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USACE / NAVFAC / AFCEC	**UFGS-09 97 02 (February 2020)**
	Change 1 - 11/21

Preparing Activity: USACE	**Superseding**
	UFGS-09 97 02 (November 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025

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SECTION 09 97 02

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SECTION 09 97 02

PAINTING: HYDRAULIC STRUCTURES
02/20, CHG 1: 11/21

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NOTE: This guide specification covers the requirements for the preparation of surfaces and the application of paints for hydraulic structures and appurtenant items. This section was originally developed for USACE Civil Works projects.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

1.1 LUMP SUM PRICE

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NOTE: If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is included in the project specifications, this paragraph title (LUMP SUM PRICE) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 20 00.

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1.1.1 Painting: Hydraulic Structures

1.1.1.1 Payment

Payment will be made for costs associated with "Painting: Hydraulic Structures", which includes full compensation for furnishing all materials, equipment, and labor required to paint the hydraulic structures in accordance with this section.

1.1.1.2 Unit of Measure

Unit of measure: lump sum.

1.2 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D153	(1984; R 2014) Specific Gravity of Pigments
ASTM D235	(2022) Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D281	(2012; R 2016) Standard Test Method for Oil Absorption of Pigments by Spatula Rub-Out
ASTM D520	(2025) Standard Specification for Zinc Dust Pigment
ASTM D561	(1982; R 2014) Carbon Black Pigment for Paint
ASTM D740	(2011) Methyl Ethyl Ketone

ASTM D841	(2019) Standard Specification for Nitration Grade Toluene
ASTM D962	(1981; R 2014) Aluminum Powder and Paste Pigments for Paints
ASTM D1045	(2019) Standard Test Methods for Sampling and Testing Plasticizers Used in Plastics
ASTM D1152	(2006; R 2012) Methanol (Methyl Alcohol)
ASTM D1153	(2012) Methyl Isobutyl Ketone
ASTM D1200	(2010; R 2014) Viscosity by Ford Viscosity Cup
ASTM D1210	(2005; R 2014) Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
ASTM D2917	(2007; R 2013) Methyl Isoamyl Ketone
ASTM D3465	(2014) Standard Test Method for Purity of Monmeric Plasticizers by Gas Chromatography
ASTM D3721	(2005; R 2011) Synthetic Red Iron Oxide Pigment
ASTM D4228	(2005; R 2017) Standard Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces
ASTM D4417	(2021) Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D7091	(2021) Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nondestructive Coatings Applied to Non-Ferrous Metals
ASTM E1347	(2006; R 2020) Standard Test Method for Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2020) Occupational and Educational Personal Eye and Face Protection Devices
ANSI/ISEA Z358.1	(2014; R 2020) American National Standard for Emergency Eyewash and Shower Equipment

MASTER PAINTERS INSTITUTE (MPI)

MPI 46	(2016) Undercoat, Enamel, Interior

MPI 47	(2016) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 48	(2016) Alkyd, Interior, Gloss (MPI Gloss Level 6-7)
MPI 49	(2015) Alkyd, Interior, Flat (MPI Gloss Level 1)
MPI 50	(2015) Primer Sealer, Latex, Interior
MPI 51	(2016) Alkyd, Interior, (MPI Gloss Level 3)2
MPI 52	(2016) Latex, Interior, (MPI Gloss Level 3)
MPI 53	(2012) Latex, Interior, Flat (MPI Gloss Level 1)
MPI 54	(2016) Latex, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 114	(2012) Latex, Interior, Gloss (MPI GLoss Level 6)
MPI 212	(2018) Floor Coating, Thin Film, for Aircraft Maintenance Facilities

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2026) National Electrical Code

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 2003-154	(2003; 4th Ed; Supple 3) NIOSH Manual of Analytical Methods

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC Guide 6	(2021) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC PA 2	(2015; E 2018) Procedure for Determining Conformance to Dry Coating Thickness Requirements
SSPC PS 26.00	(2000; E 2004) Aluminum Pigmented Epoxy Coating System Materials Specification, Performance-Based (Type I for use over Blast Cleaned Steel and Type II for use over Hand Cleaned Steel)
SSPC Paint 16	(2023) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC Paint 20	(2019) Zinc-Rich Primers (Type I,

	Inorganic, and Type II, Organic)
SSPC Paint 33	(2023; R 2023; S 2023) Coal Tar Mastic, Cold-Applied
SSPC Paint 38	(2006) Single-Component Moisture-Cure Weatherable Aliphatic Polyurethane Topcoat, Performance-Based
SSPC Paint 40	(2019) Zinc-Rich Moisture-Cure Polyurethane Primer, Performance-Based
SSPC Paint 41	(2008) Moisture-Cured Polyurethane Primer or Intermediate Coat, Micaceous Iron Oxide Reinforced, Performance-Based
SSPC QP 1	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components)
SSPC QP 2	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Removal of Hazardous Coatings from Structures)
SSPC QP 3	(2010) Standard Procedure for Evaluating Qualifications of Shop Painting Applicators
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 3	(2024) Power Tool Cleaning
SSPC SP 5/NACE No. 1	(2007) White Metal Blast Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 16	(2010) Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Occupational Health (SOH) Requirements

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441	(2009; Rev D; Notice 1 2021) Paint, Epoxy-Polyamide, General Specification for
MIL-PRF-85285	(2024; Rev F; Am 1 2024) Topcoat, Aircraft and Support Equipment

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-3130	(Rev A) Paint (For Application to Wet Surfaces)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1910.94	Ventilation
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1926.62	Lead
40 CFR 50.6	National Primary and Secondary Ambient Air Quality Standards for PM10
40 CFR 50.12	National Primary and Secondary Ambient Air Quality Standards for Lead
40 CFR 58	Ambient Air Quality Surveillance
40 CFR 60	Standards of Performance for New Stationary Sources
40 CFR 117	Determination of Reportable Quantities for Hazardous Substances
40 CFR 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 262.22	Number of Copies
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
49 CFR 171	General Information, Regulations, and Definitions

1.3 SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS

Perform work in accordance with all applicable health, safety, and environmental requirements as well as EM 385-1-1. Submit matters of interpretation of these requirements to the Contracting Officer for resolution before starting work. If no clarifications are sought, then the submittal is not necessary. Where the regulations conflict, the most stringent requirements apply. This paragraph supplements the health, safety, and environmental requirements of EM 385-1-1.

1.3.1 Safety

Submit an Accident Prevention Plan in accordance with the requirements of Section 01 of EM 385-1-1, including, but not limited to, each of the topic areas listed in Appendix A therein and the specified requirements. Develop each topic in a concise manner to include management and operational aspects. Submit a Ventilation Assessment Plan complying with all applicable safety standards.

1.3.1.1 Abrasive Blasting

For abrasive blasting comply with the requirements in Section 06.I of EM 385-1-1. In addition to the requirements in Section 20 of EM 385-1-1, use hoses and hose connections of a type to prevent shock from static electricity. Join hose lengths together by approved couplings of a material and type designed to prevent erosion and weakening of the couplings. The couplings and nozzle attachments must fit on the outside of the hose and be designed to prevent accidental disengagement.

1.3.1.2 Workers Other Than Blasters

Protect workers, other than blasting operators working in close proximity to abrasive blasting operations. Use MSHA/NIOSH-approved half-face or full-face air purifying respirators equipped with high-efficiency particulate air (HEPA) filters and eye protection meeting ANSI/ISEA Z87.1. Use hearing protectors (ear plugs and/or ear muffs) providing a noise reduction rating of at least 20 dBA or as needed to provide adequate protection. Provide personal protective equipment where required by 29 CFR 1910.146 and in accordance with 29 CFR 1910, Subpart I.

1.3.1.3 Cleaning Before and After Abrasive Blasting

Cleaning with compressed air must be in accordance with Section 20.B.5 of EM 385-1-1 and personnel protected as specified in 29 CFR 1910.134. When cleaning with solvents, provide ventilation where required by 29 CFR 1910.146 or where the concentration of solvent vapors exceeds 10 percent of the Lower Explosive Limit (LEL). Ventilation must be in accordance with 29 CFR 1910.94, paragraph (c)(5).

1.3.1.4 Pretreatment of Metals and Concrete with Acids

Personnel must be protected in accordance with 29 CFR 1910, Subpart I. In addition to the requirements of Section 05 of EM 385-1-1, provide an eyewash in accordance with ANSI/ISEA Z358.1, paragraph (6).

1.3.1.5 Paint Mixing

Provide local exhaust ventilation in the area where coatings are mixed. This ventilation system must be capable of providing at least 30.5 linear

meters per minute 100 linear fpm of capture velocity in the mixing zone. Avoid exposure of skin and eyes by wearing appropriate chemically resistant gloves, safety goggles, and face shields meeting the requirements of ANSI/ISEA Z87.1. Provide a personal eyewash unit within close proximity to the mixing operation in accordance with ANSI/ISEA Z358.1, paragraph (9). All powered mixing equipment must be either pneumatic or double insulated (intrinsically safe), in order to guard against fire or explosion. Individuals who have a history of, or develop a sensitivity to epoxy or polyurethane resin systems, must not conduct work tasks or otherwise be exposed to such chemicals.

1.3.1.6 Confined Spaces

When using solvent-based paint in confined spaces, prepare a Confined Spaces Plan. Provide ventilation to exchange air in the space at a minimum rate of 140 cubic meters 5,000 cubic feet per minute per spray gun in operation. It may be necessary to install both a mechanical supply and exhaust ventilation system to effect adequate air changes within the confined space. Locate and affix all air-moving devices to an opening of the confined space in a manner assuring that the airflow is not restricted or short circuited and is supplied in the proper direction. A suitable means of egress must be maintained at all times. Continue ventilation after completion of painting and through the drying phase of the operation. If the ventilation system fails or the concentration of volatiles exceeds 10 percent of the LEL (except in the zone immediately adjacent to the spray nozzle), stop painting and evacuate spaces until adequate ventilation is provided. Provide an audible alarm that signals system failure as an integral part of the ventilation system. Check the effectiveness of the ventilation by using ventilation smoke tubes and making frequent oxygen and combustible gas readings during painting operations. Exhaust ducts must discharge clear of the working areas and away from possible sources of ignition. Submit detailed written standard operating procedures for confined spaces in accordance with 29 CFR 1910.146 and EM 385-1-1, Section 6H, Section 34. The procedures must include:

a. Certificates of calibration for all testing and monitoring equipment. The certificates of calibration must include: type of equipment, model number, date of calibration, firm conducting calibration, and signature of individual certifying calibration.

b. Methods of inspection of personal protective equipment prior to use.

c. Engineering controls and other work practices designed to reduce airborne hazardous chemical exposures to a minimum.

d. Specification of the design and installation of ventilation systems which provide adequate oxygen content and provide for the dilution of paint solvent vapor, lead, and other toxic particulates within the confined space. Procedures must also include plans to evaluate the adequacy of air flow patterns.

1.3.1.7 Paint Spraying

Submit a comprehensive written Respiratory Protection Plan in accordance with 29 CFR 1910.134, 29 CFR 1926.62, and EM 385-1-1, Section 05.G. During all spray painting operations, spray painters must use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations compatible with the Assigned Protection Factor (APF) of an air-purifying

respirator. Persons with facial hair that may interfere with the seal or valve function of a half or full facepiece style respirator may wear a hood or helmet respirator provided the APF is sufficient for the exposure. Air-purifying chemical cartridge/canister respirators that have a particulate prefilter and are suitable for the specific type(s) of gas/vapor and particulate contaminant(s) may be used for nonconfined space painting, mixing, and solvent cleaning. These respirators may be used provided the measured or anticipated concentration of the contaminant(s) in the breathing zone of the exposed worker does not exceed the APF for the respirator and the gas/vapor has good warning properties or the respirator assembly is equipped with a NIOSH-approved end of service life indicator for the gas(es)/vapor anticipated or encountered. Where paint contains toxic elements that may become airborne during painting in nonconfined spaces, air-purifying half- and full-facepiece respirators or powered air-purifying respirators equipped with appropriate gas vapor cartridges, in combination with a high-efficiency filter, or an appropriate canister incorporating a high-efficiency filter, must be used.

