect, and test all protective coating work to verify complete compliance with the specified requirements.

c. Document the work on the inspection forms described in section 5.4.

d. Prepare and sign the daily inspection reports on a daily basis and submit them to the Contracting Officer on a weekly basis as a minimum.

e. When a nonconformance report is required, sign and submit it to the Contracting Officer within 1 workday from the time that it is written.

f. After determining that all nonconformances have been corrected and/or the coating work is in compliance with this Standard and the project specifications, complete a conformance verification report for the specific item, area, or project.

g. Sign and seal the conformance verification report. The application of the certified inspector's seal to the verification conformance report indicates that the inspector personally

inspected the indicated work and has found it to be in compliance with the specified requirements.

h. Not affix the seal to the daily inspection report or to the nonconformance report.

5.2 Requirements for Inspection

a. Zones 1, 2, and 3. Since these zones are located in the highly corrosive launch environment or other chemical exposures, NACE inspection shall be required for all surface preparation and coating applications, including all new work, touchup of new work, major refurbishment of existing coatings, and modifications.

b. Zone 4. For systems requiring abrasive blasting and coating of metallic substrates, all surfaces shall require full NACE inspection with the following exception: For touchup of existing coatings, NACE inspection is not mandatory but recommended in cases of critical systems or equipment.

c. Zone 5a and 5b. All clean-room structures fabricated of aluminum or carbon steel that will be abrasive-blast-cleaned and/or coated outside Zone 5 environments shall require NACE inspection.

All other aluminum or carbon steel structures in Zone 5a environments are exempt from NACE inspection. NACE inspections are required for Zone 5b locations.

d. Zone 6. Since this zone is located in a highly corrosive underground environment or other submerged exposures, NACE inspection shall be required for all surface preparation and coating applications, including all new work, touchup of new work, major refurbishment of existing coatings, and modifications.

e. Zone 7. Since this zone is located in a highly corrosive environment, NACE inspection shall be required for all surface preparation and coating applications, including all new work, touchup of new work, major refurbishment of existing coatings, and modifications.

5.3 Inspection Hold Points

Mandatory inspection hold points shall include, but not be limited to, the following:

a. Verification of ambient weather conditions in accordance with section 4.4.3.5.

b. Prior to beginning of surface preparation work, to include the operation of equipment.

c. After surface preparation work and before the beginning of the coating application work, to include the mixing of products.

d. Before and after the application of each coat of material.

e. After completion and prior to final acceptance.

5.4 Inspection Forms

All inspections shall be recorded and documented on forms acceptable to the customer.

See Appendix F and G for examples of these forms.

5.5 Inspection Prior to Surface Preparation and Coating Application

The conditions in the following sections shall be inspected before beginning surface preparation and coating application operations.

5.5.1 Surface Condition

a. The surface condition shall be visually inspected for compliance with section 4.4.2.

b. Special attention shall be given to weld spatter, sharp edges, flame or saw cuts, delaminations, burrs, slag, or other surface irregularities that affect performance of protective coatings prior to surface preparation.

5.5.2 Protection of Adjacent Surfaces

a. Adjacent surfaces shall be visually inspected for adequate protection in accordance with section 4.4.2.

b. This inspection shall be jointly conducted with a Government Quality Engineering representative.

5.5.3 Ambient Weather Conditions

a. The ambient weather conditions at the actual location of the work shall be determined before and during the surface preparation and coating application operations to ensure they are correct for the work being conducted.

b. All measurement instrumentation shall be calibrated per the manufacturer's instructions prior to use.

c. Proper instrumentation shall be used to measure air temperature, relative humidity, dewpoint, surface temperature, and wind speed and direction.

d. No spray painting shall proceed when the measured wind speed in the immediate area of the coating work is above 25 km/hr (15 mph).

e. All of these ambient weather conditions shall be recorded on the Coating System Daily Inspection Report as shown in Appendix F, Coating System Daily Inspection Report.

5.5.4 Compressed Air Cleanliness

a. The compressed air supply shall be inspected for the use of inline moisture and oil traps.

b. Proper functioning of the traps shall be evaluated daily by allowing the air supply (down line from the traps) to blow against a clean, white cloth for several minutes, in accordance with ASTM D4285, Standard Test Method for Indicating Oil or Water in Compressed Air.

