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February 3, 1992

STANDARD FOR PROTECTIVE COATING OF CARBON STEEL, STAINLESS STEEL, AND ALUMINUM ON LAUNCH STRUCTURES, FACILITIES, AND GROUND SUPPORT EQUIPMENT

ENGINEERING DEVELOPMENT DIRECTORATE

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Approved By:

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Walter T. Murphy
Director of Engineering Development

JOHN F. KENNEDY SPACE CENTER, NASA

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ABBREVIATIONS AND ACRONYMS

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
cfm	cubic feet per minute
DE-EMO	Engineering Development Directorate, Environmental Management Office
DFT	dry film thickness
DM-MSL	Mechanical Engineering, Materials Science Laboratory
DOD	Department of Defense
FED	Federal
GFE	Government-furnished equipment
GSE	ground support equipment
KHB	Kennedy handbook
kPa	kilopascal
KSC	John F. Kennedy Space Center
ksi	kip per square inch
MD-MED	Biomedical Operations and Research Office, Medical and Environmental Health Office
MIL	military
MPa	megapascal
NACE	National Association of Corrosion Engineers
NASA	National Aeronautics and Space Administration
NICITCP	National Association of Corrosion Engineers (NACE) International Coating Inspector Training and Certification Program
NIOSH	National Institute of Occupational Safety and Health
no.	number
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PPE	personal protective equipment
psi	pounds per square inch
RT-SAF	Safety and Reliability, Safety Operations Division
SI-PMS	Center Support Operations, Propellants Consumables Management Staff
SSPC	Steel Structures Painting Council
STD	standard
TCLP	Toxicity Characteristic Leaching Procedure
T.O.	technical order
VAB	Vehicle Assembly Building
VOC	Volatile Organic Content

STANDARD FOR PROTECTIVE COATING OF CARBON STEEL, STAINLESS STEEL, AND ALUMINUM ON LAUNCH STRUCTURES, FACILITIES, AND GROUND SUPPORT EQUIPMENT

1. SCOPE

This document establishes standard requirements for the application of protective coatings to prevent corrosion of exposed carbon steel, stainless steel, and aluminum. This standard is applicable to launch structures, facilities, and ground support equipment. It provides a design standard to experienced corrosion control engineers for the development of specifications including requirements for materials, equipment, safety, procedures, and quality assurance inspections. Due to the ever changing environmental considerations, new advances in corrosion technology and the wide array of possible applications, this document should not be used as a stand-alone specification that meets every contingency. Refer to 6.1 for the intended use and surfaces to be coated according to this standard.

1.1 Zones of Exposure. - The following zones of exposure are established to define coating system requirements for surfaces located in specific environments:

a. Zone 1. - Surfaces that receive rocket engine exhaust impingement.

b. Zone 2. - Surfaces that receive elevated temperatures [above 65 degrees Celsius (above 150 degrees Fahrenheit)] and acid deposition from solid rocket booster exhaust with no exhaust impingement.

c. Zone 3. - Surfaces, other than those located in Zones 1 or 2, that receive acid deposition from solid rocket booster exhaust products or that receive other types of chemical contamination (e.g., cooling towers, diesel exhaust stacks, etc.).

d. Zone 4. - Surfaces not located in the launch environment but located in the corrosive marine environment of John F. Kennedy Space Center (KSC), such as the Vehicle Assembly Building (VAB), industrial areas, and indoor nonair-conditioned environments.

e. Zone 5. - Continuous indoor air-conditioned environment.

1.2 Method of Specifying Coating Requirements - Specifications referencing this standard shall include the type of surface to be coated, the zone of exposure, surface preparation, defined paint system, coating thicknesses and, when applicable, the finish color required. These requirements should be assembled in a coating schedule for easy reference. The coating specification should 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.

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendments, and approval dates of said documents shall be specified in an attachment to the Solicitation/Statement of Work/Contract.

2.1 Governmental.

2.1.1 Specifications.

John F. Kennedy Space Center (KSC), NASA

KSC-E-165	Electrical Ground Support Equipment, Fabrication, Specification for
KSC-SPEC-F-0006	Heat and Blast Protection Coating Materials

Federal

TT-S-230	Sealing Compound, Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)

Military [Department of Defense (DOD)]

DOD-C-24667	Coating System, Nonskid for Roll or Spray Application (Metric)
DOD-P-15328	Primer (Wash) Pretreatment (Formula No. 117 for Metals) (Metric)
MIL-A-22262	Abrasive Blasting Media Ship Hull Blast Cleaning
MIL-C-5541	Chemical Conversion Coatings on Aluminum Alloys
MIL-T-81772	Thinner, Aircraft Coating

2.1.2 Standards.

John F. Kennedy Space Center (KSC), NASA

KSC-STD-SF-0004	Safety Standard for Ground Piping Systems Color Coding and Identification

Federal

FED-STD-595	Colors Used in Government Procurement

2.1.3 Publications.

John F. Kennedy Space Center (KSC), NASA

KMI 8800.6	KSC Environmental Control
KHB 1710.2	KSC Safety Practices Handbook Volumes I and II

KHB 8800.6	Environmental Control Handbook
KHB 8800.7	Hazardous Waste Management
KSC-TM-584	Corrosion Control and Treatment Manual

Military

T.O. 1-1-691	Aircraft Weapons Systems Cleaning and Corrosion Control

(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.)

2.2 Non-Governmental.

American Society for Testing and Materials (ASTM)

ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A525	Specification for General Requirements for Steel Sheet Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A780	Practice for Repair of Damaged Hot-Dip Galvanized Coatings
ASTM D520	Standard Specification for Zinc Dust Pigment
ASTM D610	Method for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	Method for Evaluating Degree of Blistering of Paints
ASTM D1654	Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D4752	Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

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

Compressed Gas Association, Inc.

G-7	Commodity Specification for Air, Third Edition

(Application for copies should be addressed to the Compressed Gas Association, Inc., Crystal Gateway 1, Suite 501, 1235 Jefferson Davis Highway, Arlington, VA 22202).

National Association of Corrosion Engineers (NACE)

RP0188-88	Discontinuity (Holiday) Testing of Protective Coatings
RP0288-88	Inspection of Linings on Steel and Concrete
TM 01-70	Visual Standard for Surfaces of New Steel Airblast Cleaned With Sand Abrasive
TM 01-75	Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned With Steel Grit and Shot

(Application for copies should be addressed to the National Association of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218-8340.)

Steel Structures Painting Council (SSPC)

SSPC AB1	Mineral and Slag Abrasives
SSPC PA 2-82	Measurement of Dry Paint Thickness With Magnetic Gages
SSPC SP 1-82	Solvent Cleaning
SSPC SP 2-89	Hand Tool Cleaning
SSPC SP 3-89	Power Tool Cleaning
SSPC SP 5-89	White Metal Blast Cleaning
SSPC SP 10-89	Near-White Blast Cleaning
SSPC SP 11-89	Power Tool Cleaning to Bare Metal
SSPC VIS 1-89	Guide to SSPC VIS 1-89 Visual Standard for Abrasive Blast Cleaned Steel

(Application for copies should be addressed to the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.)

3. REQUIREMENTS

3.1 Materials.

3.1.1 Abrasive Blasting Aggregate - Blasting aggregates shall be approved materials in accordance with MIL-A-22262 or SSPC AB1, Type I or II, Class A, or steel grit. The grade selected must produce the required surface profile and possess physical properties that are compatible with the requirements of this standard. The steel grit shall be neutral, rust and oil free, dry, commercial-grade blasting grit with a hardness of 40 to 50 Rockwell C. The size shall be selected to produce the required anchor profile.