1.3.1.8 Explosion Proof Equipment

Electrical wiring, lights, and other equipment located in the paint spraying areas must be of the explosion proof type designed for operation in Class I, Division 1, Group D, hazardous locations as required by the NFPA 70. Electrical wiring, motors, and other equipment, outside of but within 6 m 20 feet of any spraying area, must not spark and must conform to the provisions for Class I, Division 2, Group D, hazardous locations. Electric motors used to drive exhaust fans must not be placed inside spraying areas or ducts. Fan blades and portable air ducts must be constructed of nonferrous materials. Properly maintain and ground motors and associated control equipment. Electrically bond and ground the metallic parts of all air-moving devices, spray guns, connecting tubing, and duct work.

1.3.1.9 Further Precautions

a. Workers must wear nonsparking safety shoes.

b. Solvent drums taken into the spraying area must be grounded. Maintain metallic bonding between containers and drums when materials are being transferred.

c. Inspect insulation on all power and lighting cables to ensure that the insulation is in excellent working condition and is free of all cracks and worn spots. Ensure that no connections are within 15 m 50 feet of the operation, that lines are not overloaded, and that they are suspended with sufficient slack to prevent undue stress or chafing.

1.3.1.10 Ignition Sources

Ignition sources, including lighted cigarettes, cigars, pipes, matches, or cigarette lighters, and electronic smoking devices are prohibited in areas of solvent cleaning, paint storage, paint mixing, or paint application.

1.3.2 Health

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NOTE: It is the responsibility of the designer to determine which structures are coated with a lead-based paint or other toxic material. Where

lead is present and the appropriate text from this guidance document is included in the contract, it is not necessary to include text from other UFGS documents that deal specifically with lead removal or disposal projects.

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Prepare and submit a Medical Surveillance Plan and a statement from the examining physician indicating the name of each employee evaluated and any limitations which will preclude the employee from performing the work required. The statement must include the date of the medical evaluation, the physician's name, signature, and telephone number.

1.3.2.1 Air Monitoring

Prepare and submit an Air Monitoring Test Plan. Perform air sampling and testing as needed to assure that workers are not exposed to contaminants above the permissible exposure limit. In addition, provide the Contracting Officer with a copy of the Air Monitoring Test Report from the laboratory within five working days of the sampling date, including records of air monitoring plans and tests performed. Submit reports as soon as information is available. Also provide results from direct-reading instrumentation on the same day the samples are collected. Prepare and submit an Airborne Sampling Plan detailing the NIOSH 2003-154, Factory Mutual, or Underwriters Laboratories approved equipment, equipment calibration procedures, sampling methods, sampling to be performed, and analytical procedures to be used based on the type of work to be performed and anticipated toxic contaminants to be generated. Include the name of the accredited laboratory, listed by the American Industrial Hygiene Association (AIHA), that will be used to conduct the analysis of any collected air samples.

1.3.2.2 Medical Status

Prior to the start of work, and annually thereafter, submit a Report of Medical Status Records. This report will certify that Medical Status Records, in accordance with the requirements below are maintained for all required employees. The Contractor-maintained Medical Status Reports will document the medical evaluation of all employees working with or around paint systems, thinners, blast media, those required to wear respiratory protective equipment, and those who will be exposed to high noise levels for the particular type of exposure they may encounter. The Contractor-maintained Records must include the employee's name, the tests performed and the name of the physician responsible for performing the tests, and a physician's statement that medical status would permit specific task performance. Maintain medical records as required by 29 CFR 1910.20. The evaluation must include:

a. Audiometric testing and evaluation of employees who will work in a noise environment with a time weighted average greater than or equal to 85 dBA.

b. Vision screening of employees who will require eye protection (employees who use full-facepiece respirators cannot wear contact lenses).

c. Medical evaluation of employees who will be required to wear respiratory protection must include, but is not limited to, the following:

(1) Medical history including, but not limited to, alcohol use, with emphasis on liver, kidney, and pulmonary systems, and sensitivity to chemicals to be used on the job.

(2) General physical examination with emphasis on liver, kidney, and pulmonary system.

(3) Determination of the employee's physical and psychological ability to wear respiratory protective equipment and to perform job-related tasks.

(4) Determination of baseline values of biological indices for later comparison to changes associated with exposure to paint systems and thinners or blast media, which include: liver function tests to include SGOT, SGPT, GGPT, alkaline phosphates, bilirubin, complete urinalysis, EKG (employees over age 40), blood urea nitrogen (bun), serum creatinine, pulmonary function test, FVC, and FEV, chest x-ray (if medically indicated), blood lead and ZPP (for individuals where it is known there will be an exposure to materials containing lead), other criteria that may be deemed necessary by the Contractor's physician.

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NOTE: 29 CFR 1926.62 Lead requires the development of a Worker Protection Plan for jobs involving removal of lead-containing coatings. It is the specifier's responsibility for determining when lead-containing paint will be removed and requiring the appropriate submittals including environmental compliance, worker protection, and waste management.

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(5) For lead-based paint removal, prepare and submit a Worker Protection Plan in accordance with the requirements of 29 CFR 1926.62, addressing all necessary aspects of worker protection. The plan must include medical screening, activities emitting lead, means to achieve compliance, alternative technologies considered, air monitoring program, implementation schedule, work practice program, administrative controls, multi-Contractor site arrangements, and jobsite inspections.

1.3.2.3 Change in Medical Status

Any employee whose medical status has changed negatively due to work related chemical and/or physical agent exposure while working with or around paint systems and thinners, blast media, or other chemicals must be evaluated by a physician, and obtain a physicians statement as described in paragraph MEDICAL STATUS prior to allowing the employee to return to those work tasks. Maintain Change in Medical Status Records detailing any negative changes in employee medical status and the results of the physicians reevaluation statement. Submit a Change in Medical Status Report detailing the negative changes in medical status and a summary of the physician's reevaluation without including personal information of the impacted employee.

1.3.3 Environmental Protection

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NOTE: An Environmental Compliance Plan for jobs involving removal of lead-containing coatings serves to demonstrate the Contractor's strategy for protecting the environment and the public from lead exposure. Elements of this plan may be redundant with other submittals listed herein including the Water Quality Plan, Soil Quality Plan, Ambient Air Monitoring Plan, and Visible Emissions Monitoring Plan. These submittals may be required for other jobs which do not involve the removal of lead-containing paint. The Environmental Compliance Plan integrates these plans as well as other lead-specific elements.

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In addition to the requirements of Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS, prepare an Environmental Protection Plan incorporating the submittals for Water Quality Plan, Containment Plan, Waste Disposal Plan, Soil Quality Plan, TSP Monitoring Plan, PM-10 Monitoring Plan, and Visible Emissions Monitoring Plan. The submitted plan must also address all aspects of establishing and demarcating regulated areas, ventilation/containment system performance verification, and reporting of accidental releases. Comply with the following environmental protection criteria.

1.3.3.1 Waste Classification, Handling, and Disposal

Prepare and submit a Waste Disposal Plan in accordance with the requirements of 40 CFR 261 and 40 CFR 262 including classification and handling. The Contractor is responsible for assuring the proper disposal of all hazardous and nonhazardous waste generated during the project. Regardless of the results of 40 CFR 261 App II, Mtd 1311, all waste generated from abrasive blasting, lead-containing paints with recyclable steel or iron abrasives must be either disposed of as a hazardous waste or be stabilized with proprietary pre-blast additives . Where stabilization is preferred, employ a proprietary blast additive, that has been blended with the blast media prior to use. Place hazardous waste in properly labeled, closed containers shielded adequately to prevent dispersion of the waste by wind or water. Any evidence of improper storage is cause for immediate shutdown of the project until corrective action is taken. Store nonhazardous waste in closed containers separate from hazardous waste storage areas. Transport all hazardous waste by a licensed transporter in accordance with 40 CFR 263 and 49 CFR 171, Subchapter C. Transport all nonhazardous waste in accordance with local regulations regarding waste transportation. In addition to the number of copies required by 40 CFR 262.22, supply one copy of each Waste Manifest to the Contracting Officer prior to transportation.

1.3.3.2 Containment

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NOTE: It is the responsibility of the specifier to determine whether containment is required and if so, to specify it.

Specify the containment requirements using SSPC Guide 6. Where lead or other hazardous materials are present and abrasive blasting will be performed, specify either Class 1A or Class 2A containment.

Where Class 1A containment is specified, instrument verification of negative pressure should be required. Class 1A provides the greatest level environmental protection and should be specified in areas where high levels of lead are present and the work is in the vicinity of critical receptors (parks, schools, residences, or sensitive water sources). Class 2A containment is the most commonly specified level of containment for civil works structures in non-critical areas. Class 3A containment may provide an adequate degree of environmental protection for some lead-containing paint removal jobs, however, an adequate degree of worker protection may not be achievable under some circumstances.

Where lead or other hazardous materials are not present but abrasive blasting will be performed, specify Class 2A or 3A containment. Where the Contractor proposes to use a low-dusting recyclable abrasive such as steel grit, then the Contracting Officer should allow one class lower of containment. Classes 3A and 4A containment provide minimal control over emissions. Minimal control of emissions would be used in situations where critical receptors are not near the work site. Containment of dust producing abrasive blasting operations is recommended because of NAAQS for PM-10.

Where lead or other hazardous materials are present and power tool cleaning will be performed, specify Class 1P containment. Where the Contractor proposes to use vacuum-shrouded power tools then the Contracting Officer should allow their use with ground covers and/or free hanging tarpaulins. Classes 2P or 3P can be specified where the paint contains low-levels of lead, less than 1 percent. As an option the Contractor should be allowed to use vacuum shrouded power tools without additional protection. Containment is not generally specified for power tool removal of nonhazardous paint materials.

A Containment Plan should also be required for nonlead jobs where containment is specified.

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Prepare a Containment Plan for containing debris generated during paint removal operations. Include drawings, load-bearing capacity calculations, and wind load calculations. When the design is such that the spent abrasive is allowed to accumulate in quantities greater than 453 kg 1,000 pounds, and/or impart a significant wind load on the structure, have the drawings approved by a registered structural engineer. The drawings and calculations must be stamped with the engineer's seal. Also identify the type and placement of water booms, methods for anchoring the booms, and the procedures for removing debris. Contain debris generated during paint removal operations in accordance with the requirements of SSPC Guide 6, Class [_____]. Where required, verify the containment air pressure [by instrument] [visually].

1.3.3.3 Visible Emissions Monitoring

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NOTE: It is the responsibility of the specifier to determine whether monitoring of visible emissions will be required and if so, to specify the requirements. The 40 seconds in 1-hour, 75 seconds in 2-hours, and 1 percent daily visible emissions criteria should be invoked for all lead and other hazardous paint removal jobs. The 200 seconds in 1-hour, 300 seconds in 2-hours, and 5 percent daily visible emissions criteria should be called for on jobs where abrasive blasting will be used to remove nonhazardous paints. Visible emissions monitoring should not be specified for power tool removal of nonhazardous paints. See NOTE for paragraph CONTAINMENT above.

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Prepare a Visible Emissions Monitoring Plan including the provisions for halting work and correcting the containment in the event unacceptable emissions are observed. General statements must not be used; specific methods, procedures, and details are required. Measure the time of emissions in accordance with 40 CFR 60, App A, Mtd 22. Monitor visible emissions for not less than 15 minutes of every hour. Calculate visible emissions for each hour by extrapolation. Visible emissions must not extend greater than 45 m 150 feet in any direction horizontal from the containment. Visible emissions must not be observed in the area of any sensitive receptor. If such emissions occur shut down the job immediately and take corrective action. Notify the foreman whenever visible emissions exceed [40] [200] seconds in a 1 hour period. Whenever visible emissions exceed [75] [300] seconds in a 2 hour period notify the foreman, shut down the job, and take corrective action. If the total observed visible emissions from the containment exceeds [1] [5] percent of the work day, shut down the job and take corrective action to prevent such an occurrence. Document each time that the work is halted due to a violation of the visible emissions criteria. Documentation must include the cause for shutdown and the corrective action taken to resolve the problem.