5.5.5 Surface Salt Concentration

a. The surface chloride concentration shall be determined on all structures prior to surface preparation operations using an industry-recognized method, such as described in SSPC-TU4, Field Methods for Retrieval and Analysis of Soluble Salts on Substrates, and recorded in the inspection records weekly.

b. Surfaces that measure 5 $\mu g/cm^2$ (0.00016 oz/ft^2) or above shall require washing with water in accordance with section 4.4.2.1 prior to surface preparation.

5.6 Surface Preparation Inspection

The inspections in the following sections shall be made to ensure compliance with the surface preparation requirements in section 4.4.2.

5.6.1 Abrasive-Blasting Material

The abrasive-blasting material shall be verified for compliance with section 4.1.1.

5.6.2 Blast Nozzle Air Pressure and Size

a. The air pressure at the blast nozzle shall be determined through the use of a hypodermic needle air pressure gage.

b. The needle of the gage shall be inserted as close to the nozzle as practically possible and in the direction of the air flow.

c. Pressure readings shall be taken with the blasting system in full operation.

d. The nozzle pressure shall be recorded.

e. To ensure the compressor output correlates with the nozzle size, the nozzle shall be checked with a blast nozzle orifice gage initially and then at a frequency determined by the NACE inspector.

5.6.3 Degree of Surface Cleanliness

a. The surface cleanliness shall be inspected after the surface preparation and before primer application to determine compliance with the applicable requirements of section 4.5.

b. The degree of cleanliness of abrasive-blasted carbon steel shall be verified with a visual inspection in accordance with section 4.5.1.1.2.

c. Galvanized steel, aluminum, and stainless steel shall be inspected for cleanliness in accordance with sections 4.5.1.2, 4.5.2, and 4.5.3.

d. The surface preparation cleanliness requirements defined in section 4.5 shall be applicable to 100 percent of the subject area, including places that are difficult to reach.

Use of SSPC-VIS 1-89, Visual Standard for Abrasive Blast Cleaned Steel, and SSPC-VIS 3, Visual Standard for Power- and Hand-Tool Cleaned Steel, is recommended for judging surface cleanliness.

5.6.4 Surface Profile or Roughness

a. The anchor profile of an abrasive-blasted carbon steel surface shall be determined by using a surface profile gage, comparator, or replica tape.

b. The profile shall be in accordance with section 4.5.1.1.2.

c. Galvanized steel, stainless steel, and aluminum surfaces shall be visually inspected as required for slight roughening in accordance with sections 4.5.1.2, 4.5.2, and 4.5.3.

5.6.5 Blasting of Abrasive-Sensitive Components

a. Thin-walled, abrasive-sensitive components, such as bellows assemblies or tubing, shall be protected during normal blasting operations in accordance with section 5.5.2.

b. Walnut shells or an approved equivalent shall be used for surface preparation of these sensitive components in accordance with section 4.1.1 or mechanical methods in accordance with section 4.4.2.3.

5.7 Coating Application Inspection

The inspections in the following sections shall be made to ensure compliance with the coating application requirements defined in section 4.4.3.

5.7.1 Surface Condition

a. The prepared surface shall be visually inspected.

b. The time before coating shall be monitored for compliance with section 4.4.3 before coatings are applied.

5.7.2 Coating Materials

The coating materials shall be visually inspected for compliance with section 4.4.3.1.

5.7.3 Storage of Coating Material

Coating material storage conditions shall be periodically inspected for compliance with section 4.4.3.3.

5.7.4 Mixing and Application of Coatings

The mixing and application of all coatings shall be visually inspected to ensure compliance with sections 4.4.3.4, 4.4.3.6, and 4.4.3.9.

5.7.5 Coating Finish and DFT

a. The finish and DFT of each applied coating shall be inspected for compliance with sections 4.4.3.7 and 4.5 prior to the application of successive coats.

b. The DFT measurement on carbon steel shall be taken using a magnetic gage calibrated in accordance with SSPC-PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

c. DFT measurements on aluminum and stainless steel shall be taken using an eddy current instrument that has been properly calibrated on surfaces similar to the coated surface.

5.8 Caulking Inspection

All surfaces shall be visually inspected to determine whether they comply with the requirements for sealing and caulking in accordance with section 4.4.4.

5.9 Galvanizing Inspection

Galvanized carbon steel shall be inspected in accordance with the applicable ASTM standard in section 4.5.1.2.1.