NOTE

Only aggregates that are free of crystalline silica shall be selected for use at KSC. Exemptions to this policy shall be coordinated with MD-MED, Biomedical Operations and Research Office, Medical and Environmental Health Office.

NOTE

Blasting aggregate for abrasion-sensitive hardware such as bellows, gimbal joints, and other thin-walled components, shall be walnut shell or approved equivalent.

3.1.2 Protective Coatings, Thinners, and Cleaners - The following paragraphs establish minimum requirements for each generic type of protective coating specified in this document. See 3.4.3.1 for coating intercoat compatibility requirements. All coatings must possess physical properties and handling characteristics that are compatible with the application requirements of this standard, and all coatings must be self-curing. Thinners and cleaners for each coating, except those specified in 3.1.2.6, shall be procured from the manufacturer of the coating.

Procurement awards for coatings to be supplied according to this standard shall be made only for those products that have been tested, evaluated, and approved. The attention of suppliers is called to this requirement, and manufacturers 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 testing criteria, manufacturers must contact DM-MSL, Mechanical Engineering, Materials Science Laboratory, NASA, John F. Kennedy Space Center, FL 32899.

3.1.2.1 Inorganic Zinc Coatings. - Inorganic zinc coatings are listed in appendix A. A coating must meet the following minimum requirements to be listed.

a. Self-curing, two package.

b. Dry-temperature resistance to 400 degrees Celsius (750 degrees Fahrenheit) for 24 hours.

c. Minimum shelf life of 12 months.

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

e. Asbestos free, lead free, cadmium free, and chromate free.

f. Zinc dust pigment shall be Type II in accordance with ASTM D520.

g. Attain a numerical rating of not less than 9 in accordance with ASTM D610 and ASTM D1654 and 9F in accordance with ASTM D714 when applied to composite test panels and exposed at the KSC beach corrosion test site. The coatings will be evaluated for initial acceptance following an exposure period of 18 months. The coatings must continue to provide acceptable protection and performance for a period of 5 years. Application characteristics must be judged acceptable prior to beach testing.

3.1.2.2 Primer and/or Intermediate Coatings

3.1.2.2.1 Inhibitive Polyamide Epoxy Coatings - Polyamide epoxy coatings shall conform to the following minimum requirements:

a. Polyamide-cured

b. Rust-inhibitive

c. Lead free, cadmium free, and chromate free

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

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

f. Meet the compatibility requirements of 3.4.3.1

g. Minimum 40-percent volume solids

3.1.2.2.2 Noninhibitive Polyamide Epoxy Coatings - Polyamide epoxy coatings shall conform to the following minimum requirements:

a. Polyamide-cured

b. Lead free, cadmium free, and chromate free

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

d. Meet the compatibility requirements of 3.4.3.1

e. Minimum 40-percent volume solids

f. Not to be used as a primer on steel

3.1.2.2.3 Water-Reducible Intermediate Coatings - Water-reducible intermediate coatings shall conform to the following minimum requirements:

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

b. Lead free, cadmium free, and chromate free

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

d. Meet the compatibility requirements of 3.4.3.1

e. Minimum 30-percent volume solids

f. Not to be used as a primer on steel

3.1.2.3 Finish Coatings.

3.1.2.3.1 Aliphatic Polyurethane Coatings - Aliphatic polyurethane coatings shall conform to the following minimum requirements:

a. Catalyst isocyanate cured

b. High-gloss finish

c. Gloss and color retentive 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 3.4.3.1

f. Minimum 44-percent volume solids

g. Lead free, cadmium free, and chromate free

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

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

b. Lead free, cadmium free, and chromate free

c. Gloss and color retentive upon prolonged exterior exposure

d. Semi-gloss or high-gloss finish

e. Meet the compatibility requirements of 3.4.3.1

3.1.2.3.3 Inorganic Topcoats. - Inorganic topcoats shall conform to the following minimum requirements:

a. Dry-temperature resistance to 400 degrees Celsius (750 degrees Fahrenheit)

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

c. Ameron 741 or equal

d. May be used over the other manufacturer's inorganic zinc primers

e. Lead free, cadmium free, and chromate free

3.1.2.4 Epoxy Mastic Coatings. - Epoxy mastic coatings shall conform to the following minimum requirements:

a. Specifically intended for use over mechanically cleaned steel

b. Minimum 80-percent volume solids

c. Two-component, catalyst cured

d. Lead free, cadmium free, and chromate free

3.1.2.5 Coal Tar Epoxy. - Coal tar epoxy coating shall be a two-component, high-build tar epoxy. The coal tar epoxy shall have minimum volume solids of 65 percent and shall produce a one coat thickness of 585 to

710 micrometers (23 to 28 mils) wet coat or 405 to 510 micrometers (16 to 20 mils) per coat dry film thickness (DFT). Examples of coal tar epoxies which currently meet these requirements include the following:

a. Sherwin Williams Hi-Mil Sher-Tar

b. Porter International Tarset Maxi-Build II, #7080

c. Devoe Devtar 247

3.1.2.6 Potable Water Epoxy. - All coatings for potable water immersion service shall be three-coat epoxy systems that are certified by the National Sanitation Foundation (NSF), Standard 61. Some NSF approved products include:

a. Ameron, Inc., Amercoat 395

b. Devoe Coatings Co., Bar Rust 233

c. Porter International, Magna-Line

d. Sherwin Williams Co., Potable Water Epoxy.

3.1.2.7 Nitrile Rubber/Aluminum Coating. - A nitrile-rubber-base, aluminum- pigmented coating may be obtained from KSC Supply under Federal stock number 8030-00-485-3656. This material should be Government-furnished equipment (GFE) to the Contractor under the terms of the contract. Thinner for this coating shall be MIL-T-81772 and shall be used in accordance with 3.4.3.4. This material may be applied by brush or spray.

3.1.2.8 Nonskid Coating. - The nonskid coating shall be DOD-C-24667, Type 1B, Composition G, Grade A, Class 1, as supplied by American Abrasive Metals, Inc., 460 Coit Street, Irvington, NJ 07111, telephone (201) 373-7060, or approved equal (Primer Pripoxo 5-C, Topcoat Epoxo 400G).

3.1.3 Sealants/Caulking. - Sealants shall be self-curing, single-component, polysulfide-rubber or polyurethane conforming to TT-S-230, Type II, Class A. If not topcoated, the caulking shall match the color of the joint surface being caulked. If caulking is to be used in a cleanroom environment, an approved low off-gassing material should be selected.

3.1.4 Wash Primer. - Wash primer specified for use with this document shall comply with DOD-P-15328.

3.2 Equipment.

3.2.1 Compressed Air. - The compressed air system shall be capable of delivering a continuous nozzle pressure to achieve the required surface cleanliness and profile, typically 620 kilopascals (kPa) [90 pounds per square inch (psi)] minimum to each blast nozzle in operation. The required air capacity will depend 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. The compressed air system shall be equipped with oil and moisture separators to ensure only clean, dry air is provided to the service outlet.