1.3.3.4 PM-10 Monitoring

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NOTE: It is the specifier's responsibility to contact the local authorities and state Bureaus of Air Pollution Control to determine if PM-10 (particulate matter less than 10 microns in size) monitoring is required. If so, include paragraph PM-10 MONITORING PLAN. The National Ambient Air Quality Standard (NAAQS) for lead does not apply to lead paint removal. However, if the (NAAQS) requirement for lead [total suspended particulate (TSP) lead] is invoked by a State or Local governing body on lead paint removal projects, include paragraph TSP MONITORING. In either case, air monitoring should be modified to address the specific state or local regulations. TSP lead monitoring is recommended for all lead paint removal jobs even where not required. TSP lead monitoring

data is useful in determining the efficacy of containment. PM-10 monitoring is not recommended for lead or other paint removal jobs where it is not required. It is a generally accepted fact that if there is no TSP-Pb exceedance predicted by TSP monitoring then there will also not be a PM-10 exceedance. For this reason SSPC recommends that just TSP monitoring be performed on lead jobs.

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Prepare and submit a PM-10 Monitoring Plan for monitoring emissions of particulate matter 10 microns or less in size (PM-10) in compliance with the requirements of EPA regulation 40 CFR 50.6 and this paragraph. The plan must also include provisions for halting work and correcting the containment in the event unacceptable emissions occur. Position the air monitoring equipment in accordance with 40 CFR 58, App E, Subpart (8). In addition, a minimum of two PM-10 monitors must be used at the project site, one downwind from the project and one in the area of greatest public access (e.g., playground, school yard, or homeowner's yard). When the project is in an area where there are critical receptors nearby, monitoring must be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, perform monitoring 4 of the first 8 days and on a regular basis thereafter for a sum total of 25 percent of the time surface preparation and debris cleanup are performed. If air quality regulatory limits are not met, take corrective actions and immediately repeat air monitoring. Conduct the preproject PM-10 monitoring a minimum of 2 weeks prior to the beginning of the project and continue for a minimum of 3 days to establish background levels. Submit a PM-10 Test Report to the Contracting Officer within 48 hours, that includes:

a. Name and location of jobsite.

b. Date of monitoring.

c. Time of monitoring (i.e., time monitoring begins and ends each day).

d. Identification and serial number of monitoring units.

e. Drawing showing specific location of monitoring units.

f. Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.

g. Wind direction and velocity.

h. A flow chart verifying the rate of air flow across the filter throughout the sampling period.

i. Name and address of laboratory.

j. Laboratory test procedure.

k. Laboratory test results.

l. Signatures of field and laboratory technicians conducting the work.

1.3.3.5 TSP Monitoring

Prepare a TSP Monitoring Plan for monitoring emissions of Total Suspended Particulates (TSP) in compliance with the requirements of EPA regulation 40 CFR 50.12 and this paragraph. The plan must include provisions for halting work and correcting the containment in the event unacceptable emissions occur. Position the air monitoring equipment in accordance with 40 CFR 58, App E, Subpart (8). A minimum of two TSP monitors must be used at the project site, one downwind from the project and one in the area of greatest public access (e.g. playground, school yard, or homeowner's yard). When the project is in an area where there are critical receptors nearby, TSP-lead monitoring must be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, perform monitoring 4 of the first 8 days and on a regular basis thereafter for a sum total of 25 percent of the time surface preparation and debris cleanup are performed. If air quality regulatory limits are not met, require air monitoring to be repeated immediately after corrective actions have been taken. Also conduct preproject TSP monitoring. Conduct the preproject TSP monitoring a minimum of 2 weeks prior to the beginning of the project and continue the monitoring for a minimum of 3 days to establish background levels. Submit a TSP Test Report to the Contracting Officer within 48 hours including:

a. Name and location of jobsite.

b. Date of monitoring.

c. Time of monitoring (i.e., time monitoring begins and ends each day).

d. Identification and serial number of monitoring units.

e. Drawing showing specific location of monitoring units.

f. Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.

g. Wind direction and velocity.

h. A flow chart verifying the rate of air flow across the filter throughout the sampling period.

i. Name and address of laboratory.

j. Laboratory test procedure.

k. Laboratory test results.

l. Signatures of field and laboratory technicians conducting the work.

1.3.3.6 Water Quality

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NOTE: If the work is proximate to storm sewers, rivers, bays, streams, or other bodies of water, include paragraph WATER QUALITY to prohibit contamination of the water from the project activities; otherwise delete paragraph WATER QUALITY. Modify if necessary to comply with State or local EPA requirements.

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Prepare a Water Quality Plan for all job sites where lead-containing or other hazardous paint will be removed, including provisions for halting work if spills or emissions are observed entering into bodies of water or found in areas where storm water runoff could carry the debris into bodies of water or storm sewers. The plan must also address cleanup and reporting procedures. Conduct operations in such a manner that lead-containing and other hazardous paint debris do not contaminate the water and so that NPDES permits in accordance with EPA regulation 40 CFR 122 are not required for the project. Any release of lead paint debris into the waterways having a reportable quantity of hazardous substance pursuant to Section 311 of the Clean Water Act, must be reported to the EPA in accordance with 40 CFR 117 and 40 CFR 355. The plan must require the thorough documentation of any release or spill that carries into waterways or storm sewers. Include the time and location of the release, amount of material released, actions taken to clean up the debris, amount of debris recovered, and corrective action taken to avoid a reoccurrence. Also report releases to the Coast Guard and other state and local authorities as appropriate. If the release is equivalent to 4.5 kg 10 pounds or more of lead-containing material in a 24-hour period, it is considered to be a reportable quantity under CERCLA. Comply with 40 CFR 302.

1.3.3.7 Soil Quality

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NOTE: If the work is near exposed ground (e.g., soil, sand, clay, etc.), include the requirements of paragraph SOIL QUALITY to assure that the ground is not contaminated by project activities. Contact the State or local EPA to determine if a specific soil contamination criteria exists. If so, modify this section accordingly.

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Prepare a Soil Quality Plan for all job sites where lead-containing or other hazardous paint will be removed. The plan must include provisions for halting the work should soil contamination occur, correcting the deficiencies responsible for the contamination, and provide procedures for removing and replacing contaminated soil. Establish and implement practices and procedures for preventing contamination of the soil from the removal of lead-containing or other hazardous paints. Unless otherwise directed by the Contracting Officer, soil is considered to have been contaminated by the Contractor's operation if an increase in the total lead content of 100 PPM or greater over background levels occurs. For purposes of computing the increase compute the mean background levels and the mean post-removal levels. The 100 PPM criteria is met if the difference between the means is less than 100 PPM plus the 95 percent confidence limit. Conduct soil sampling and testing prior to the beginning of the project and after the project is completed. Interim testing may also be performed in the event the Contractor or Contracting Officer wants to confirm that the containment system and work practices continue to provide satisfactory protection of the soil. Unless otherwise directed by the Contracting Officer, the following minimum test locations must be selected for soil analysis. Select two locations beneath or immediately adjacent to the structure being prepared. Take additional samples within 30 m 100 feet in each direction of the project (i.e., N, S, E, W) in which soil is present. The number of soil sample locations must

be sufficient to adequately characterize the soil contaminant levels within and around the project area. Collect five composite samples at each location. Each of the five samples must be comprised of five individual plugs of soil combined in a single bag. Use the following procedure to collect the composite samples:

a. Place a 0.093 square m 1-square foot template at each location.

b. Remove a sample of soil 19 mm 3/4 inch in diameter and 13 mm 1/2 inch in depth at the center of the template and at each of the four corners. Place the five soil plugs into a single bag. This represents one of the three samples to be removed at a given location.

c. Move the template 25 mm 1 inch in any direction and repeat the process to collect the second sample. Place all plugs in a separate bag. Move the template 5 mm 1 inch farther to collect the third sample.

d. Identify each sample bag with the date, specific location of the sample, name and signature of the sampling technician, and complete chain of custody records.

e. It is critical that the specific location of each sample be thoroughly measured and documented as the final project testing (and any interim testing) must be sampled in the precise locations.

Analyze three samples collected at each location. One of the remaining two samples is to be maintained by the Contractor for the duration of the project and the other by the Contracting Officer in the event reanalysis is required. Analyze lead-containing samples in accordance with EPA testing guidance as published in 40 CFR 261, App III, by a laboratory listed by the American Industrial Hygiene Association (AIHA) as being proficient in conducting the test. Note that if it is determined that contamination of the soil has occurred as a result of the paint removal operations, TCLP testing must be employed to determine if the soil must be handled and disposed of as a hazardous waste. The initial sampling of the soil for total lead content does not establish whether the soil will be considered hazardous by TCLP testing. As a result, at the Contractor's option, additional prework soil samples may be removed (minimum of 105 grams is required for a single test at each site) to conduct TCLP testing to establish whether the soil would be classified as hazardous prior to project startup. In the event that there is a release of lead paint debris onto the soil and if the release is 4.5 kg 10 pounds or more of lead-containing material in a 24-hour period, it is considered to be a reportable quantity under CERCLA. Comply with 40 CFR 302. Thoroughly document the occurrence of any spills of lead debris into the soil. The documentation must include the time and location of the release, amount of material released, actions taken to clean up the debris, amount of debris reclaimed, and corrective action taken to avoid a reoccurrence. Provide the documentation to the Contracting Officer including the Soil Quality Test Report with results of the prework and post work soil quality tests.

1.4 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification

technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Safety, Health, and Environmental Requirements; G, [_____]

Accident Prevention Plan; G, [_____]

Confined Spaces Plan; G, [_____]

Respiratory Protection Plan; G, [_____]

Airborne Sampling Plan; G, [_____]

Ventilation Assessment Plan; G, [_____]

Medical Surveillance Plan; G, [_____]

Worker Protection Plan; G, [_____]

Environmental Protection Plan; G, [_____]

Waste Manifest

Waste Disposal Plan; G, [_____]

Containment Plan; G, [_____]

Visible Emissions Monitoring Plan; G, [_____]

PM-10 Monitoring Plan; G, [_____]

TSP Monitoring Plan; G, [_____]

Water Quality Plan; G, [_____]

Soil Quality Plan; G, [_____]

SD-03 Product Data

Manufacturer's Safety Data Sheet; G, [_____]

SD-04 Samples

Product Samples; G, [_____]

Special Paint Formulas; G, [_____]

Solvent and Thinners; G, [_____]

SD-06 Test Reports

PM-10 Test Report

TSP Test Report

Soil Quality Test Report

Inspection Reports

Medical Status Records

Change in Medical Status Report

Air Monitoring Test Plan; G, [_____]

Air Monitoring Test Report

SD-07 Certificates

Certified EHS Professional

Certified Lead Laboratory

SSPC [QP 1][QP-2][QP-3] Certificate; G, [_____]

Qualified Hazardous Paint Removal Contractor; G, [_____]

Coating Thickness Gage Qualification

Qualified Coating Applicator; G, [_____]

1.5 QUALIFICATIONS

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NOTE: USACE has identified an ongoing problem throughout the districts regarding poor paint performance due to unqualified contractors and/or unskilled painters. Districts can require Contractor certification by requiring industry certification by SSPC: THE SOCIETY FOR PROTECTIVE COATINGS (SSPC-QP1, QP2, or QP3). While there are some industry certification programs for painters, none include the application of fast drying coatings such as the vinyl systems in this document.Guidance for attaining better and more economical paint jobs is provided in EM 1110-2-3400. Any consulting in reference to this guide specification or painting problems in general should be directed to the Paint Technology Center, U.S. Army Construction Engineering Research Laboratory, ATTN: CEERDC-CF-M, Champaign, IL; e-mail: paint@usace.army.mil; Phone: 217-373-7486.

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Qualifications and experience must comply with the following.

1.5.1 Certified Environmental, Health, and Safety (EHS) Professionals

Provide a certificate for each Certified EHS Professional; submit qualifications and experience of qualified and competent persons employed to provide preconstruction and onsite environmental, safety, and health services. Obtain acceptance of this submission prior to the submission of other required environmental, safety, and health submittal items. Utilize a qualified and competent person as defined in EM 385-1-1, Section 01 to develop the required safety and health submittal and to provide onsite safety and health services during the contract period. The person must be a Certified Industrial Hygienist (CIH), an Industrial Hygienist (IH), or a Certified Safety Professional (CSP) with a minimum of 3 years of demonstrated experience in similar related work. The CIH, IH, or CSP may utilize other qualified and competent persons, as defined in EM 385-1-1, to conduct on-site safety and health activities as long as these persons have a minimum of 2 years of demonstrated experience in similar related work and are under the direct supervision of the CIH, IH, or CSP. For lead containing jobsites, the competent and qualified person must have successfully completed an EPA or state accredited lead-based paint abatement Supervisor course specific to the work to be performed and possess current and valid state and/or local government certification, as required.