APPENDIX A

APPROVED PRODUCTS LIST FOR INORGANIC ZINC COATINGS

This list shall be used by or for the Government in the procurement of products covered by this Standard, and such listing of a product is not intended to and does not connote endorsement of the product by NASA. All products listed herein have been tested and meet the requirements for the product as specified. This list is subject to change without notice; revisions or amendments of this list will be issued as necessary. The listing of a product does not release the supplier from compliance with the specification requirements. This list is arranged in two sections based on the coating material's VOC. Use of the information shown herein for advertising or publicity purposes is strictly forbidden.

Thinners and cleaners for each of these coatings shall be procured from the manufacturer of the coating in accordance with sections 4.4.3.1 and 4.4.3.4.

The Materials Test and Corrosion Control Branch in the Engineering Directorate at KSC is responsible for conducting the testing and evaluation of candidate coatings for inclusion in the APL and for submitting updates to the KSC Engineering Directorate, which is responsible for this list.

Section I. Materials With Greater Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

Coating Designation	Type	Manufacturer
Dimetcote 9	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgpmc.com/
Carbo-Zinc 11	SB	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 304K Cathacoat 304L	SB SB	International Paint LLC/ Devoe Coatings 6001 Antoine DriveHouston, TX 77091(713) 682-1711 (800) 654-2616
Metalhide 1001	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 www.ppg.com
ZincClad II	SB	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com

Section II. Materials With Less Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

Coating Designation	Type	Manufacturer
Dimetcote D-9HS Dimetcote D-9H	SB SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgpmc.com/
Carbo-Zinc 11HS Carbo-Zinc 11WB Carbo-Zinc 11 VOC	SB WB SB	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 305 Cathacoat 304V	WB SB	International Paint LLC/Devoe Coatings Co. 6001 Antoine DriveHouston, TX 77091 (713) 682-1711 (800) 654-2616
InterZinc 22HS	SB	International Paint LLC 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 www.international-pc.com
Zinc Clad XI Zinc Clad II Plus	WB SB	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com
Kolor-Zinc 2.8 VOC	SB	Keeler & Long/PPG 856 Echo Lake Road Watertown, CT 06795 1-800-238-8596 http://www.ppg.com/coatings/pmc/brands/keelerlong

APPENDIX B

APPROVED PRODUCTS LIST FOR TOPCOAT SYSTEMS

This list shall be used by or for the Government in the procurement of products covered by this Standard, and such listing of a product is not intended to and does not connote endorsement of the product by NASA. All products listed herein have been tested and meet the requirements for the product as specified. This list is subject to change without notice; revisions or amendments of this list will be issued as necessary. The listing of a product does not release the supplier from compliance with the specification requirements. This list is arranged in two sections based on the coating material's VOC. Use of the information shown herein for advertising or publicity purposes is strictly forbidden.

Thinners and cleaners for each of these coatings shall be procured from the manufacturer of the coating in accordance with sections 4.4.3.1 and 4.4.3.4.

The Materials Test and Corrosion Control Branch in the Engineering Directorate at KSC is responsible for conducting the testing and evaluation of candidate coatings for inclusion in the APL and for submitting updates to the KSC Engineering Directorate, which is responsible for this list.

Section I. Materials With Greater Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
Cathacoat 304L (SB) Cathacoat 304L (SB) Cathacoat 304L (SB) Cathacoat 304K (SB)	Devran 201 (SB)* Devran 230 (SB) Devran 201 (SB)* Devran 201 (SB)*	Devthane 359 (SB) Devthane 369 (SB) Devthane 369 (SB) Devthane 379 UVA (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616 www.international-pc.com Houston, TX 77091
MetalHide 1001 (SB)	PittGuard 95-245 (SB)*	PittThane 95-812 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 www.ppg.com
Kolor-Zinc 2.8 VOC (SB)	N/A	Coraflon ADS (SB)	Keeler & Long/PPG 856 Echo Lake Road Watertown, CT 06795 1-800-238-8596 http://www.ppg.com/coatings/pmc/brands/keelerlong
Carbozinc 11 (SB)	N/A	Carbothane 133 LH (SB)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
* Can be used as a direct-to-metal primer for stainless steel, aluminum, and other materials in Zone 5a and 5b environments.			