3.2.2 Abrasive Blasting System - The abrasive blasting system shall comply with Occupational Safety and Health Act (OSHA), American National Standards Institute (ANSI), and National Institute of Occupational Safety and Health (NIOSH) configurations consisting of, but not limited to, a remote-controlled welded pressure pot conforming to American Society of Mechanical Engineers Standards, the required length of blast hose, a venturi nozzle, a respiratory air-line filter, and a blast hood approved by the Mine Safety and Health

Administration/NIOSH with the required length of air hose. The blasting system shall be designed to produce the specified cleanliness and profile when coupled with the available compressed air supply.

3.2.3 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 3.4.3.6.

3.2.4 Breathing Air. - Compressed breathing air supplied to respiratory protection devices shall meet the requirements of the specification for Grade D breathing air as described in Compressed Gas Association, Inc., specification G-7. Compressors for breathing air shall be constructed and located so as to avoid entry of contaminated air into the air supply system. Oil-lubricated compressors shall be equipped with a suitable in-line air filtration system that includes a carbon monoxide sensor and alarm and air-purifying sorbent beds and filters that remove water, dust particles, odors, oil, and other hydrocarbons. Oil-free breathing air compressors do not require carbon monoxide monitoring or air filtration systems. MD-MED will be notified of all compressors brought on KSC for breathing air supply to coordinate breathing air system inspection. Breathing air couplings shall not be compatible with outlets for nonrespirable shop air or other gas systems to prevent inadvertent servicing of air-line respirators with nonrespirable gases or oxygen. The maximum air-line length for any approved supplied air respirator shall not exceed 100 meters (330 feet) measured from the pressure reducing valve. Air lines shall be protected from damage, including cutting, kinking, crushing, or burning. Notification will include written certification that the breathing air supplied by the compressors has been tested and the air meets the specification for grade D breathing air.

3.3 Safety Requirements - Necessary precautions, in accordance with OSHA regulations, manufacturers' recommendations, and KHB 1710.2, shall be taken to ensure the safety of personnel performing the work required by this document 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. The Contractor shall be responsible for providing equipment as required for safe application and for instructing the users regarding the hazards and proper handling and disposal procedures to prevent damage to health. The Contractor shall provide safe access to all areas for the coating inspector. The Contractor shall submit a written safety plan that includes a Hazard Communication Program, a Respiratory Protection Program, and a Hearing Conservation Program that conforms to OSHA requirements. Where the Contractor is required to perform removal of surface coatings that contain lead, chromium, mercury, or cadmium, the safety plan shall also include specific provisions for OSHA compliance for work with these materials.

3.3.1 Environmental Requirements - The operations described in this standard have the potential to pollute the environment. All local, state, and Federal environmental regulations, as well as KSC environmental policies, shall be followed. Questions regarding these regulations and policies should be directed to DE-EMO, Engineering Development Directorate, Environmental Management Office. Refer to KMI 8800.6 and KHB 8800.6 for environmental requirements and policies. Material waste shall be handled and disposed in accordance with KHB 8800.7.

3.3.2 Personal Protective Equipment (PPE) - When engineering controls are not available to protect workers, then PPE and/or administrative controls shall be used. Where required, PPE shall be provided, used, and maintained in a reliable and sanitary condition. Both the supervisors and the workers shall be properly instructed in the selection, use, and maintenance of PPE.

3.4 General Requirements

3.4.1 Applicator Qualifications. - To ensure the highest quality of workmanship, only journeyman applicators having extensive prior experience in abrasive blasting and the application of high-performance protective coatings shall be assigned to perform the work described herein. The Contractor shall be responsible for providing all painting personnel an orientation on the proper mixing and application of the coatings specified,

particularly inorganic zinc coatings. Topics in the orientation shall include specification requirements, material application characteristics, and inspection criteria. Only personnel receiving training may mix or apply coatings. The Contractor shall prepare representative sample areas which meet specification requirements.

3.4.2 Preparation of Surfaces - All surfaces to be coated shall be clean, dry, and free from oil, grease, dirt, dust, corrosion, peeling paint, weld spatter, and any other surface contaminants. All surfaces that will become inaccessible after fabrication, erection, or installation shall be prepared and coated while accessible. Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter. All equipment and adjacent surfaces not to be coated shall be protected from surface preparation operations. Working mechanisms shall be protected against intrusion of abrasive. All surfaces shall be degreased, as required, prior to subsequent surface preparation procedures or the application of protective coatings, or both. The following surface preparation techniques shall be used when specified in 3.5.

3.4.2.1 Cleaning and Degreasing - Degreasing shall be by solvent cleaning, detergent washing, or steam cleaning in accordance with SSPC SP-1. This procedure will be followed when cleaning steel or stainless steel. NASA policy mandates the phaseout of the use of chlorofluorocarbon solvents by the year 1995. Selection of solvents shall be coordinated with SI-PMS, Center Support Operations, Propellants Consumables Management Staff. Water washing shall be done when high levels of chloride or other undesirable contaminants are found on the surfaces and shall be accomplished using standard industrial pressure cleaners with a pressure versus volume output balance that will ensure thorough and productive cleaning. High-pressure water cleaning shall not be used as a cleaning method if existing paint film on a surface exceeds any Toxicity Characteristic Leaching Procedure (TCLP) listed toxic characteristics. No chemical shall be added to the water used for the paint blasting/
removal operation, and no discharge shall be directed to surface waters. A 40-micrometer filter mesh shall be utilized to screen wastewater discharge on operations performed over pervious surfaces. Points of discharge shall be identified prior to water blasting operations performed over impervious surfaces. All discharges shall then be channeled to pervious areas with a combination of sandbags and a 40-micrometer filter mesh. Any residues generated in water blasting operations shall be disposed of in accordance with KHB 8800.7. All records of water blasting operations shall be submitted to DE-EMO. The cleaned surface shall be free of loose coatings, chlorides, dirt, dust, mildew, grinding/welding/cutting debris, and visible contaminants. The surface shall be clean and dry prior to the abrasive blasting operations and application of coatings.

3.4.2.2 Abrasive Blasting - The abrasive blasting aggregate shall be clean and dry and shall conform to 3.1.1. Abrasive blasting shall be in accordance with the applicable paragraphs in 3.5. Abrasive residue shall be removed from the surface, leaving it clean and dry prior to the application of coatings. All abrasive blasting operations shall be contained for particulate emissions during work. The containment system shall be designed to comply with all applicable Federal, state, and local regulations as well as all KSC policies. Exemptions to this requirement shall be coordinated with DE-EMO.

Care shall be taken in the identification and selection of aggregate for preparation of abrasive-sensitive hardware such as bellows, gimbal joints, and other thin-walled components.

3.4.2.3 Mechanical Cleaning Methods - Mechanical methods shall be in accordance with the applicable paragraph in 3.5.

3.4.3 Application of Coatings. - All prepared surfaces shall be coated within 6 hours after completion of surface preparation and before rusting or recontamination occurs. Any surface not coated within 6 hours or that shows rusting or contamination, regardless of the length of time after preparation, shall be re-prepared. The application and handling characteristics of all coatings will vary. To obtain optimum performance, adequate instructions from the manufacturer are essential and must be closely followed in conjunction with the

requirements defined herein. The manufacturer's recommendations for thinning, mixing, handling, and applying his product shall be strictly followed. All coatings shall be thoroughly worked into all joints, crevices, and open spaces. All newly coated surfaces shall be protected from damage. All equipment and adjacent surfaces not to be coated shall be protected from overspray and splattered coatings. All spray painting operations shall be contained for particulate emissions during work. The containment system shall be designed to comply with all Federal, state, and local regulations as well as all KSC policies. Exemptions to this requirement shall be coordinated with DE-EMO.