1.5.2 Certified Lead Laboratory

Provide documentation which includes the name, address, and telephone number of the laboratories to be providing services. In addition, the documentation must indicate that each laboratory is an EPA National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory and that each is rated proficient in the NIOSH/EPA Environmental Lead Proficiency Analytical Testing Program (ELPAT) and will document the date of current accreditation. Certification must include accreditation for heavy metal analysis, list of experience relevant to analysis of lead in air, and a Quality Assurance and Quality Control Program. Submit a certificate for the Certified Lead Laboratory.

[1.5.3 Qualified Painting Contractor

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NOTE: The specifier should decide whether the work is of sufficient complexity or size that the use of a Qualified Painting Contractor is warranted. In general, very large jobs of moderate complexity or small but very complex painting work should be performed by a Qualified Painting Contractor. Very complex work includes steel structures that will be painted and exposed in immersion. Large jobs are work where more than 9300 square m 100,000 square feet will be painted. SSPC utilizes an independent third party auditing firm to evaluate and certify painting Contractors for compliance with various types of work: QP-1 is for Field Application to Complex Structures; QP-2 requires QP-1 certification plus the ability to remove hazardous paint; QP-3 evaluates Shop Painting contractors. Lists of qualified Contractors are provided on the SSPC website at sspc.org. The designer may visit the site to determine the availability of qualified contractors in the project area.

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The Painting Contractor must be a certified SSPC QP 1 Painting Contractor. Submit a copy of the applicable SSPC [QP-1][QP-2][QP-3] Certificate. The contractor must have been certified prior to award of this contract and must remain certified for the duration of this contract. Certifications scheduled to expire during the contract performance period must be renewed and submitted to the Contracting Officer prior to expiration.

][1.5.4 Qualified Hazardous Paint Removal Contractor

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NOTE: The specifier should decide whether the work is of a nature such that the use of a Qualified Hazardous Paint Removal Contractor is warranted. A Qualified Hazardous Paint Removal Contractor is recommended for jobs involving more than the incidental removal of lead-containing paints. A qualified Contractor is not generally recommended for jobs where the lead paint contains low levels of lead, less than 1 percent. The risk of worker overexposure and environmental contamination is still significant for such jobs, but not to the extent necessary to warrant a certified hazardous paint removal Contractor. SSPC utilizes an independent third party auditing firm to evaluate and certify painting Contractors for compliance with Qualification Procedure SSPC QP 2, Standard Procedure for Evaluating The Qualifications of Painting Contractors To Remove Hazardous Paint. QP 2 provides two categories of qualification based on the level of containment. Category A qualifies the Contractor for work requiring a containment Class 1A or 2A - recommended classes for most Corps lead removal projects. Category B is for work in classes

of containment with lesser requirements.

The specifier should select the necessary qualification category. The QP 2 certification is an extension of QP 1 certification. QP 2 certification should also be considered by the specifier for removal of other toxic paints such as those that contain hexavalent chromium or cadmium. Lists of qualified Contractors are provided on the SSPC website at sspc.org. The designer may visit the site to determine the availability of qualified contractors in the project area.

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The Painting Contractor must be a certified SSPC QP 2 [Category A] [Category B] Painting Contractor for all surface preparation or coating application. Submit a copy of the applicable SSPC Certificate. The contractor must have been certified prior to award of this contract and must remain certified for the duration of this contract. Submit all renewals if they occur during the contract performance period. Renewals must be achieved prior expirations occurring.

][1.5.5 Qualified Shop Painting Contractor

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NOTE: The specifier should decide whether the work is of sufficient complexity or size that the use of a Qualified Shop Painting Contractor is warranted. In general, large jobs of moderate complexity or small but very complex painting work that may be performed in a shop should be performed by a Qualified Shop Painting Contractor. Shops having the certification are typically dedicated painting shops; typical fabricating shops are generally not certified. Lists of qualified Contractors are provided on the SSPC website at sspc.org. The designer may visit the site to determine the availability of qualified contractors in the project area.

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The Painting Contractor must be a certified SSPC QP 3 Painting Contractor for all off-site surface preparation or coating application. Submit a copy of the applicable SSPC Certificates. The contractor must have been certified prior to award of this contract and must remain certified for the duration of this contract. Submit all renewals if they occur during the contract performance period. Renewals must be achieved prior expirations occurring.

][1.5.6 Qualified Coating Applicator

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NOTE: The specifier should decide whether the work is of sufficient complexity or size that the use of Qualified Coating Applicators is warranted. In general, very large jobs of moderate complexity or small but very complex painting work should be performed by applicators who have shown they have the ability to apply the specified coating system.

Very complex work includes steel structures that will be painted and exposed in immersion. Large jobs are work where more than 9300 square m 100,000 square feet will be painted. Application of vinyl coating systems using conventional spray equipment frequently justifies the qualification of applicators. Applicators typically have more experience in the application of slower drying coatings such as epoxies and urethanes and use of airless spray equipment. This paragraph may also be modified replacing the panel described in ASTM D4228 with a selected area of the structure under contract.

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Submit records of qualification tests for each Qualified Coating Applicator. Prior to the initiation of any work all coating applicators must be tested and certified as meeting the requirements of ASTM D4228. Certification must be administered by an authorized government representative. Applicators failing the certification procedure will not be permitted to apply any paint on the project.

1.5.6.1 Certification Test Procedure

Conduct certification testing of coating applicators at the job site in coordination with the Contracting Officer. Supply the fabricated test plates to be used for the tests and provide crane service, rigging, and any other work necessary to provide accessibility for the certification testing and inspection. The test plate must be painted in a near vertical position. In preparation, clean and prepare the test plate in accordance with the requirements of the contracted work. Perform abrasive blasting with the blast media to be used in the contract. The paints to be applied are Contractor supplied materials and are those previously tested and approved for use on the contract. Paints must be applied as specified in this contract. The painter being tested must mix and thin the paints to be used in the test and set up and adjust the application equipment for use. Each painter must apply each of the types of paint comprising the specified system. The contractor's QC inspector must be present during the procedure to monitor the actions of the painter being tested.

1.5.6.2 Certification Criteria

Evaluate the paint applicator based on the conformance of the applied paint system to the requirements of this specification. Deficiencies in the coatings, improper mixing or improper application methods are basis for failure. The authorized Government Representative is the sole judge as to the acceptability of each coating applicator's performance.

]1.5.7 Coating Thickness Gage Qualification

Submit Coating Thickness Gage Qualification documentation of manufacturer's certification for all coating thickness gages. Use magnetic flux thickness gages as described in ASTM D7091 to make all coating thickness measurements on ferrous metal substrates. Use eddy current thickness gages as described in ASTM D7091 to measure coating thickness on all nonferrous metal substrates. Gages to be used on the job must have an accuracy of 3 percent or better and be certified by the manufacturer as meeting this requirement.

1.5.8 Certified Coating Inspector

Provide a certified coating inspector who is listed as either SSPC-PCI Level 2, or NACE CIP Level 2 for all surface preparation and painting activities. Submit a copy of the applicable SSPC or NACE Certificates. Submit all renewals if they occur during the contract performance period. Renewals must be achieved prior expirations occurring.

1.6 DELIVERY, STORAGE, AND HANDLING

Process and package paints to ensure that within a period of one year from date of manufacture, they will not gel, liver, or thicken deleteriously, or form gas in the closed container. Paints, unless otherwise specified or permitted, must be packaged in standard containers not larger than 20 L 5 gal, with removable friction or lug-type covers. Containers for vinyl-type paints must be lined with a coating resistant to solvents in the formulations and capable of effectively isolating the paint from contact with the metal container. Each container of paint or separately packaged component thereof must be labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name, and formula or specification number of the paint together with special labeling instructions, when specified. Paint must be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather must be stored in ventilated, heated shelters. All paints must be stored under cover from the elements and in locations free from sparks and flames.

1.7 AMBIENT CONDITIONS

Paint must be applied in accordance with the manufacturers written instructions or to the special requirements contained herein. Surfaces that are less than 2.8 degrees C 5 degrees F above the dew point temperature must be monitored closely to assure that are completely free of moisture as determined by sight and touch. Paint must not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, paint must not be applied if the temperature of the surfaces to be painted and of air in contact therewith is less than 9 degrees C 45 degrees F during paint application nor if the surfaces can be expected to drop to 0 degrees C 32 degrees F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and utilizing climate control equipment (e.g. dehumidification, heaters, etc.), provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint must not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

PART 2 PRODUCTS

2.1 PRODUCT SAMPLES

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NOTE: US Army Construction Engineering Research Laboratory provides paint testing services on a reimbursable basis. Allowing 30 days for testing of Special Formulation and Military Specification paints is sufficient. Complete testing commercial products submitted to meet SSPC requirements may

take in excess of 6 months - the Contracting Officer may wish to discuss options with the Laboratory. Products listed on the MPI web site do not need further testing. Testing costs vary based on the type of paint. Specifier should contact ERDC-CERL for cost of testing. (E-mail:) Samples may be submitted to US Army ERDC-CERL, ATTN: Paint Laboratory, 2902 Newmark Drive, Champaign, IL 61822. Requiring the contractor to submit samples directly to the laboratory saves time and avoids problems associated with shipment of hazardous materials.

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Submit product samples of each batch of thinner, solvent, and paint to the Government for testing. Submit manufacturer's Safety Data Sheet (SDS) for each type of paint used; for products that are specified to be applied in accordance with the manufacturer's recommendations, submit the paint manufacturer's product data sheet (PDS) or other written instructions for those products. Allow at least 30 days from time of delivery to the contracting officer for testing of samples of paints and thinners. Sampling may be at the jobsite or source of supply. Coordinate sampling and submission of all samples of paint and thinner with the Contracting Officer. Standard sample size for liquid paints and thinners is 1 L 1-quart; powders and other additives for multi component paints may be of appropriately smaller size. The sample must be labeled to indicate formula or specification number and nomenclature, batch number, batch quantity, color, date made, and applicable project contract number. Testing will be performed by the Government. Costs for retesting rejected material will be deducted from payments to the Contractor at the rate of [_____] dollars for each paint sample retested and [_____] dollars for each thinner retested.

2.2 SPECIAL PAINT FORMULAS

Special paints must have the composition as indicated in the formulas listed herein. Where so specified, package paint formulation components in separate containers for mixing on the job. If not specified or otherwise prescribed, the color must be that naturally obtained from the required pigmentation.

2.3 PAINT FORMULATIONS

Special paint formulas must comply with the following:

2.3.1 Formula V-102E

This formula is for Vinyl-Type Ready-Mixed Aluminum Impacted Immersion Coating, the ingredients are shown below.

INGREDIENTS	PERCENT BY MASS
Vinyl Resin, Type 3	18.2
Aluminum Powder	8.3

INGREDIENTS	PERCENT BY MASS
Plasticizer	3.1
Methyl Isobutyl Ketone (MIBK)	33.8
Toluene	36.6
Total	100.0

a. Furnish the paint with the aluminum pigment mixed into the vehicle.

b. The finished paint must show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods, and have a viscosity between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

2.3.2 Formula V-103C

This formula is for Vinyl-Type Black-Finish Impacted Immersion Coating, the ingredients are shown below.

INGREDIENTS	PERCENT BY MASS
Vinyl Resin, Type 3	20.0
Carbon Black	1.5
Plasticizer	3.4
Methyl Isobutyl Ketone (MIBK)	36.0
Toluene	39.1
Total	100

a. Disperse the carbon black to a fineness of grind ASTM D1210 of not less than 7 on the Hegman scale. A paste composed of carbon black milled into a Type 3 vinyl resin dissolved in an appropriate solvent may be used provided the finished product has the specification composition and grind. Material must be free from seeding, gelling, and other deleterious effects. No grinding aids, antisettling agents, or any other materials except those shown in the formula will be permitted.

b. The finished paint must show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods, and have a viscosity between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

2.3.3 Formula V-106D

This formula is for Vinyl-Type Red Oxide (Light or Dark Color) Impacted Immersion Coating, the ingredients are shown below.