Section II. Materials With Less Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
D-9HS (SB) D-9HS (SB) D-9H (SB) D-9H (SB) D-9H (SB)	Amerlock 400 (SB)* N/A Amercoat 383 (SB) Amerlock 2/400 (SB)* Amerlock 2/400 (SB)*	Amercoat 450HS (SB) PSX700 (SB) PSX1001 (SB) Amercoat 450H (SB) Amercoat 335 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgpmc.com/
CZ-11HS (SB) CZ-11HS (SB) CZ-11HS (SB) CZ-11WB (WB) CZ-11WB (WB) CZ-11WB (WB)	Carboguard 893(SB)* Carbomastic 15(SB)*Carb 893 (SB)* N/A Carboguard 893 (SB)* Carboacrylic 3358 (WB)	Carbothane 134HS (SB) Carboacrylic 3359(WB) Carboxane 2000 (SB) Carboxane 2000 (SB) Carboacrylic 3359(WB) Carboacrylic 3359(WB)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 304V (SB)	Devran 201 H (SB)*	Devthane 379 (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616
Zinc Clad XI (WB) Zinc Clad II Plus (SB) Zinc Clad II Plus (SB)	N/A Macropoxy 646-100 (SB)* Macropoxy 646-100 (SB)*	Polysiloxane XLE Hydrogloss WB (WB) Hi-Solids Poly-CA (SB)	Sherwin-Williams 101 Prospect Ave Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com
InterZinc 22HS (SB) InterZinc 22HS (SB)	Interseal 670HS (SB)* Interseal 670HS (SB)*	Interfine 979 (SB) Interfine 878 (SB)	International Paint LLC 6001 Antoine Dr. Houston, TX 77091 (713) 682-1711 www.international-pc.com
* Can be used as a direct-to-metal primer for stainless steel, aluminum, and other materials in Zone 5a and 5b environments.			

Section III. Inorganic Topcoat Systems (SB is Solvent-Based and WB is Water-Based):

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
D-9 HS (SB)	N/A	741 (SB) (IOT)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgpmc.com
CZ-11 VOC (SB) CZ-11(SB)	N/A N/A	Carbozinc Finish (SB) (IOT) Carbozinc Finish (SB) (IOT)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 304V (SB)	N/A	Devram 701 (SB) (IOT)	International Paint LLC/ Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616
InterZinc 22HS (SB)	N/A	Intertherm 181 (SB) (IOT)	International Paint LLC 6001 Antoine Dr Houston, TX 77091 (713) 682-1711 www.international-pc.com
Zinc Clad II (SB)	N/A	L03 (SB) (IOT)	Sherwin-Williams 101 Prospect Ave. Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com

APPENDIX C

APPROVED PRODUCTS LIST FOR METALLIZED (TSC) SYSTEMS

This list shall be used by or for the Government in the procurement of products covered by this Standard, and such listing of a product is not intended to and does not connote endorsement of the product by NASA. All products listed herein have been tested and meet the requirements for the product as specified. This list is subject to change without notice; revisions or amendments of this list will be issued as necessary. The listing of a product does not release the supplier from compliance with the specification requirements. Use of the information shown herein for advertising or publicity purposes is strictly forbidden.

Thinners and cleaners for each of these coatings shall be procured from the manufacturer of the coating in accordance with sections 4.4.3.1 and 4.4.3.4.

The Materials Test and Corrosion Control Branch in the Engineering Directorate at KSC is responsible for conducting the testing and evaluation of candidate coatings for inclusion in the APL and for submitting updates to the KSC Engineering Directorate, which is responsible for this list.

Section I. Materials With Greater Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based): N/A

Section II: Materials With Less Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

TSC Primer	Intermediate	Topcoat	Manufacturer
Pure Zinc Pure Zinc Pure Zinc	Interseal 1100 (WB) N/A N/A	Interthane 2100 (SB) Intercryl 520 (WB) Intertherm 181 (SB) (IOT)	International Paint LLC 6001 Antoine Dr Houston, TX 77091 (713) 682-1711 www.international-pc.com
Pure Zinc Pure Zinc Pure Zinc	Macropoxy 646-100 (SB)* Macropoxy 646-100 (SB)*	0 VOC Acrylic (WB) Hi-solids Poly 100 (SB) L03 (SB) (IOT)	Sherwin-Williams 101 Prospect Ave. Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com
Pure Zinc Pure Zinc Pure Zinc	N/A N/A N/A	Carbothane 134MC (SB) Carbothane 133MC (SB) Carbozinc Finish (SB) (IOT)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com