3.4.3.1 Coating Systems. - Coating systems for specified uses and substrates shall be as defined in 3.5 and shall conform to 3.1.2. All thinners and cleaners shall be products of the coating manufacturer except as defined in 3.1.2.7. To ensure intercoat compatibility, coating systems consisting of more than one coat shall be products of the same manufacturer, except for inorganic topcoat as referenced in 3.1.2.3.3. Continuity of the coating manufacturer's system shall be maintained for the duration of an individual project.

3.4.3.2 Colors. - 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. Color coding for fluid system piping shall be in accordance with KSC-STD-SF-0004. Finish coat colors shall be in accordance with the following FED-STD-595 color numbers using pigments free of lead, chromium, and cadmium:

a. White, no. 17875

b. Blue, no. 15102 (safety)

c. Yellow, no. 13538 (standard)

d. Yellow, no. 13655 (safety)

e. Red, no. 11136

f. Red, no. 11105 (safety)

g. Black, no. 17038

h. Green, no. 14110 (safety)

i. Gray, no. 16187 (safety)

j. Brown, no. 10080 (safety)

k. Gray, no. 16473 (standard)

3.4.3.3 Storage of Coating Materials - Coating materials and thinners shall be stored in their original containers bearing the manufacturer's name, product identification, shelf life, and batch number. Coatings, 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, high heat, or rainfall. The manufacturer's instructions for storage limitations shall be followed. Tarpaulins shall not be utilized as a sole means of covering coating materials for storage. If Material Safety Data Sheets are included with coating materials or thinners, they must be maintained in the area. The Contractor shall submit a plan for storage of coating materials for coordination with RT-SAF, Safety and Reliability, Safety Operations Division.

3.4.3.4 Mixing and Application Instructions. - 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, Inc., San Francisco, CA, or approved equal. The mixer shall be powered by an air motor or an explosionproof electric motor. All mixing operations shall be performed over an impervious surface with provisions to prevent runoff to grade of any spilled material. The mixed coating material shall be strained through a 30- to 60-mesh screen prior to application. Thinning shall be for viscosity control only. The manufacturer's recommended thinner and amount shall be used except as defined in 3.1.2.6. (The nitrile-rubber/aluminum coating can be reduced approximately 50 percent with MIL-T-81772 for spray applications.) The material shall be agitated as required during application to maintain uniform suspension of solids. Continuous rapid agitation shall be avoided. Spray equipment shall be adjusted to produce an even, wet coat with minimum overspray. The conventional pressure pot, when used, shall be kept at approximately the same level or above the spray gun for proper material delivery. Coatings shall be applied in even, parallel passes, overlapping 50 percent.
3.4.3.5 Weather Conditions. - No coating shall be applied when contamination from rainfall is imminent or when the temperature or humidity is outside limits recommended by the coating manufacturer. To prevent moisture condensation during application, surface temperature must be at least 3 degrees Celsius (5 degrees Fahrenheit) above the dewpoint. Wind speed shall not exceed 25 kilometers per hour (15 miles per hour) in the immediate coating area.

3.4.3.6 Methods of Application. - Coatings shall be applied with airless or conventional spray equipment, or both, according to 3.2.3. Application with brushes shall be permitted for minor touchup and when spray application is prohibited in the area of work.

3.4.3.7 Coating Finish. - Each coat of material applied shall be free of runs, sags, blisters, bubbles, and mudcracking; variations in color, gloss, and texture; holidays (missed areas); excessive film buildup; foreign contaminants; dry overspray; etc. Special care shall be taken to ensure complete coverage and proper thickness on welds, corners, crevices, sharp edges, bolts, nuts, and rivets. Each coat of applied material shall be rendered clean, dry, and free from surface contaminants prior to the application of the next successive coating.

3.4.3.8 Touchup of Welds and Damaged Coatings - Field welds and damaged coatings shall be touched up in accordance with 3.5.7. The coating shall be applied in accordance with 3.4.3.4 and 3.4.3.6. Touchup and repair shall be accomplished promptly after the damage or welding has occurred.

3.4.3.9 Coating, Drying, and Curing - The coating manufacturer's recommended drying and curing times for handling, recoating, and topcoating shall be followed. Proper curing of solvent-based inorganic zinc-rich coatings must be verified by ASTM D4752 prior to further coating. Water-based inorganic zinc-rich coatings must be verified for curing, in accordance with the same procedure, but water must be substituted as the solvent.

3.4.4 Sealing/Caulking. - The perimeter of all faying surfaces, joints open less than 13 millimeters (1/2 inch), and skip-welded joints shall be completely sealed. The sealant shall be a self-curing, single-component, polysulfide rubber or polyurethane type, conforming to 3.1.3. The sealant shall be applied to the joint with a caulking gun following the application of the inorganic zinc primer on carbon steel. For topcoated zinc primers, apply caulking after epoxy intermediate coat, and for coatings on stainless steel, galvanized steel, and aluminum, apply caulking before application of the topcoat. The bead shall have a smooth and uniform finish and shall be cured (tacky to touch) prior to topcoat application.

3.5 Specific Requirements.

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

New steel components, such as stair treads, grating, handrails, pipes, and hardware (nuts, bolts, and fasteners), shall be hot-dip galvanized in accordance with 3.5.1.2.1, as applicable. All other carbon steel surfaces that are exposed to the atmosphere shall be coated with inorganic zinc conforming to 3.1.2 in accordance with 3.4.3 or hot-dip galvanized (zinc coated) in accordance with 3.5.1.2.1. The zinc coatings may require topcoating with additional protective coatings as specified, but in neutral atmospheres, testing has proven untopcoated zinc to have superior performance. Carbon steel faying surfaces that are a part of all friction-type joints shall be abrasive blasted and coated with 100 to 150 micrometers (4 to 6 mils) of inorganic zinc only, in accordance with 3.5.1.1.4, prior to installation. The recommended coating application sequence for carbon steel shall be to abrasive blast and prime with inorganic zinc prior to installation or erection. Further topcoating, if required, shall be accomplished after all welding, grinding, or drilling has been completed, and areas damaged by these procedures have been properly repaired with inorganic zinc.

3.5.1.1 Protection With Inorganic Zinc

3.5.1.1.1 Mechanical Cleaning of Carbon Steel - After cleaning and degreasing in accordance with SSPC SP-1, mechanical cleaning of carbon steel shall be used only as a preabrasive blasting preparation method. Carbon steel shall be mechanically cleaned using needle scalers and/or abrasive discs or wheels in accordance with SSPC SP-2 or SSPC SP-3. All weld slag, weld spatter, and foreign matter shall be removed from welds prior to abrasive blasting.

3.5.1.1.2 Abrasive Blasting of Carbon Steel - Carbon steel shall be abrasive blasted to near-white metal (NACE no. 2 in accordance with NACE STD TM-01-70, NACE STD TM 01-75, or SSPC SP-10) with aggregate conforming to the requirements in 3.1.1. The anchor profile of the blasted surface shall be 40 to 75 micrometers (1.5 to 3.0 mils). All rust shall be completely removed from pits and depressions.

3.5.1.1.3 Stripe Coat Application. - Brush coating and/or stripe coating with a primer shall be applied to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure complete coverage and proper thickness prior to final primer applications.