INGREDIENTS	PERCENT BY MASS
Vinyl Resin, Type 3	5.50
Vinyl Resin, Type 4	11.20
Synthetic Iron Oxide (Red) (Light or Dark Color)	15.80
Plasticizer	2.90
Methyl Isobutyl Ketone	31.00
Toluene	33.54
Propylene Oxide	0.06
Total	100.00

a. Disperse the pigment by means of pebble mills or other approved methods to produce a fineness of grind (ASTM D1210) of not less than 7 on the Hegman scale. Grinding in steel-lined or steel-ball mills will not be permitted. No grinding aids, antisettling agents, or any other materials, other than those listed in the formula, will be permitted.

b. The finished paint must show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods, and have a viscosity between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

c. Furnish the paint in two colors which are obtained by the alternative use of synthetic red iron oxide pigments of different shade. The dark paint must reasonably approximate color 10076 of SAE AMS-STD-595A, and light colored paint must be readily distinguishable in the field from the dark. Furnish the two shades in the volume ratio designated by the purchaser.

2.3.4 Formula VZ-108D

This formula is for Vinyl-Type Zinc-Rich Impacted Immersion Coating, the ingredients are shown below.

INGREDIENTS	PERCENT BY WEIGHT	KILOGRAMSPOUNDS	LITERSGALLONS
COMPONENT A			
Vinyl Resin, Type 3	16.6	49.5109.2	36.539.65
Methyl Isobutyl Ketone	80.6	239.9528.9	300.1879.30
Suspending Agent E	0.7	2.14.6	1.060.28
Suspending Agent F	0.4	1.22.7	0.720.19
Methanol	0.5	1.53.3	1.890.50

INGREDIENTS	PERCENT BY WEIGHT	KILOGRAMSPOUNDS	LITERSGALLONS
Synthetic Iron Oxide (Red)	1.2	3.67.9	0.720.19
Total	100.0	297.8656.6	341.1090.11
COMPONENT B			
Silane B	100.0	1.84.1	1.780.47
COMPONENT C			
Zinc Dust	100.0	249.5550.0	35.669.42
		Total Volume	378.54100.00 (mixed paint)

a. Disperse the iron oxide and suspending agents into the vehicle (Component A) to a fineness of grind of not less than 4 on the Hegman scale (ASTM D1210). Grinding in steel-lined containers or using steel-grinding media will not be permitted. The paint must show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods. The sole purpose of the iron oxide pigment is to produce a contrasting color. A red iron oxide-type 3 vinyl resin vehicle paste may be used in place of dry iron oxide provided compensating adjustments are made in the additions of Type 3 resin and methyl isobutyl ketone. The finished product with zinc dust added must produce a paint which has a red tone upon drying and a reflectance of not more than 16 (ASTM E1347).

b. Supply VZ-108D paint as a kit. Each kit must consist of 17 L 4.5 gal (15 kg 33.1 pounds) of Component A in a 20 L 5-gallon lug closure type pail, 12 kg 27.5 pounds of zinc dust (Component C) packaged in a 4 L 1-gal plastic pail, and 89 mL 3 fluid ounces of silane (Component B) packaged in a glass bottle of suitable size having a polyethylene lined cap. Place the bottle of silane on the zinc dust in the 4 L 1-gal pail. In addition to standard labeling requirements, identify each container of each component as to component type. Each container label of Component A must carry the following: MIXING AND APPLICATION INSTRUCTIONS: WARNING - THIS PAINT WILL NOT ADHERE TO STEEL SURFACES UNLESS COMPONENT B IS ADDED. Remove the 89 mL 3 ounces of bottled Component B (silane) from the Component C (zinc dust) container and add to the base paint Component A) with thorough stirring. Then sift the zinc dust into the base paint while it is being vigorously agitated with a power-driven stirrer and continue the stirring until the zinc dust has been dispersed. At some point strain the mixed paint through a 30-60 mesh screen to prevent zinc dust slugs from reaching the spray gun nozzle. Stir the paint continuously during application at a rate that will prevent settling. If spraying is interrupted for longer than 15 minutes, vigorously whip the entire length of the hose to redisperse the zinc. If the spraying is to be interrupted for more than 1 hour, empty the hose by blowing the paint back into the paint pot. Thinning will not normally be required when ambient temperatures are below about 26 degrees C 80 degrees F, but when the ambient and steel temperatures are higher, methyl isoamyl ketone (MIAK) or methyl isobutyl ketone (MIBK) should

be used. If paint is kept covered at all times, its pot life will be about 8 days.

2.3.5 Formula V-766E

This formula is for Vinyl-Type White (or Gray) Impacted Immersion Coating, the ingredients are shown below.

INGREDIENTS	PERCENT BY MASS
Vinyl Resin, Type 3	5.6
Vinyl Resin, Type 4	11.6
Titanium Dioxide and (for Gray) Carbon Black	13.0
Plasticizer	2.9
Methyl Isobutyl Ketone	32.0
Toluene	34.7
Ortho-Phosphoric Acid	0.2
Total	100.0

a. Disperse the pigment by means of pebble mills or other approved methods to produce a fineness of grind (ASTM D1210) of not less than 7 on the Hegman scale. Grinding in steel-lined or steel-ball mills will not be permitted. No grinding aids, antisettling agents, or any other materials except those shown in the formula will be permitted. Measure the ortho-phosphoric acid accurately and dilute it with at least four parts of ketone to one part of acid. Add it slowly into the finished paint with constant and thorough agitation.

b. The finished paint must show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods, and have a viscosity between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

c. Furnish the white and gray paints in the volume ratio designated by the purchaser. The gray paint must contain no pigments other than those specified. Include enough carbon black to produce a dry paint film having a reflectance of 20-24 (ASTM E1347). The resulting gray color must approximate color 26231 of SAE AMS-STD-595A.

2.3.6 Formula C-200A, Coal Tar-Epoxy (Black) Paint

The paint must conform to SSPC Paint 16 manufactured with Type 1 pitch. In addition to standard labeling, container labels must include the term, Corps of Engineers Formula C-200A.

2.4 INGREDIENTS FOR SPECIAL PAINT FORMULAS

The following ingredient materials and thinners apply only to those

special paints whose formulas are shown above in detail.

2.4.1 Pigments and Suspending Agents

2.4.1.1 Aluminum Powder

For vinyl paint aluminum powder must conform to ASTM D962, Type 1, Class B.

2.4.1.2 Carbon Black

Carbon black must conform to ASTM D561, Type I or II.

2.4.1.3 Zinc Dust

Zinc dust pigment must conform to ASTM D520, Type II.

2.4.1.4 Iron Oxide

Iron oxide, (Dry) synthetic (red), must conform to ASTM D3721. In addition, the pigment must have a maximum oil absorption of 24 and a specific gravity of 4.90 to 5.20 when tested in accordance with ASTM D281 and ASTM D153, Method A, respectively. When the pigment is dispersed into specified vinyl paint formulation, the paint must have color approximating SAE AMS-STD-595A color 10076 (dark red paint), and show no evidence of incompatibility or reaction between pigment and other components after 6 months storage.

2.4.1.5 Titanium Dioxide

Titanium dioxide in vinyl paint Formula V-766E must be one of the following: Kronos 2160 or 2101, Kronos, Inc.; Ti-Pure R-960, E.I. Dupont DeNemours and Co., Inc.

2.4.1.6 Suspending Agent E

Suspending Agent E must be a light cream colored finely divided powder having a specific gravity of 2 to 2.3. It must be an organic derivative of magnesium aluminum silicate mineral capable of minimizing the tendency of zinc dust to settle hard without increasing the viscosity of the paint appreciably. M-P-A-14, produced by Elementis Specialties, has these properties.

2.4.1.7 Suspending Agent F

Suspending Agent F must be a light cream colored finely divided powder having a specific gravity of approximately 1.8. It must be an organic derivative of a special montmorillonite (trialkylaryl ammonium hectorite). Bentone 27, produced by Elementis Specialties, has these properties.

2.4.2 Resins, Plasticizer, and Catalyst

2.4.2.1 Plasticizer

The plasticizer must be either Di 2-propyl Heptyl Phthalate (DPHP) or Diisodecyl Phthalate (DIDP). DPHP must have an ester content of not less than 99.5 percent (ASTM D3465), must contain not more than 0.1 percent water, and must have an acid number (ASTM D1045) of not more than 0.07.DIDP must have a purity of not less than 99.0 percent, must contain

not more than 0.1 percent water, and must have an acid number (ASTM D1045) of not more than 0.10.

2.4.2.2 Vinyl Resin, Type 3

Vinyl resin, Type 3, must be a vinyl chloride-acetate copolymer of medium average molecular weight produced by a solution polymerization process and must contain (by weight) 85 +/- 1.0 percent vinyl chloride and 15 +/- 1.0 percent vinyl acetate by weight. The resin must have film-forming properties and must, in specified formulations, produce results equal to Vinnol H 15/50, as manufactured by Wacker Chemie AG.

2.4.2.3 Vinyl Resin, Type 4

Vinyl resin, Type 4, must be a vinyl chloride-acetate type produced by a solution polymerization process, must contain 1 percent interpolymerized dicarbonic acid, 84 +/- 1.0 percent vinyl chloride, and 15 +/- 1.0 percent vinyl acetate. The resin must have film-forming properties and must, in the specified formulations, produce results equal to Vinnol H 15/45 M, as manufactured by Wacker Chemie AG.

2.4.2.4 Ortho-phosphoric Acid

Ortho-phosphoric acid must be a chemically pure 85-percent grade.

2.4.3 Solvent and Thinners

2.4.3.1 Methanol

Methanol (methyl alcohol) must conform to ASTM D1152.

2.4.3.2 Methyl Ethyl Ketone

Methyl ethyl ketone (MEK) must conform to ASTM D740.

2.4.3.3 Methyl Isobutyl Ketone

Methyl isobutyl ketone (MIBK) must conform to ASTM D1153.

2.4.3.4 Methyl Isoamyl Ketone

Methyl isoamyl ketone (MIAK) must conform to ASTM D2917.

2.4.3.5 Toluene

Toluene must conform to ASTM D841.

2.4.4 Silane B

Silane B for Formula VZ-108D must be N-beta-(aminoethyl)-gamma-aminopropyltrimethoxy silane. Silquest A-1120, produced by Momentive Performance Materials Inc., and Silane Z-6020, produced by Dow Corning Corporation, are products of this type.

2.4.5 Propylene Oxide

Propylene oxide must be a commercially pure product suitable for the intended use.

2.5 TESTING

2.5.1 Chromatographic Analysis

Solvents in vinyl paints and thinners are subject to analysis by programmed temperature gas chromatographic methods and/or spectrophotometric methods, employing the same techniques that give reproducible results on prepared control samples known to meet the specifications. If the solvent being analyzed is of the type consisting primarily of a single chemical compound or a mixture or two or more such solvents, interpretation of the test results must take cognizance of the degree of purity of the individual solvents as commercially produced for the paint industry.

2.5.2 Vinyl Paints

Vinyl paints are subject to the following adhesion test. When V-766 or V-106 formulations are tested, spray apply 125 to 175 microns 5 to 7 mils (dry) to mild steel panels. The steel panels must be essentially free of oil or other contaminants that may interfere with coating adhesion and be dry blast cleaned to a White Metal grade in compliance with SSPC SP 5/NACE No. 1. The surface must have an angular profile of 50 to 63 microns 2.0 to 2.5 mils as measured by ASTM D4417, Method C. When V-102 or V-103 formulations are tested, spray apply the product over 38 to 63 microns 1.5 to 2.5 mils (dry) of V-766 or V-106 known to pass this test. When VZ-108 is tested, the coating must be mixed in its proper proportions and then spray applied to a dry film thickness of 38 to 63 microns 1.5 to 2.5 mils above the blast profile. The VZ-108 must be top coated with a V-766 known to pass this test. In all cases, the complete system must have a total dry film thickness of 125 to 175 microns 5 to 7 mils above the blast profile. After being air dried for 2 hours at room temperature, dry the panel in a vertical position for 16 hours at 50 degrees C 120 degrees F. After cooling for 1 hour, immerse the panel in tap water at 30 to 32 degrees C 85 to 90 degrees F for 48 to 72 hours. Immediately upon removal, dry the panel with soft cloth and examine for adhesion as follows: With a pocket knife or other suitable instrument, make two parallel cuts at least 25 mm 1 inch long, 6 to 10 mm 1/4 to 3/8 inch apart through the paint film to the steel surface. Make a third cut perpendicular to and passing through the end of the first two. With the tip of the knife blade, loosen the film from the panel from the third cut between the parallel cuts for a distance of 3 to 6 mm 1/8 to 1/4 inch. With the panel being held horizontally, grasp the free end of the paint film between the thumb and forefinger and pulled vertically in an attempt to remove the film as a strip from between the first two cuts. Remove the strip of paint film at a rate of approximately 2 mm 1/10 inch per second and maintaining it in a vertical position during the process of removal. The adhesion is acceptable if the strip of paint breaks when pulled or if the strip elongates a minimum of 10 percent during its removal. Paints not intended to be self-priming must not exhibit any delamination from the primer.