TSC Primer	Intermediate	Topcoat	Manufacturer
Pure Zinc	N/A	Noxyde (WB)	Rustoleum 11 Hawthorn Parkway Vernon Hills, IL 60061 (800) 323-3584 http://www.rustoleumibg.com/
Pure Zinc	N/A	Sky White Powder	Dupont Powder Coatings 9800 Genard Rd Houston, TX 77041 (800) 247-3886 http://www2.dupont.com/Powder/en_US/
Pure Zinc Pure Zinc	BarRust 231V (SB)*	Devthane 379H(SB) Devram 701 (SB) (IOT)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616
Pure Zinc Pure Zinc Pure Zinc Pure Zinc	Amerlock Sealer (SB) Amercoat 351 (WB) Amerlock 2 VOC (SB)* N/A	PSX700 (SB) PSX700 (SB) Amershield VOC (WB) 741 (SB) (IOT)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgpmc.com
Can be used as a direct-to-metal primer for stainless steel, aluminum, and other materials in Zone 5a and 5b environments.			

APPENDIX D
COATING SPECIFICATION KEY ELEMENTS

1. SCOPE.
2. APPLICABLE DOCUMENTS.
3. SUBMITTALS.
4. ENVIRONMENTAL PROTECTION.
5. WASTE MANAGEMENT.
6. SAFETY/PERSONNEL PROTECTION.
7. MATERIALS.
8. TOOLS AND EQUIPMENT.
9. ENVIRONMENTAL CONDITIONS.
10. WORK SCHEDULE.
11. SURFACE PREPARATION.
12. COATING SCHEDULE (see next page).
13. COATING MIXING AND APPLICATION.
14. QUALITY CONTROL INSPECTION.
15. REPORTING.
16. FINAL ACCEPTANCE.

APPENDIX E

COATING SCHEDULE

SURFACE DESCRIPTION (STEEL, CONCRETE, SURFACE A, B, ETC.)	APPROXIMATE SURFACE AREA SQUARE FEET	SURFACE PREPARATION TYPE	PROFILE RANGE	FIRST COAT			SECOND COAT			THIRD COAT		
				TYPE	WFT/ DFT	COLOR	TYPE	WFT/ DFT	COLOR	TYPE	WFT/ DFT	COLOR

APPENDIX F - COATING SYSTEM DAILY INSPECTION REPORT

COATING SYSTEM DAILY INSPECTION REPORT

DATE	REPORT NO.	PROJECT REF. NO.	PAGE OF
PROJECT DESCRIPTION	LOCATION	CONTRACTOR	
INSPECTING ORGANIZATION	INSPECTOR	APPLICABLE SPECIFICATION NO.	

I. DESCRIPTION OF ITEMS AND/OR AREAS

II .DESCRIPTION OF WORK PERFORMED/REMARKS

SAMPLE

III. PRE-WORK SURFACE CONDITION

- ☐ SUBSTRATE_____
- ☐ GENERAL DESCRIPTION_____
- ☐ PRIMED FOR SUBSEQUENT COATS: REFERENCE REPORT DATED_____
- ☐ PREVIOUSLY PAINTED. DEGREE OF CORROSION_____
- ☐ NEW METAL. DEGREE OF CORROSION_____

OBSERVED DEFECTS

		CORRECTED
OIL & GREASE	☐	☐
SHARP EDGES	☐	☐
WELD SPATTER	☐	☐
MOISTURE	☐	☐
LAMINATIONS	☐	☐
SOLUBLE SALTS	☐	☐
_____	☐	☐
_____	☐	☐

IV. ENVIRONMENTAL CONDITIONS

TIME	:	:	:	:
AIR TEMP °F				
WET BULB TEMP °F				
RELATIVE HUMIDITY	%	%	%	%
DEW POINT °F				
SURFACE TEMP MIN/MAX °F	/	/	/	/
WIND DIRECTION				
WIND SPEED (MPH)				

REMARKS

V. SURFACE PREPARATION

- ☐ SOLVENT CLEAN _____
- ☐ HAND TOOL _____
- ☐ POWER TOOL _____
- ☐ HP WATER WASH _____
- ☐ _____
- ☐ _____

☐ **ABRASIVE BLAST**

- ABRASIVE TYPE _____
- BLAST NOZZLE PRESSURE _____
- SURFACE PROFILE (AVG) _____
- DEGREE OF SURFACE CLEANLINESS _____
- COMPRESSED AIR CLEANLINESS _____