3.5.1.1.4 Application of Inorganic Zinc Coatings - Inorganic zinc coatings shall be applied to a DFT of 100 micrometers (4.0 mils) minimum to 150 micrometers (6.0 mils) maximum when they will be left untopcoated or when inorganic topcoat is applied. When the zinc coatings are to be topcoated with organic topcoats, the DFT shall be reduced to 65 micrometers (2.5 mils) minimum to 100 micrometers (4.0 mils) maximum. The proper DFT for the inorganic zinc coating shall be obtained in a single application, which may consist of multiple passes, while coating is still wet.

3.5.1.1.5 Topcoat Systems for Zinc Coatings - The following topcoat systems shall be applied over the zinc coatings as required for each zone of exposure described in 1.1. Topcoats shall be applied to the DFT recommended by the manufacturer. The film thickness of the topcoats shall be sufficient to ensure uniform coverage and color.

a. Zone 1. - Zinc coatings shall be left untopcoated. As an alternate, surfaces may be topcoated with silicone ablative compound in accordance with KSGSPEC-F-0006.
b. Zone 2. - An inorganic topcoat conforming to 3.1.2.3.3 shall be applied in accordance with 3.4.3. As an alternate, surfaces may be topcoated with silicone ablative compound in accordance with KSG-SPEC-F-0006.

c. Zone 3. - An intermediate/tie coat and a finish coat conforming to 3.1.2 shall be applied in accordance with 3.4.3.

d. Zone 4. - No topcoats are required, except for color coding, safety, identification, or special conditions. When required, topcoats shall be in accordance with 3.5.1.1.5.c.

e. Zone 5. - Zinc primer is suggested but not required. As an alternate, use inhibitive epoxy primer and a polyurethane finish coat conforming to 3.1.2 at the manufacturer's recommended thickness.

3.5.1.2 Protection by Galvanizing

3.5.1.2.1 Galvanizing. - Galvanizing (zinc coating) shall be accomplished after fabrication by the hot-dip process conforming to ASTM A123, ASTM A153, and ASTM A525. Galvanizing weight for steel sheet without further coating protection shall be ASTM A525, G165. All lower galvanizing weights for steel sheet must be further protected with coatings except for Zone 5 exposures.

3.5.1.2.2 Surface Preparation of Galvanizing

CAUTION

Some galvanized configurations are susceptible to distortion when they are abrasive blasted. Special care shall be taken to ensure against any metal distortion by reducing blast nozzle pressure and increasing the working distance from nozzle to surface. In some cases, such as in the surface preparation of light-gage sheet, these precautions may not be sufficient to prevent distortion; and alternate procedures, such as abrading or mechanical cleaning, must be used to remove corrosion or roughen the surface. Galvanized surfaces shall be abrasive blasted with fine abrasives conforming to the requirements in 3.1.1 to remove corrosion and old coatings or roughen new surfaces. The blasted surface shall be free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

NOTE

High-strength steels are susceptible to embrittlement by hydrogen during the galvanizing process. Steel components with an ultimate tensile strength above 900 megapascals (MPa) [130 kips per square inch (ksi)] or hardness above Rockwell C Hardness 28 shall not be galvanized.

Galvanized surfaces to be further topcoated shall be prepared by degreasing in accordance with 3.4.2.1 prior to any additional surface preparation. After degreasing, abrasive blasting or mechanical cleaning shall be performed as required by the zone of exposure. If galvanized steel is prepared for the application of coatings by abrasive blasting, it shall be lightly brush blasted with fine abrasive at a lower pressure of 275 to 420 kPa (40 to 60 psi) to provide a corrosion-free and uniform, slightly roughened surface. Care shall be taken not to completely remove the galvanized finish. The zinc coatings shall be maintained or rendered clean, dry, and free from contaminants prior to the application of topcoat systems. Field repair of damaged galvanizing shall be accomplished in accordance with ASTM A780 using inorganic zinc coatings.

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

3.5.1.2.3 Coating Systems for Galvanizing

a. Zone 1. - Galvanizing may be left untopcoated. As an alternate, surfaces may be topcoated with silicone ablative compound in accordance with KSGSPEC-F-0006.

b. Zone 2. - After brush blasting, an inorganic topcoat conforming to 3.1.2.3.3 shall be applied at a DFT of 75 to 125 micrometers (3 to 5 mils). As an alternate, surfaces may be topcoated with silicone ablative compound in accordance with KSGSPEC-F-0006.

c. Zone 3. - After brush blasting, primer/tiecoat and finish coat shall be applied in accordance with manufacturer's recommended thicknesses. As an alternate to brush blasting, wash primer shall be applied to a DFT of 10 to 15 micrometers (0.4 to 0.6 mil). Within 8 hours, an intermediate/tie coat at a DFT of 40 to 75 micrometers (1.5 to 3 mils) and a finish coat conforming to 3.1.2 at a DFT of 75 to 125 micrometers (3 to 5 mils) shall be applied.

d. Zone 4. - No topcoats are required for galvanizing weights meeting or exceeding ASTM A123, A153, and A525 G165. When steel sheet is galvanized less than ASTM A525 G165, further coating in accordance with Zone 3 is required. As an alternate to topcoats, steel sheet shall be degreased, brush blasted, and an inorganic zinc primer conforming to 3.1.2.1 applied to a DFT of 50 to 75 micrometers (2 to 3 mils).

e. Zone 5. - No topcoats are required, except for color coding, safety, identification, or special conditions. When topcoats are required, the surface shall be degreased and a wash primer applied to a DFT of 10 to 15 micrometers (0.4 to 0.6 mil). Within 8 hours, a polyurethane finish coat conforming to 3.1.2 shall be applied to a DFT of 40 to 75 micrometers (1.5 to 3 mils).

3.5.2 Protection of Aluminum.

3.5.2.1 Surface Preparation of Aluminum.

CAUTION

Some aluminum configurations are susceptible to distortion and/or destruction when they are abrasive blasted. Special care shall be taken to ensure against any metal damage by choice of abrasive aggregate and by reducing blast nozzle pressure and increasing the working distance from nozzle to surface as necessary. 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, must be used to remove corrosion or roughen the surface. Aluminum surfaces shall be abrasive blasted with fine abrasive conforming to the requirements in 3.1.1 to remove corrosion and old coatings or roughen new surfaces. The blasted surface shall be free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

Aluminum shall be prepared by degreasing and abrasive blasting or mechanical cleaning, as required by the condition and configuration of the surface. Abrasive blasting shall be used whenever possible using abrasives specified in 3.1.1. Mechanical cleaning shall be used only when abrasive blasting is impractical, would damage the structure or component, or is prohibited in the area of work. Aluminum shall be mechanically cleaned in accordance with SSPC SP-3 using abrasive discs/sheets, or other approved methods. All corrosion and foreign matter shall be completely removed and the entire surface slightly roughened. Anodized or chemical conversion coated aluminum surfaces shall not be mechanically cleaned.

Abrasive blasting of bellows, gimbal joints, and other thin-walled, abrasion-sensitive components shall be blasted with walnut shells or approved equivalent in accordance with 3.1.1.