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

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NOTE: Although this section is primarily intended for new construction, surface preparation for maintenance painting is closely related; therefore

this guide specification may be used for maintenance painting. For further guidance, see EM 1110-2-3400.
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3.1.1 General Requirements

Clean surfaces to be painted before applying paint or surface treatments. Remove deposits of grease or oil in accordance with SSPC SP 1, prior to mechanical cleaning. Perform solvent cleaning with mineral spirits or other low toxicity solvents having a flash point above 38 degrees C 100 degrees F. Use clean cloths and clean fluids to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Protect items not to be prepared or coated from damage by the surface preparation methods. Protect machinery and electrical components against entry of blast abrasive and dust into working parts. Program cleaning and painting such that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces. Protect surfaces not intended to be painted from the effects of cleaning and painting operations. Conduct welding of, or in the vicinity of, previously painted surfaces in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum. Restore any paint damaged by welding operations to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed must be painted before they become inaccessible.

3.1.2 Ferrous Surfaces Subject to Atmospheric Exposures

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NOTE A: The option of power tool cleaning or brush-off blast cleaning is intended to be the Contractor's choice and should be retained in project specifications. It is the intention of this Note and the following paragraphs to distinguish between the type of surface preparation necessary for normal atmospheric exposure and for severe exposure conditions such as fresh and saltwater immersion, abrasion, etc.

Experience has shown that high-grade blast cleaning is generally unnecessary to obtain an adequate paint job on structural steel surfaces that will be subject only to ordinary atmospheric exposure, provided that primers are used that have the ability to effectively wet the surfaces and penetrate to base metal beneath the edges of semi-adherent mill scale as well as through the residual and tightly adherent rust that is always present to some extent when methods short of very thorough blast cleaning are employed. Shop cleaning and priming of steel that is not required to be thoroughly blast cleaned reduces unnecessary breakdown of the mill scale and attendant rusting of the surfaces.

Weathering steel may be painted if desired using the same surface preparation and coating systems as used for mild steel.

For jobs where existing coatings, including lead-based paints, will be completely removed the

specifier should select Commercial Blast Cleaning (SP 6). This recommendation applies to Paint Systems No. 1 and 23 (series).

This paragraph requires rounding of sharp edges. Rounding is desirable because paint pulls thin on sharp edges resulting in early rusting. This requirement may result in significant cost when the structure is severely corroded or pitted.

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Clean ferrous surfaces that are to be continuously in exterior or interior atmospheric exposure and other surfaces as directed by means of [power tools or by dry blasting to the brush-off grade] [dry blasting to a commercial grade]. Perform cleaning and priming in the shop unless otherwise directed or permitted. [Conduct power tool cleaning in conformance with the requirements of SSPC SP 3.] [Conduct brush-off blast cleaning in conformance with the requirements of SSPC 7/NACE No.4.] [Conduct commercial blast cleaning in conformance with the requirements of SSPC SP 6/NACE No.3.] Clean welds and adjoining surfaces within a few inches (centimeters) of weld flux, spatter, and other harmful deposits by blasting, power impact tools, power wire brush, or such combination of these and other methods as may be necessary for complete removal of each type of deposit. The combination of cleaning methods need not include blasting when preparation of the overall surfaces is carried out by the power tool method; however, brush scrubbing and rinsing with clean water, after mechanical cleaning is completed is required unless the latter is carried out with thoroughness to remove all soluble alkaline deposits. Limit wetting of the surfaces during water-washing operations to the weld area required to be treated, and assure that wetted areas, including any crevices, are completely dry before painting. Welds and adjacent surfaces cleaned thoroughly by blasting alone will be considered adequately prepared provided that weld spatter not dislodged by the blast stream is removed with impact or grinding tools. Round all sharp edges including those caused by corrosion, to a minimum radius of 0.16 cm1/16 inch to ensure adequate paint coverage. Prime all surfaces as soon as practicable after cleaning and in all cases prior to contamination or deterioration of the prepared surfaces. To the greatest degree possible, clean (and prime)all steel surfaces prior to lengthy outdoor storage.

3.1.2.1 Coated Ferrous Surfaces Subject to Atmospheric Exposures

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NOTE B: Coated ferrous surfaces degrade with time. Touch up or spot painting mildly degraded coatings can extend the useful life of the coating system. Spot repair and overcoating can extend the useful life of moderately degraded coatings.

Coating System 23-D is well suited for maintaining degraded coatings. Overcoating does present a significant degree of risk, because of the possibility the overcoated system may either fail catastrophically or will not provide the desired period of protection. The applicability of overcoating is limited by the condition of the existing coating, the underlying substrate and the severity of the exposure environment. If the existing coating is too thick, brittle, or poorly

adherent, then overcoating should not be performed. If the degree of substrate corrosion is significant, then the level of effort needed to prepare the substrate may indicate that overcoating is not economically viable. Overcoating is not recommended for severe exposure environments because an all new paint system will last significantly longer than overcoating and is more cost effective. For additional information on overcoating contact the Paint Technology Center.

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Power tool clean coated ferrous surfaces to be overcoated in accordance with SSPC SP 3. The entire surface to be overcoated does not have to be power tool cleaned provided that all surfaces are free of all loose rust, loose paint and visible surface contaminants. Following power tool cleaning, further clean surfaces by power washing using a rotating tip and pressures of 10.3 to 34.5 MPa1500 to 5000 PSI. Adjust water pressure such that all chalk is removed without significantly eroding the existing coating. After drying, spot prime all surfaces as soon as practicable and in all cases prior to contamination or deterioration of the prepared surfaces.

3.1.3 Ferrous Surfaces Subject to Severe Exposure

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NOTE C: Thorough removal of mill scale, corrosion products, and other surface contaminants from surfaces subject to immersion is specified because very clean, blast-roughened surfaces are necessary to obtain adequate adherence of the coating in the severe exposure conditions involved and because the organic coatings that have good durability in immersed exposure are particularly unsuited to any except thoroughly cleaned surfaces.

This paragraph requires rounding of sharp edges. Rounding is desirable because paint pulls thin on sharp edges resulting in early rusting. This requirement may result in significant cost when the structure is severely corroded or pitted.

Except to provide laminar flow, excessive pit depth, or other special considerations, the filling of pits with weld or epoxy based filler materials is typically not justified. When a filler is required, a compatible coating system must be selected. Weld must be ground smooth and abrasive blasted to provide required surface profile. Typically, a vinyl coating will not adhere to an epoxy based filler. Epoxy coatings typically provide good adhesion to epoxy fillers, but a specific recoat window or roughening of the filler material may be required by the coating manufacturer.

The parenthetical provisions relative to blasting in the shop should not be included in project specifications except after consideration of such factors as: surface area of components, probable

adequacy of shop inspection, probable amount of damage to shop coating during shipment, field assembly, and cleaning, and painting capabilities of fabricators in the geographical area. Shop blast cleaning should be permitted only where the facilities and experience of the fabricator assure a satisfactory blasting and priming job. Field blasting and painting gives, in general, more satisfactory results and is better adapted to thorough inspection. In no case should shop blasting be made mandatory, since many fabricators are not equipped for such work. Blasting, priming, and partial painting in the shop should not be considered in connection with epoxy systems because of the possibility of poor adhesion between shop and field coats.

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Dry blast-clean ferrous surfaces subject to extended periods of immersion or as otherwise required to white metal according to SSPC SP 5/NACE No. 1. The blast profile must be angular with a minimum profile height of 38 microns 1.5 mils. Select appropriate abrasive size and equipment operating parameters to limit maximum surface profile on new steel to 63 microns 2.5 mils and to prevent increasing existing profile height on previously blasted steel. Where an existing profile is encountered, remove representative spots of existing coating with a chemical stripper and measure and document the existing profile prior to initiating blasting operations. Measure all surface profiles in accordance with ASTM D4417, Method C. Steel shot or other abrasives that do not produce an angular profile must not be used. If recycled blast media is used, maintain an appropriate particle size distribution so that the specified profile is consistently obtained. Round all sharp edges including those caused by corrosion, to a nominal 0.16 cm 1/16 inch radius and reblast the areas prior to painting. Remove weld spatter not dislodged by blasting with impact or grinding tools and reblast the areas prior to painting. Surfaces must be dry at the time of blasting. Conduct blast cleaning to SSPC SP 5/NACE No. 1 in the field and, unless otherwise specifically authorized, after final erection. Within 8 hours after blast cleaning, and in any case prior to the deposition of any detectable moisture, contaminants, or corrosion, clean all ferrous surfaces of dust and abrasive particles by brush, vacuum cleaner, and/or blown down with clean, dry, compressed air, and apply the first coat of paint. Authorization to extend this 8 hour coating requirement for shop application, application within dehumidified containment, or other conditions will not be granted. Upon written request by the Contractor, the Contracting Officer may authorize mill or shop cleaning of assembled or partially assembled components specified to receive one of the vinyl-type paint systems or Systems 6-A-Z and 21-A-Z employing the epoxy zinc-rich primer or Systems 23-A-Z and 23-B-Z employing SSPC Paint 40 moisture cure urethane zinc-rich primer. Shop coat all shop blasted surfaces with the first and second coats of the specified paint system. At the time field painting is initiated, apply an additional single spray coat of the zinc rich primer to the epoxy zinc-rich and moisture cure urethane primed surfaces as specified in the paint system instructions. Maintain the shop coating in good condition by cleaning and touching up of areas damaged during the construction period. If pinpoint or general rusting appears, the defective areas must be reblasted and repainted at no added cost to the Government. Prior to the field application of subsequent coats, thoroughly clean soiled areas of the shop coating and all welds or other

unpainted or damaged areas must be cleaned and coated in a manner to make them equivalent to adjacent, undamaged paint surfaces.

3.1.4 Damp and Wet Ferrous Metal Surfaces

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NOTE D: Painting of surfaces wet with condensation or standing and running water is not generally recommended. Dehumidification should be considered as a first choice for surfaces wet with condensation. However, in some cases it is not possible to achieve a dry surface for painting. In such cases the procedures outlined here should be used. Thorough removal of mill scale, corrosion products, and other surface contaminants is specified because very clean, blast-roughened surfaces are necessary to obtain adequate adhesion of the coating in the severe application and exposure conditions involved.

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Blast-clean ferrous surfaces that are wet with condensation or standing or running water, to white metal according to SSPC SP 5/NACE No. 1. The blast profile must be angular with a minimum profile height of 38 microns 1.5 mils. Select appropriate abrasive size and equipment operating parameters to limit maximum surface profile on new steel to 63 microns 2.5 mils and to prevent increasing existing profile height on previously blasted steel. Where an existing profile is encountered, remove representative spots of existing coating with a chemical stripper and measure and document the existing profile prior to initiating blasting operations. Measure all surface profiles in accordance with ASTM D4417, Method C. Steel shot or other abrasives that do not produce an angular profile are not to be used. If recycled blast media is used, maintain an appropriate particle size distribution so that the specified profile is consistently obtained. Round all sharp edges including those caused by corrosion, to a nominal 0.16 cm 1/16 inch radius and reblast the areas prior to painting. Remove weld spatter not dislodged by blasting with impact or grinding tools and reblast the areas prior to painting. Immediately after cleaning and prior to the formation of extensive corrosion products, clean all ferrous surfaces of residual abrasive particles, and apply the first coat of paint in accordance with manufacturer's recommendations. A slightly visible rust bloom is permitted on surfaces to be painted.