START TIME ____:____ STOP TIME ____:____
APPROXIMATE SQ. FT. PREPARED _____
REMARKS _____

PROFILE EFFECT ON TYPE ☐ 1 ☐ 2 GAUGE _____mils

VI. PRODUCT/MIXING

COATING PRODUCT TYPE _____ MANUFACTURER _____ CATALOG NO./NAME _____ COLOR _____

COATING BATCH NUMBERS
(A) _____
(B) _____
(C) _____

THINNING
THINNER _____
BATCH NO. _____
QTY ADDED _____
% BY VOLUME _____

CAULKING
TYPE _____
MFG _____
PRODUCT NO. _____
BATCH NO. _____

☐ **FIRST COAT**
☐ **SECOND COAT**
☐ **THIRD COAT**
☐ _____

TIME MIXED _____ : _____
KIT SIZE _____
GALS MIXED _____
CONTAINER CONDITION _____
PROPERLY STORED? _____
MIXING INSTRUMENT _____
MATERIAL TEMP °F _____

REMARKS

VII. COATING APPLICATION

METHOD OF APPLICATION _____
EQUIPMENT DESCRIPTION _____
ATOMIZING AIR CLEANLINESS _____
BRUSHED STRIPE COAT APPLIED TO HARD TO COAT AREAS? _____

START TIME ____:____ STOP TIME ____:____
APPROXIMATE SQ. FT. COATED _____
GALS COATING APPLIED _____
REMARKS _____
WET FILM THICKNESS (AVG) _____ MILS

VIII. POST CURE INSPECTION

☐ DFT WORKSHEET ATTACHED

	GAUGE READING	ACTUAL	DATE VERIFIED
SURFACE EFFECT ON GAUGE		N/A	
TOTAL DFT FROM PREVIOUS COATS (AVG)			
DFT THIS COAT (AVG)			

GENERAL APPEARANCE/REMARKS _____

IX.NON-CONFORMANCE ITEMS

DESCRIPTION OF DEFECT	DEFECTIVE ITEMS/AREAS	SPECIFICATION REF. SECTION	N.C.R. NO.	DATE CORRECTED

INSPECTOR'S SIGNATURE _____ DATE _____

KSC FORM 28-589 (REV. 8/95)

APPENDIX F - COATING SYSTEM DAILY INSPECTION REPORT (Continued)

COATING SYSTEM DAILY INSPECTION REPORT (CONTINUATION SHEET)

DATE	REPORT NO.	PROJECT REF. NO.	PAGE OF

TIME	REMARKS

INSPECTOR'S SIGNATURE _____ DATE

KSC FORM 28-589A (3/91)

APPENDIX G - DRY FILM THICKNESS MEASUREMENT WORKSHEET

DRY FILM THICKNESS MEASUREMENT WORKSHEET

DATE	REPORT NO.	PROJECT REF. NO.	APPLICABLE SPECIFICATION	PAGE OF

ITEM/AREA DESCRIPTION	SPOT	SPOT READINGS			TOTAL	AVG (÷3)	% MIN
		1	2	3			
	A						
	B						
	C						
APPROX SQ. FT.	D						
	E						
							TOTAL
							AVG (÷5)

SPECIFIED DFT ______ - ______ MILS

RANGE ACHIEVED ______ - ______ MILS

REFERENCE REPORT DATED __________ FOR APPLICATION RECORD

ITEM/AREA DESCRIPTION	SPOT	SPOT READINGS			TOTAL	AVG (÷3)	% MIN
		1	2	3			
	A						
	B						
	C						
APPROX SQ. FT.	D						
	E						
							TOTAL
							AVG (÷5)

SPECIFIED DFT ______ - ______ MILS

RANGE ACHIEVED ______ - ______ MILS

REFERENCE REPORT DATED __________ FOR APPLICATION RECORD

SAMPLE

ITEM/AREA DESCRIPTION	SPOT	SPOT READINGS			TOTAL	AVG (÷3)	% MIN
		1	2	3			
	A						
	B						
	C						
APPROX SQ. FT.	D						
	E						
							TOTAL
							AVG (÷5)

SPECIFIED DFT ______ - ______ MILS

RANGE ACHIEVED ______ - ______ MILS

REFERENCE REPORT DATED __________ FOR APPLICATION RECORD

ITEM/AREA DESCRIPTION	SPOT	SPOT READINGS			TOTAL	AVG (÷3)	% MIN
		1	2	3			
	A						
	B						
	C						
APPROX SQ. FT.	D						
	E						
							TOTAL
							AVG (÷5)