3.5.2.2 Protective Coatings. - The following protective coatings shall be applied to aluminum surfaces as required for each zone of exposure described in 1.1.

a. Zones 1, 2, and 3. - A nitrile-rubber-base, aluminum-pigmented coating conforming to 3.1.2.7 shall be applied. Coating shall have a DFT of 65 micrometers (2.5 mils) minimum to 100 micrometers (4 mils) maximum. To facilitate washdown of SRB residue on critical hardware, polymide epoxy coating and aliphatic polyurethane topcoat may be used as an alternate.

b. Zones 4 and 5. - No protective coatings are required except for color coding, safety, identification, or special conditions for normal atmospheric service of 1000, 5000, and 6000 series alloys. However, aluminum that is located within 3.5 kilometers (2 miles) of the coastline or other series alloys shall be fully coated according to 3.5.2.2.a. As an alternate to 3.5.2.2.a, aluminum may be degreased, wash primed with DOD-P-15328 to a DFT of 10 to 15 micrometers (0.4 to 0.6 mil), or conversion coated in accordance with MIL-C-5541, Class 1A, to meet electrical ground support equipment (GSE) requirements of KSC-E-165. Finish coats of epoxy primer to a DFT of 50 to 75 micrometers (2 to 3 mils) and topcoat of polyurethane, or equivalent, to a DFT of 40 to 75 micrometers (1.5 to 3.0 mils) shall be applied, as a minimum, to external surfaces where conversion coating is employed, such as racks and panels.

NOTE

Aluminum requires special coatings if immersion conditions could occur. See 3.5.4 for coatings for immersion.

3.5.3 Protection of Stainless Steel

CAUTION

Some stainless steel configurations are susceptible to distortion and/or destruction when they are abrasive blasted. Special care shall be taken to ensure against any metal damage by choice of abrasive aggregate and by reducing blast nozzle pressure and increasing the working distance from nozzle to surface as necessary. 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, must be used to remove corrosion or roughen the surface. Stainless steel surfaces shall be abrasive blasted with fine abrasive conforming to the requirements in 3.1.1 to remove corrosion and old coatings or roughen new surfaces. The blasted surface shall be free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

3.5.3.1 Surface Preparation of Stainless Steel - Stainless steel shall be prepared by degreasing in accordance with SSPC SP-1 and mechanical cleaning or abrasive blasting. Abrasive blasting shall be used whenever possible. Using abrasives specified in 3.1.1, stainless steel shall be mechanically cleaned in accordance with SSPC SP-3 using abrasive discs/sanding sheets, or other approved methods. All corrosion and foreign matter shall be completely removed and the entire surface slightly roughened.

3.5.3.2 Protective Coating

a. Zones 1, 2, and 3. - A nitrile-rubber-base, aluminum-pigmented coating conforming to 3.1.2.7 shall be applied. Coating shall have a DFT of 65 micrometers (2.5 mils) minimum to 100 micrometers (4 mils) maximum. To facilitate washdown of SRB residue on critical hardware, polyamide epoxy coating and aliphatic polyurethane topcoat may be used as an alternate.

b. Zones 4 and 5. - No protective coatings are normally required for normal atmospheric service except for color coding, safety, identification, or special conditions. As an alternative for special conditions, stainless steel may be brush blasted and coated with inhibitive epoxy primer to a DFT of 50 to 75 micrometers (2 to 3 mils) followed by an appropriate finish coat that will provide a DFT of 50 to 75 micrometers (2 to 3 mils). Degreasing followed by a wash primer may be substituted for the epoxy primer in Zone 5.

3.5.4 Underground, Submerged, or Continuously Wetted Surfaces - Surfaces that will be underground, submerged, or continuously wetted shall be prepared in accordance with SSPC SP-5 with a profile of 75 to 100 micrometers (3 to 4 mils) and coated with coal tar epoxy conforming to 3.1.2.5.

NOTE

Coal tar epoxy coatings shall not be used for contact with potable water.

The coating shall be applied to a minimum DFT of 410 micrometers (16.0 mils) and checked for missed areas or pinholes with a properly calibrated holiday detector in accordance with NACE RP0188-88. Cathodic protection requirements shall be coordinated with the application of this coating.

3.5.5 Coating Systems for Potable Water Immersion Service - All surface preparation for carbon steel shall be in accordance with SSPC-SP-5 with a surface profile of 75 to 100 micrometers (3 to 4 mils). All coatings for potable water service shall be selected from 3.1.2.6. All potable water coating systems shall be inspected in accordance with NACE Standard recommended practices RP0288-88 and with RP0188-88.

3.5.6 Provision for Nonskid Surfaces - Where a nonskid walking surface is required, a nonskid coating conforming to 3.1.2.8 shall be applied as follows:

a. Carbon Steel. - Apply directly over the zinc coating (inorganic zinc or galvanizing). Follow surface preparation instructions defined for topcoating in 3.5.1.

b. Aluminum and Stainless Steel. - Apply directly over these surfaces after surface preparation following instructions defined for topcoating in 3.5.2 and 3.5.3.

3.5.7 Repair of Applied Coatings. - Newly applied coatings shall be repaired in accordance with table 1. Surfaces shall be prepared by water washing and by mechanical methods to SSPC SP-11 to remove corrosion, weld slag, and to "feather back" coating edges. Touchup and repair shall be accomplished promptly after the damage has occurred. Touchup and repair of shop-applied coatings shall be accomplished using coatings from the same manufacturer as those applied in the shop.

3.5.8 Maintenance of Existing Coatings - Each support contractor responsible for maintaining facilities or ground support equipment should develop a Coating Maintenance Plan. The plan shall include the following key elements: record keeping, routine inspection of facilities, coating repair criteria, coating systems, equipment requirements, procedures, training and certification, in-process inspection, and worker protection and environmental compliance.

Table 1. Repair of Applied Coatings

Existing Coating	Repair Coating
Inorganic zinc	
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 system for small area touchup
Galvanized steel	
Zones 1 and 4	Inorganic zinc/epoxy mastic for small area touchup
Zones 2	Inorganic zinc/inorganic topcoat
Zones 3 and 5	Epoxy mastic/polyurethane system for small area touchup
Inorganic topcoat	
Zone 2	Inorganic zinc/inorganic topcoat
Epoxy/Polyurethane**	
Zones 3, 4 and 5	Epoxy/polyurethane system
Water reducible	
Zones 3, 4, and 5	Water reducible intermediate/finish
AR-7	
All zones	AR-7

*Zones are defined in 1.1

**When this coating is replaced with inorganic zinc, complete removal of the existing coating is required.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection. - The coating contractor/applicator shall provide continuous quality control inspection of his work to ensure complete conformance to the project specifications. A project-specific quality control coating inspection plan shall be submitted to the Contracting Officer for approval.

In addition, the Government and/or the Government's representative shall provide inspection of the surface preparation and coating application processes defined herein as required by the project specifications. The inspector shall perform all of the in-process inspections required by this standard and the project specifications. The assigned inspector shall be certificated under the National Association of Corrosion Engineers (NACE) International Coating Inspector Training and Certification Program (NICITCP). The inspector shall witness, inspect, and test all protective coating work to verify complete compliance with the specified requirements. The assigned inspector shall document the work on the inspection forms described in 4.4. The daily inspection reports shall be prepared and signed daily and submitted to the Contracting Officer on a weekly basis as a minimum. When a nonconformance report is required, it shall be signed and submitted to the Contracting Officer within 1 working day from the time that it is written. After determining that all nonconformances have been corrected and/or the coating work is in compliance with this standard and the project specifications, a conformance verification report shall be completed for the specific item, area, or project. This report shall be signed and sealed by the assigned inspector. The application of the certificated inspector's seal to the verification conformance report indicates that he has personally inspected the indicated work and has found it to be in compliance with the specified requirements. The seal shall not be affixed to the daily inspection report or to the nonconformance report. The contractor/applicator shall provide the inspector with safe access to the work.

The NICITCP is provided by NACE International, Education Department, P.O. Box 218340, Houston, Texas, 77218-8340, (713) 492-0535, FAX (713) 492-8254.