3.1.5 Non-Ferrous Metal Surfaces

Abrasive blast all non-ferrous metal surfaces to be painted in accordance with SSPC SP 16 in order to roughen the surface and promote adhesion. Only non-metallic abrasives are permitted. All existing coatings must be removed and a minimum surface profile of 1.5 mils must be produced. Measure the surface profile in accordance with ASTM D4417 Method C. Prime all surfaces as soon as practicable after cleaning and in all cases prior to contamination or deterioration of the prepared surfaces.

3.2 PAINT APPLICATION

3.2.1 General

Unless otherwise specified, the finished coating must be free from

holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Do not initiate the application of initial or subsequent coatings until the Contracting Officer has verified that atmospheric conditions and the surfaces to be coated are satisfactory. Each paint coat must be applied in a manner that will produce an even, continuous film of uniform thickness. Provide special attention to edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities to ensure that they receive an adequate thickness of paint. Spray equipment must be equipped with traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles must be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. The use of airless-type equipment is not allowed for the application of vinyl paints.

3.2.2 Mixing and Thinning of Coatings other than the Vinyl Formulations

Paints must be thoroughly mixed, strained where necessary, and kept at a uniform composition and consistency during application. Incorporate dry-powder pigments specified to be added at the time of use, into the vehicle or base paint with the aid of powered stirrers, in a manner that will produce a smooth, homogeneous mixture free of lumps and dry particles. Where necessary to suit conditions of the surface temperature, weather, and method of application, the paint may be thinned immediately prior to use. Thinning, induction time and pot life must comply with the manufacturers written instructions (PDS). Bring any paint that has been stored at a temperature below the manufacturer's application temperature range up to at least 21 degrees C 70 degrees F before being mixed and thinned. Its temperature in the spray tank or other working container must not fall below the manufacturer's specified application temperature range during the application. Any paint that has deteriorated in any manner to a degree that it cannot be restored to essentially its original condition by customary field-mixing methods must not be used and must be removed from the project site. In order to determine its suitability for application, resample and submit for testing any paint and thinner that is more than 1 year from the date of manufacture or last documented testing. Moisture cure urethane paint must be resampled and resubmitted for testing to determine its suitability for application whenever the paint is more than six months beyond the date of manufacture on the container or more than 6 months beyond the last documented laboratory testing.

3.2.3 Time between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting must be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface.

3.2.4 Method of Paint Application

Unless otherwise specified, paint must be applied by brush, roller, or spray to ferrous and nonferrous metal surfaces. Special attention must be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces are subject to the specific

approval of the Contracting Officer. Paint on plaster, concrete, or other nonmetallic surfaces must be applied by brush, roller, and/or spray.

3.2.5 Coverage and Film Thickness

Film thickness or spreading rates must be as specified hereinafter. Where no spreading rate is specified, apply the paint at a rate consistent with the manufacturer's written instructions. In any event, the combined coats of a specified paint system must completely hide base surface and the finish coats must completely hide undercoats of dissimilar color.

3.2.6 Coating Thickness Measurement on Metal

Where dry film thickness requirements are specified for coatings on metal surfaces, make measurements with a gage qualified in accordance with paragraph Coating Thickness Gage Qualification and calibrated and used in accordance with ASTM D7091. Prior to each use, establish the Base Metal Reading (BMR) for the gage as specified in the test method. Verify the accuracy of the gage using plastic shims as specified by the test method both prior to and following each set of measurements. Perform dry film measurements on all areas of the structure being coated in accordance with SSPC PA 2 with Level 1 thickness restrictions. Perform a sufficient number of thickness measurements to ensure that every area on every member is in compliance with the requirements of this contract. Report all thickness measurements as the mean for each spot determination.

3.2.7 Progress of Painting Work

Where field painting on any type of surface has commenced, complete the entire painting operation on that portion of the work, including priming and finishing coats, as soon as practicable and without prolonged delays. Allow sufficient time between successive coats to permit them to dry properly for recoating, modifying this period as necessary to suit adverse weather conditions. Paint is considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces must be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, clean undercoats of dust, grease, overspray, or foreign matter by means of air blast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, must be brush-off blast cleaned and completely repainted as required. If necessary for establishment of good adhesion, scuff sand high gloss undercoats, and, solvent wipe, or otherwise treat prior to application of a succeeding coat. Apply field coats on metal after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.8 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted, but any resulting crevices must subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections must not be painted. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of

the metal must be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, must not be painted.

3.2.9 Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion are: epoxy and moisture cure urethane systems at least 5 days, vinyl-type paint systems at least 3 days, and cold-applied coal tar systems at least 7 days. Increase minimum drying periods twofold if the drying temperature is below 18 degrees C 65 degrees F and/or if the immersion exposure involves considerable abrasion.

3.2.10 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures must be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted must not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. Store all metalwork coated in the shop or field prior to final erection out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets; soiling, contamination, and deterioration of the paint film. Damaged areas of paint on such metalwork must be cleaned and touched up without delay. Apply the first field coat of paint within a reasonable period of time after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.2.11 Vinyl Paints

3.2.11.1 General

Vinyl paints must be thoroughly mixed and kept at a uniform composition and consistency during application. Any paint that has deteriorated in any manner to a degree that it cannot be restored to essentially its original condition by customary field-mixing methods must not be used and must be removed from the project site. In order to determine its suitability for application, resample and submit for testing any paint and thinner that is more than 1 year from the previous documented testing. Each applied coat of vinyl paint must be free from any holidays, pinholes and bubbles. The finished coating must be free of excessive or unsightly brush marks, runs, drops, ridges, waves, laps and variations in color, and texture. Vinyl paints must be spray applied, except that areas inaccessible to spraying must be brushed. Vinyl Paints (Formulas V-102E, V-103C, V-106D, and V-766E) are ready-mixed paints designed to be spray applied over a wide range of ambient temperatures by field thinning with the proper type and amount of thinner. For spray application, they must be thinned as necessary up to approximately 25 percent (250 mL/L 1 quart/gallon of base paint) with the appropriate thinner; when ambient and steel temperatures are above normal, up to 40-percent thinning may be necessary for satisfactory application. The zinc-rich vinyl paint (Formula VZ-108D) will normally require thinning only under certain weather conditions. Thinners for vinyl paints must be as follows:

APPROXIMATE AMBIENT AIR TEMPERATURE (Degrees C) (Degrees F)	
Below 10 50	MEK
10 - 2150 - 70	MIBK
Above 21 70	MIAK

Vary the amount of thinner to provide a wet spray and avoid deposition of particles that are semidry when they strike the surface. Do not apply vinyl paints when the temperature of the ambient air and receiving surfaces is less than 2 degrees C 35 degrees F nor when the receiving surfaces are higher than 51 degrees C 125 degrees F. Each double spray coat of vinyl paint must consist of a preliminary stripe coat applied by spray, brush, or combination thereof on edges, corners, interior angles, pits, seams, crevices, junctions of joining members, rivets, weld lines, and similar surface irregularities followed by an overall double spray coat. A double spray coat of vinyl-type paint consists of applying paint to a working area of not less than several hundred square feet (meters) in a single, half-lapped pass, followed after drying to at least a near tack-free condition by another spray pass applied at the same coverage rate and where practicable at right angles to the first. Rivets, bolts, and similar surface projections must receive sprayed paint from every direction to ensure complete coverage of all faces. Pits, cracks, and crevices must be filled with paint insofar as practicable, but in any event, all pit surfaces must be thoroughly covered and all cracks and crevices must be sealed off against the entrance of moisture. Keep fluid and atomization pressures as low as practicable consistent with good spraying results. Application of more than 50 microns 2.0 mils, average dry film thickness, of vinyl paint per double spray coat typically indicates semidry application and must be avoided. Except where otherwise indicated, an undercoat of the vinyl-type paint may receive the next coat any time after the undercoat is tack-free and firm to the touch, provided that no speedup or delay in the recoating schedule results in film defects such as sags, runs, air bubbles, air craters, or poor intercoat adhesion. Do not walk on, or otherwise abrade the prime coat or any other coat until it has hardened sufficiently to resist mechanical damage.

3.2.11.2 Vinyl Zinc-Rich Primer

Primer must be field mixed combining components A, B, and C in accordance with label instructions. After mixing, keep the paint covered at all times to avoid contamination and apply the mixed paint within 8 days after mixing. When the ambient and/or steel temperature is below about 26 degrees C 80 degrees F, the paint will not normally require thinning; however, the paint must at all times contain sufficient volatiles (thinners) to permit it to be satisfactorily atomized and to provide a wet spray and to avoid deposition of particles that are semidry when they reach the surface. The paint must be stirred continuously during application at a rate that will prevent the zinc dust from settling. When spraying is resumed after any interruption of longer than 15 minutes, the entire length of the material hose must be whipped vigorously until any settled zinc is redispersed. Long periods of permitting the paint to remain stagnant in the hose must be avoided by emptying the hoses whenever the painting operation is to be suspended for more than 1 hour. Keep the material (paint) hoses as short as practicable, preferably not more than 15 m 50 feet in length. Equipment used for spraying this zinc primer must not be used for spraying other vinyl-type paints without first being thoroughly cleaned, since many of the other paints will not tolerate zinc

contamination. Do not use any type of hot spray. An average dry film thickness of up to 63 microns 2.5 mils may be applied in one double-spray coat. Unless specifically authorized, any coat of VZ-108 must receive a succeeding coat within 8 days.

3.2.11.3 Repair of Vinyl Coating Defects

Coating defects should be repaired when they are first observed but must be repaired prior to coating acceptance. Runs and sags may be brushed out before becoming dry. Pinholes must be physically closed by scrubbing with a brush wet with ketone solvent before the succeeding coat is applied. Overspray that will not be melted smooth by the succeeding coat must be removed by scrubbing with a brush wet with ketone solvent. Minor overspray in the final coat that results only in a reduced gloss at the outer limits of the spray pattern is not considered a defect and requires no additional attention. Insufficient thickness or incomplete hiding must be corrected with additional paint before the succeeding coat is applied. If any defect extends to the substrate, it must be determined if the substrate is corroding. In the case of pinholes it may be necessary to use magnification to observe the substrate. If the substrate is showing any corrosion, the required surface preparation must be restored by spot blasting, and the entire coating system replaced at that location. Following the spot blasting the edges of the remaining coating must be scrubbed with ketone solvent to assure all remaining coating is tightly adhering before the new coating is applied. If VZ-108 does not receive the required succeeding coat within the required 8 days, it must be removed by abrasive blasting and replaced.

3.2.12 Coal Tar-Epoxy (Black) Paint (Formula C-200A)

3.2.12.1 Mixing

Add Component B to previously stirred Component A and thoroughly mix together with a heavy-duty mechanical stirrer just prior to use. The use of not more than 0.5 L 1 pint of xylene thinner per 4 L 1 gal of paint is permitted to improve application properties and extend pot life. The pot life of the mixed paint, extended by permissible thinning, may vary from 2 hours in very warm weather to 5 or more hours in cool weather. Pot life in warm weather may be extended by precooling the components prior to mixing; cooling the mixed material; and/or by slow, continuous stirring during the application period. Apply the mixed material before unreasonable increases in viscosity take place.

3.2.12.2 Application

High-pressure airless spray equipment must be equipped with spray tips of appropriate size for the structural members being coated. Brush application must be with a stiff-bristled brush heavily laden with material and wielded in a manner to spread the coating smoothly and quickly without excessive brushing. The coverage rate of the material is approximately 2.7 square meters/L 110 square feet/gal per coat to obtain 500 microns 20 mils (dry thickness) in a two coats of the C-200a. The paint must flow together and provide a coherent, pinhole-free film. The direction of the spray passes (or finish strokes if brushed) of the second coat must be at right angles to those of the first where practicable.