SPECIFIED DFT ______ - ______ MILS

RANGE ACHIEVED ______ - ______ MILS

REFERENCE REPORT DATED __________ FOR APPLICATION RECORD

ITEM/AREA DESCRIPTION	SPOT	SPOT READINGS			TOTAL	AVG (÷3)	% MIN
		1	2	3			
	A						
	B						
	C						
APPROX SQ. FT.	D						
	E						
							TOTAL
							AVG (÷5)

SPECIFIED DFT ______ - ______ MILS

RANGE ACHIEVED ______ - ______ MILS

REFERENCE REPORT DATED __________ FOR APPLICATION RECORD

ITEM/AREA DESCRIPTION	SPOT	SPOT READINGS			TOTAL	AVG (÷3)	% MIN
		1	2	3			
	A						
	B						
	C						
APPROX SQ. FT.	D						
	E						
							TOTAL
							AVG (÷5)

SPECIFIED DFT ______ - ______ MILS

RANGE ACHIEVED ______ - ______ MILS

REFERENCE REPORT DATED __________ FOR APPLICATION RECORD

REMARKS

TOTAL SQUARE FOOTAGE COATED (APPROX)	INSPECTOR'S SIGNATURE	DATE

KSC FORM 28-588 (3/91)

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APPENDIX H

DELIVERABLES

H.1 GSE Documentation Deliverables

a. The GSE provider shall submit documentation to verify that the hardware/software has been developed in accordance with this Standard.

b. The GSE provider shall provide all documentation to the using organization when the GSE is delivered for use, regardless of who "owns" the GSE at the time of delivery.

Examples of this documentation include, but are not limited to, the following:

(1) *Certification Approval Request (indicates how the GSE was certified as complying with this Standard).*

(2) *Master Verification Matrix (indicates which GSE requirements were met and how).*

(3) *Material Inspection and Receiving Report.*

(4) *Validation and verification compliance records.*

(5) *Drawings with parts list or bills of material.*

(6) *Maintenance manuals/procedures.*

(7) *Material certifications and lot traceability.*

(8) *Operating manuals/procedures.*

(9) *Software Version Description document.*

(10) *Firmware Version Description document.*

(11) *Facility and Flight Vehicle Interface requirements.*

(12) *Hazard Analyses or Ground Safety Data pack.*

(13) *Failure Modes, Effects, and Criticality Analysis.*

(14) *Critical Items List.*

c. Intent/Rationale: The using organization requires documentation for safely operating, maintaining, and servicing the GSE.

d. To reduce risk to the mission as well as to ground personnel and flight crews, the GSE provider shall complete and submit a failure mode and effects analysis in accordance with the criticality assigned to the GSE by the responsible program or project.

APPENDIX I

GUIDANCE

I.1 Purpose and/or Scope

The purpose of this appendix is to provide guidance and is made available in the reference documents listed below.

I.2 Reference Documents

ASTM

ASTM D4228	Standard Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces

Code of Federal Regulations (CFR)

29 CFR Part 1910	Occupational Safety and Health Administration (Occupational Safety and Health Standards)
29 CFR Part 1926	Occupational Safety and Health Administration (Safety and Health Regulations for Construction)

Department of Defense

MIL-P-85891	Plastic Media for Removal of Organic Coatings
TO 1-1-691	Cleaning and Corrosion Prevention and Control, Aerospace and Non-Aerospace Equipment

NASA

KSC-SPEC-F-0006	Heat and Blast Protection Coating Materials and Application Methods, Specification for
KSC-TM-584	Corrosion Control and Treatment Manual

The Society for Protective Coatings (SSPC)

SSPC-SP 6/NACE No. 3	Commercial Blast Cleaning
SSPC-SP 7/NACE No. 4	Brush-off Blast Cleaning
SSPC-VIS 1-89	Visual Standard for Abrasive Blast-Cleaned Steel
SSPC-VIS 3	Visual Reference for Power and Hand Tool Cleaned Steel

I.3 Additional Related Information

For information and guidance on dissimilar metals, corrosion-inhibiting lubricants, etc., refer to TO 1-1-691, Cleaning and Corrosion Prevention and Control, Aerospace and Non-Aerospace Equipment; and KSC-TM-584, Corrosion Control and Treatment Manual.