4.2 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. This includes all new work, new work touchup, 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 5. - All clean room structures fabricated of aluminum or carbon steel that will be abrasive blast cleaned and/or coated outside Zone 5 environments require NACE inspection. All other aluminum or carbon steel structures in Zone 5 environments are exempt from NACE inspection.

4.3 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 3.4.3.5

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

4.4 Inspection Forms. - All inspections shall be recorded and documented on KSC Form Nos. 28-588, 28-589, 28-589A, 28-675, and 28-676. Forms can be obtained from the Contracting Officer.

4.5 Inspection Prior to Surface Preparation and Coating Application - The following conditions shall be inspected prior to commencement of surface preparation and coating application operations.

4.5.1 Surface Condition. - The surface condition shall be visually inspected for compliance with 3.4.2. Special attention shall be given to weld spatter, sharp edges, flame or saw cuts, etc., prior to surface preparation.

4.5.2 Protection of Adjacent Surfaces - Adjacent surfaces shall be visually inspected for adequate protection in accordance with 3.4.2. This inspection shall be in conjunction with Government Quality Engineering.

4.5.3 Ambient Weather Conditions. - 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. The air temperature, relative humidity, and dewpoint shall be determined through the use of a psychrometer in accordance with the manufacturer's instructions. The surface temperature shall be determined by using a surface temperature thermometer. Wind speed and direction shall be determined with a suitable instrument. No spray painting may proceed when the measured wind speed in the immediate coating area is above 25 kilometers per hour (15 miles per hour). All of these ambient weather conditions shall be recorded on the Daily Inspection Record.

4.5.4 Compressed Air Cleanliness. - The compressed air supply shall be inspected for the use of inline moisture and oil traps. Proper functioning of the traps shall be evaluated daily by allowing the air supply (downline from the traps) to blow against a clean, white cloth for several minutes. No moisture or oil should be deposited on the cloth.

4.5.5 Surface Salt Concentration - On structures within 3.5 kilometers (2 miles) of the ocean shore, the surface chloride concentration shall be determined using Saltesmo test strips [available from Gallard-Schlesinger Chemical Manufacturing Corporation (516) 333-5600] or other suitable methods and recorded in the Inspection Records weekly. Surfaces that measure 50 milligrams per square meter (0.00016 ounce per square foot) or above require water washing in accordance with 3.4.2.1.

4.6 Surface Preparation Inspection - The following inspections shall be made to ensure compliance with the surface preparation requirements in 3.4.2.

4.6.1 Abrasive Blasting Material - The abrasive blasting material shall be verified for compliance with 3.1.1.

4.6.2 Blast Nozzle Air Pressure and Size - The air pressure at the blast nozzle shall be determined through the use of a hypodermic needle air pressure gage. The needle of the gage shall be inserted as close to the nozzle as practically possible and in the direction of the air flow. Pressure readings should be taken with the blasting system in complete operation. The nozzle pressure shall be recorded. The nozzle shall be checked initially and then at a frequency determined by the NACE inspector with a blast nozzle orifice gage to ensure the compressor output correlates with the nozzle size.

4.6.3 Degree of Surface Cleanliness - The surface cleanliness shall be inspected after the completion of surface preparation procedures and prior to primer application to determine compliance with the applicable

requirements of 3.5. The degree of cleanliness of abrasive blasted carbon steel shall be verified through the use of visual standards in accordance with 3.5.1.1.2. Galvanized steel, aluminum, and stainless steel shall be inspected for cleanliness in accordance with 3.5.1.2, 3.5.2, and 3.5.3. The surface preparation cleanliness requirements defined in 3.5 shall be applicable to 100 percent of the subject area, including places that are difficult to reach. Use of SSPC-VIS 1-89 is recommended for judging surface cleanliness.

4.6.4 Surface Profile or Roughness - The anchor profile of an abrasive-blasted carbon steel surface shall be determined by using a surface profile gage, comparator, or replica tape. The profile shall be in accordance with 3.5.1.1.2. Galvanized steel, stainless steel, and aluminum surfaces shall be visually inspected as required for slight roughening in accordance with 3.5.1.2, 3.5.2, and 3.5.3.

4.6.5 Blasting of Abrasive-Sensitive Components - Thin-walled, abrasive-sensitive components will be protected during normal blasting operations in accordance with 4.5.2. Surface preparation of these sensitive components will use walnut shell or approved equivalent in accordance with 3.1.1.

4.7 Coating Application Inspection. - The following inspections shall be made to ensure compliance with the coating application requirements defined in 3.4.3.

4.7.1 Surface Condition. - The prepared surface shall be visually inspected and the time before coating shall be monitored for compliance with 3.4.3 before coatings are applied.

4.7.2 Coating Materials. - The coating materials shall be visually inspected for compliance with 3.4.3.1.

4.7.3 Storage of Coating Material - Coating material storage conditions shall be periodically inspected for compliance with 3.4.3.3.

4.7.4 Mixing and Application of Coatings. - The mixing and application of all coatings shall be visually inspected to ensure compliance with 3.4.3.4, 3.4.3.6, and 3.4.3.9.

4.7.5 Coating Finish and DFT. - The finish and DFT of each applied coating shall be inspected for compliance with 3.4.3.7 and 3.5 prior to the application of successive coats. The DFT measurement on carbon steel shall be taken using a magnetic gage calibrated in accordance with SSPC PA2. 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.

4.8 Caulking Inspection. - All surfaces shall be inspected to determine compliance with the requirements for sealing and caulking in accordance with 3.4.4.

4.9 Galvanizing Inspection. - Galvanized carbon steel shall be inspected in accordance with the applicable ASTM standard in 3.5.1.2.1.

5. PREPARATION FOR DELIVERY

Not applicable.

6. NOTES

6.1 Intended Use. - This standard is intended to establish uniform practices, methods, and procedures. The information provided herein shall be used for the preparation of written, individual coating specifications for specific projects for the prevention of atmospheric corrosion on space vehicle launch structures, facilities, and ground support equipment in a seacoast/corrosive environment. Due to the changing environmental considerations, new advances in corrosion control technology, and the wide array of possible applications, this document should not be used as a stand-alone specification that meets every contingency.

6.2 Additional Related Information - For information and guidance on dissimilar metals, corrosion-inhibiting lubricants, etc., refer to T.O. 1-1-691 and KSC-TM-584.

Custodian:

NASA - John F. Kennedy Space Center
Kennedy Space Center, FL 32899

Preparing Activity:

John F. Kennedy Space Center
Mechanical Engineering
Engineering Development Directorate

APPENDIX A

APPROVED PRODUCTS LIST FOR INORGANIC ZINC COATINGS

This list has been prepared for use by or for the Government in the procurement of products covered by this document, 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 Volatile Organic Content (VOC). Use of the information shown hereon 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 3.4.3.1 and 3.4.3.4.

The agency responsible for this list is the KSC Engineering Development Directorate.

Section I. Materials With Greater Than 420 Grams/Liter (3.5 Pounds/Gallon) VOC (SB Is Solvent-Based and WB Is Water-Based)

Coating Designation	Type	Manufacturer
Dimetcote 6 Dimetcote 9	SB	Ameron P.C.D. 201 North Berry Street Brea, CA 92691 (714) 529-1951
Carbo-Zinc 11	SB	Carboline Company 350 Hanley Industrial Court St. Louis, MO 63114 (314) 644-1000
Zinc-Plate 21	SB	Con-Lux Coatings, Inc. 226 Talmadge Road Edison, NJ 08818 (201) 287-4000

Coating Designation	Type	Manufacturer
Cathacoat 304	SB	Devoe Coatings Co. 4000 Dupont Circle Louisville, KY 40207 (502) 897-9861
Ganicin 347-Y-931	SB	DuPont 1007 Market Street

		Wilmington, DE 19898 (302) 774-8297
Engard 519	SB	Engard Coatings Corp. 15541 Commerce Lane Huntington Beach, CA 92649 (714) 891-4402
Zinc-Lock 311	SB	Porter International 400 South 13 Street Louisville, KY 40201 (502) 588-9200
PPG 1001	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (412) 434-3131
Zinc-Clad B69-V-1	SB	Sherwin Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (216) 566-3349
Sigma 7551	SB	Sigma Coatings, Inc. P.O. Box 826 Harvey, LA 70059 (504) 347-4321
Valspar 13-F-12	SB	Valspar Corp. 1101 Third Street South Minneapolis, MN 55415 (612) 332-7371

Section II. Materials With Less Than 340 Grams/Liter (2.8 Pounds/Gallon) VOC (SB Is Solvent-Based and WB Is Water-Based)

Coating Designation	Type	Manufacturer
Dimetcote D-21-7 Dimetcote D-21-9	WB SB	Ameron P.C.D. 210 North Berry Street Brea, CA 92691 (714) 529-1951
Briner V-65	WB	Briner Paint Company 3713 Agnes Street Corpus Christi, TX 78405 (512) 884-4804

Carbo-Zinc 11HS Carbo-Zinc D7	SB WB	Carboline Company 350 Hanley Industrial Court St. Louis, MO 63114 (314) 644-1000
Zinc-Plex 6	WB	Con-Lux Coatings, Inc. 226 Talmadge Road Edison, NJ 08818 (201) 287-4000
Cathacoat 305	WB	Devoe Coatings Co. 4000 Dupont Circle Louisville, KY 40207 (502) 897-9861
Ganicin 347WB	WB	DuPont 1007 Market Street Wilmington, DE 19898 (302) 774-8297
Elite 4610	WB	Elite Coatings Co., Inc. P.O. Box 130 Gordon, GA 31031 (912) 628-2111

Coating Designation	Type	Manufacturer
Galvosil 1562	WB	Hempel Coatings, Inc. 6901 Cavalcade Houston, TX 77028 (713) 672-6641
IC-531	WB	Inorganic Coatings 500 Lapp Road Malvern, PA 19355 (215) 640-2880
MAB 24-A-190	WB	M.A. Bruder & Sons, Inc. 600 Reed Road Broomall, PA 19008 (215) 353-5100
Mo-Zinc 2	WB	BLP Mobile Paints P.O. Box 717 Theodore, AL 36590 (205) 653-0110
Zinc-ite 9030	SB	Plas-Chem Coatings, Inc.

Zinc-ite W-9108	WB	P.O. Box 40246 Jacksonville, FL 32203 (904) 766-8000
IZ-91N TQ-4374H	WB WB	Porter International 400 South 13 Street Louisville, KY 40201 (502) 588-9200
Zinc Clad II Zinc Clad 10	SB WB	Sherwin Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (216) 566-3349
Tornusil 7550	WB	Sigma Coatings, Inc. P.O. Box 826 Harvey, LA 70059 (504) 347-4321

Coating Designation	Type	Manufacturer
Chemtec 600	WB	Southern Coatings, Inc. P.O. Box 160 Sumter, SC 29151 (803) 775-6351
V13-F-12 13-F-6	SB WB	Valspar Corp. 1101 Third Street South Minneapolis, MN 55415 (612) 332-7371

APPENDIX B

APPROVED PRODUCTS LIST FOR TOPCOAT SYSTEMS

This list has been prepared for use by or for the Government in the procurement of products covered by this document, 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 Volatile Organic Content (VOC). Use of the information shown hereon 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 3.4.3.1 and 3.4.3.4.

The agency responsible for this list is the KSC Engineering Development Directorate.

Section I. Materials With Greater Than 420 Grams/Liter (3.5 Pounds/Gallon) VOC (SB Is Solvent-Based and WB Is Water-Based)

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
Cathacoat 304 (SB)	201 (SB)	359 (SB)	Devoe Coatings Co.
Cathacoat 304 (SB)	230 (SB)	369 (SB)	4000 Dupont Circle
Cathacoat 304 (SB)	201 (SB)	369 (SB)	Louisville, KY 40207
			(502) 897-9861
Engard 519 (SB)	1447 (SB)	428 (SB)	Engard Coatings Corp.
Engard 519 (SB)	1447 (SB)	449 (SB)	15541 Commerce Lane
			Huntington Beach, CA 92649
			(714) 891-4402

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
Zinc-Lock 311 (SB)	MCR-4335 (SB)	8610 (SB)	Porter International
			400 South 13th St.
			Louisville, KY 40201
			(502) 588-9200
PPG 1001 (SB)	97-139 (SB)	97-812 (SB)	PPG Industries, Inc.
PPG 1001 (SB)	97-148 (SB)	97-812 (SB)	One PPG Place

			Pittsburgh, PA 15272 (412) 434-3131
Sigma 7551 (SB)	5434 (SB)	5523 (SB)	Sigma Coatings, Inc. P.O. Box 826 Harvey, LA 70059 (504) 347-4321

Section II. Materials With Less Than 340 Grams/Liter (2.8 Pounds/Gallon) VOC (SB Is Solvent-Based and WB Is Water-Based)

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
D-21-9 (SB)	400 (SB)	450HS (SB)	Ameron P.C.D. 210 North Berry St. Brea, CA 92691 (714) 529-1951
Briner V-65 (WB)	5382 (WB)	5353 (WB)	Briner Paint Co. 3713 Agnes Street Corpus Christi, TX 78405 (512) 884-4804
CZ-11HS (SB) CZ-11HS (SB) CZ-D7(WB)	893 (SB) CM-15 (SB) 3358 (WB)	134HS (SB) 3359 (WB) 3359 (WB)	Carboline Company 350 Hanley Industrial Ct. St. Louis, MO 63114 (314) 644-1000

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
Zinc Plex 6 (WB)	1788-90 (WB)	1788-90 (WB)	Con-Lux Coatings, Inc. 226 Talmadge Road Edison, NJ 08818 (201) 287-4000
Cathacoat 305 (WB)	648 (WB)	669 (WB)	Devoe Coatings Co. 4000 Dupont Circle Louisville, KY 40207 (502) 897-9861
Ganicin 347 (WB)	25P (SB)	333 (SB)	DuPont 1007 Market Street Wilmington, DE 19898 (302) 774-8297
IC-531 WB)	IC-46P (WB)	IC-46 (WB)	Inorganic Coatings 500 Lapp Road Malvern, PA 19355 (215) 640-2880
MAB 24-A-190 (WB)	101 (SB)	880HS (SB)	M.A. Bruder & Sons 600 Reed Road Broomall, PA 19008 (215) 353-5100
W-9108 (WB)	2316 (SB)	2885 (SB)	Plas-Chem Coatings, Inc. P.O. Box 40246 Jacksonville, FL 32203 (904) 766-8000
Valspar 13-F-6 (WB)	76 (SB)	54 (SB)	Valspar Corp. 1101 Third St. South Minneapolis, MN 55415 (612) 332-7371