3.2.12.3 Subsequent Coats

Except at the high temperatures discussed later in this paragraph, the

drying time between coal tar-epoxy coats must not be more than 72 hours, and application of a subsequent coat as soon as the undercoat is reasonably firm is strongly encouraged. Where the temperature for substrate or coating surfaces during application or curing exceeds or can be expected to exceed 52 degrees C 125 degrees F as the result of direct exposure to sunlight, the surfaces must be shaded by overhead cover or the interval between coats reduced as may be found necessary to avoid poor intercoat adhesion. Here, poor intercoat adhesion is defined as the inability of two or more dried coats of coal tar-epoxy paint to resist delamination when tested aggressively with a sharp knife. Under the most extreme conditions involving high ambient temperatures and sun-exposed surfaces, reduce the maximum drying time between coats to 10 hours, and the reduction of this interval to a few hours or less is strongly encouraged. Where the curing time of a coal tar-epoxy undercoat exceeds 72 hours at normal temperatures, 10 hours at extreme conditions, or where the undercoat develops a heavy blush, or when spot repair of damage is required, it must be given one of the following treatments before the subsequent coat is applied:

a. Etch the coating surface lightly by brush-off blasting, using fine abrasive, low air pressure, and a nozzle-to-surface distance of approximately 1 m 3 feet.

b. Remove the blush and/or soften the surface of the coating by wiping it with cloths dampened with 1-methyl-2-pyrrolidone. The solvent may be applied to the surface by fog spraying followed by wiping, but any puddles of solvent must be mopped up immediately after they form. Apply the subsequent coat in not less than 15 minutes or more than 3 hours after the solvent treatment.

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NOTE G: On structures having complex structure or numerous fasteners, the specifier may opt to include holiday testing employing a wet sponge tester (reference ASTM D5162). Holiday testing is not commonly required on large, simply configured structures such as sheet pile, conduits, tanks, and cannot be conducted on concrete structures.

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3.2.12.4 Repair of Coal Tar-Epoxy (Black) Paint (Formula C-200A) Defects

Coating defects should be repaired when they are first observed but must be repaired prior to coating acceptance. Runs, sags, pinholes and other visible application defects in any coat may be brushed out before the material cures. Excessive thickness as a result of runs, sags or heavy application of any coat that has been allowed to cure must be reduced to the specified thickness limitation. Any actions that damage the required surface profile must be followed by spot blasting to restore the profile prior to reapplication of the coating system in that area.

3.2.12.5 Ambient Temperature

Coal tar-epoxy paint must not be applied when the receiving surface or the ambient air is below 10 degrees C 50 degrees F nor if it can be reasonably anticipated that the average ambient temperature will be 10 degrees C 50 degrees F or higher for the 5-day period subsequent to the application of any coat.

3.2.12.6 Safety

In addition to the safety provisions in paragraph SAFETY, HEALTH, AND ENVIRONMENT, other workers as well as painters must avoid inhaling atomized particles of coal tar-epoxy paint and contact of the paint with the skin.

3.3 PAINT SYSTEMS APPLICATION

The required paint systems and the surfaces to which they are to be applied are shown in this paragraph, and/or in the drawings. Supplementary information follows.

3.3.1 Fabricated and Assembled Items

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NOTE H: Thought should be given beforehand as to which items are considered suitable for receiving the manufacturer's standard coating and which are not. In some cases, it may be advisable to include a listing of the items for which the manufacturer's coating is considered adequate. In general, it is believed that a manufacturer's standard coating will be at least reasonably adequate on most items that are to be in normal interior or exterior atmospheric exposure, free from difficult environmental factors, e.g., frequent condensation, water mists and spray, marine atmospheres, etc. Information relative to the type paint to be applied as a field topcoat should be included in each paragraph of the project specification containing a requirement for shop priming.

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Items that have been fabricated and/or assembled into essentially their final form and that are customarily cleaned and painted in accordance with the manufacturer's standard practice will be exempted from equivalent surface preparation and painting requirements described herein, provided that:

a. Surfaces primed (only) in accordance with such standard practices are compatible with specified field-applied finish coats.

b. Surfaces that have been primed and finish painted in accordance with the manufacturer's standard practice are of acceptable color and are capable of being satisfactorily touched up in the field.

c. Items expressly designated herein to be cleaned and painted in a specified manner are not coated in accordance with the manufacturer's standard practice if different from that specified herein.

3.3.2 Surface Preparation

The method of surface preparation and pretreatment shown in the tabulation of paint systems is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting must be accomplished in accordance with detailed requirements previously described.

3.3.3 System No. 1

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NOTE I: This NOTE applies to System No. 1, System No.16-A and System No.23 (series).

1. System No. 1, System No. 16-A and most of the System 23 (series) are all intended for ferrous surfaces subject to atmospheric exposure, e.g. Bridges, light standards, corner wall protection, gantries, exterior machinery and electric motors, adjacent piping and conduit, water tank exteriors, etc. (Exceptions are System No. 23-B-Z which is pigmented with coal tar and designed for immersion and System No. 23-E which does not have a durable topcoat and is designed for interior steel.) Systems No. 1, No. 16-A, and No. 23-D have the ability to adhere to poorly cleaned steel but have increased performance when applied over higher quality surface preparation. The systems are not intended for coating steel subject to immersion in water. Surfaces to be immersed even once every few years for just a few weeks should be coated with a vinyl, moisture cure urethane or epoxy system designed for immersion. They may be used for interior or exterior atmospheric exposed surfaces of machinery, motors, etc., operating at a maximum temperature of 121 degrees C (250 degrees F). Where higher temperatures are involved, heat-resistant coatings as specified herein should be used. Systems No. 1 provides an aluminum finish; System No. 23-D provides a wide choice of colors including aluminum.

2. Systems No. 16-A and No. 23-D are easy to apply single component paints. System No. 16-A has a lower material cost and can be supplied tinted to custom colors. Color selection for System No. 23-D will be limited to the manufacturer's standard colors. Both may be used to touch-up and overcoat areas previously painted with FS TT-P-86, red lead primer. However, areas previously painted with FS TT-P-86 should be considered for total deleading prior to repainting and the primer upgraded to SSPC Paint 40 Type II. Non-galvanized iron and steel piping, conduit, hangers, etc., in interior unpainted spaces may also be coated with these systems or may be left bare where appearance is of no concern. System No. 23-D should be specified for miscellaneous adjacent galvanized and other nonferrous surfaces. System No. 16-A must not be applied directly to galvanized or zinc rich primed surfaces or to concrete or other masonry.

3. System No. 1 is an epoxy commercial product coating. Compatibility for use over existing oil-based coatings varies widely. Although not designed for immersion, System No. 1, when applied over a Commercial Blast, will withstand occasional immersion.

4. Systems No. 1 and 23-C-Z applied over a Commercial Blast are recommended where atmospheric conditions are more than normally severe. Applications include heavily industrialized locations, coastal structures over seawater or within a few hundred feet of the water's edge, exteriors of steel penstocks and similar surfaces exposed to long periods of condensation. System No. 21-A-Z with the optional urethane topcoat may also be specified in these applications for greater water resistance but less sunlight resistance. System No. 23-F-Z has the greatest sunlight resistance

5. Power tool cleaning and brush-off blast cleaning are intended to be Contractor's options and should be specified for minor touch up and repair of previously painted surfaces that are in generally good condition. Commercial blast cleaning is included as a specifier's option and should generally be used to prepare previously painted surfaces that are in poor condition or steel that has never been painted. When deleading is desired, a minimum of Commercial Blast, SSPC SP 6/NACE No.3, should be specified.

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This epoxy paint system must have been tested and passed all the test requirements of SSPC PS 26.00. Application must be by spray, brush or roller in accordance with the manufacturer's written instructions. Application includes a preliminary stripe coat applied by brush to all edges, corners, welds, fasteners, and other surface irregularities. Allow the stripe coat to dry as recommended by the manufacturer, prior to the application of the first full coat. Dry film thickness per coat must be within plus or minus 20 percent of that recommended by the manufacturer. Application of the system in less than two coats will not be accepted. Mix and thin the epoxy coating in accordance with the manufacturers written directions. Mixed coating material that has exceeded the manufacturers pot life, that have been mixed for more than 8 hours or that have thickened appreciably must not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats must be met.

3.3.4 System No. 3

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NOTE J: This Note applies to the next 6 paragraphs also.

1. Air quality regulations refer to solvents and thinners as "volatile organic compounds" or VOC. VOC regulations place a maximum on the amount of VOC that may be in each type of paint. (Properly thinned vinyls have a VOC of less than 780 g/L.) These regulations have been enacted at the local, state, and federal levels. Generally the regulation of the smaller body is more restrictive, and takes precedence over that of the larger body (i.e.; a city regulation could preclude the application of a vinyl paint even though it is allowed by state and

federal regulations). Content of the regulations varies widely. The 1998 federal emission standards for architectural coatings has approximately 60 categories. Its maximum allowable VOC for Industrial Maintenance paints was 450 g/L and for Impacted Immersion Coatings was 780 g/L. Prior to specifying vinyl paint systems the specifier should access the regulations which may exist in the area where the painting will take place. In many localities "architectural" painting is not regulated while shop painting is regulated. This may mean that a new tainter valve cannot be painted with vinyl paint in the fabricating shop but could be painted after it is installed in the field structure. The new federal regulation class "Impacted Immersion Coatings" would allow the use of vinyl on the gates of a dam but not on the service bridge. Some state regulations adopt the federal classifications and restrict the actual specification or use of the coating to the purpose for which it was marketed. Enforcement of this type of regulation usually allows the application of the coating to the entire item even if only a portion meets the purpose; (i.e., Atmospheric and condensation areas of tainter gates could be painted with vinyl even though these areas do not meet the "impacted immersion" requirements).

2. All of the vinyl systems are extremely durable in exterior atmospheric exposure; therefore, lock gates, crest gates, and similar structures with both immersed and weather-exposed areas may be painted overall with the same coating system. Vinyl systems should not be employed in direct immersion in seawater or other saline waters containing over 1,000 ppm chlorides or tideland splash zone area; see notes to System No. 6-A-Z, 21-A-Z and 23-B-Z with respect to the latter exposures.

3. The aluminum topcoats make Systems No. 3 and No. 3-A-Z very water and sunlight resistant but somewhat soft. They are the standard systems for surfaces subject to immersion intermittently or continuously in quiet or low-velocity fresh water or to prolonged condensation. They are considered suitable for interior surfaces or roller and double-skinplate tainter gates, control gates that normally hang in relatively quiet water, lock gates, stoplogs, and to the interior of water tanks except those subject to severe debris and ice action. The zinc primer increases the resistance to underfilm corrosion and to corrosion-undercutting at scratches and breaks in the coating and should be specified in more corrosive waters or where the complexity of the structure makes void free application difficult.

4. Systems No. 4, 5-D, 5-C-Z, and 5-E-Z provide finish colors other than aluminum. All of the systems are considerably more resistant to erosion,

abrasion, and gouging than the aluminum Systems No. 3 or 3-A-Z and the black System 5-A-Z. All may be used for immersed surfaces subject to waters of moderate-to-high velocity and turbulence, particularly where floating debris and/or ice is of some significance. Under such circumstances, surface configuration assumes importance in as much as paint on sharp edges, rivet heads, and similar projections tends to be more damage-prone than on smooth surfaces. Systems No. 4, 5-D, 5-C-Z, and 5-E-Z are considered suitable for most freshwater structures subject to moderate-to-high abrasive, erosive, and gouging stresses stemming from moving water carrying floating debris and ice, e.g., navigation dam gates, tainter valves, sluice gates, trash racks, crest gates in some circumstances, and water tanks if exposed to ice action. The systems are most generally recommended for penstocks, spiral cases, and surge tanks. The use of the Systems No. 5-C-Z and 5-E-Z undercoated with zinc-rich paint are preferred because of superior adhesion, resistance to underfilm corrosion, and to undercutting by corrosion at breaks or holidays in the film.

5. Systems No. 4, 5-D, 5-C-Z, and 5-E-Z may not perform satisfactorily on freshwater immersed gate, valve, and pipe surfaces subject to very high velocities and turbulence, either alone or in combination with the action of suspended matter, floating debris, or ice. Where such conditions are anticipated, metallizing system No. 6-Z-A, described in Section 09 97 10.00 10 METALLIC COATINGS FOR HYDRAULIC STRUCTURES, should be considered. (It must be understood that in immersion the failure mechanism of metallized coatings is different than paint coatings. A metallized coating may be able to withstand a more severe abrasion environment but absent that severe abrasion, paint coatings may provide better long term protection.)

6. Generally, entire surface areas of items such as crest gates, miter gates, etc., should be treated as though subject to immersion (e.g., painted overall with a vinyl system) even though exposed only in part to the weather to avoid the problems and costs introduced by applying a different system on the atmospheric areas. Because of its great durability in atmospheric exposure, the additional cost of the vinyl system will eventually be recovered in lower maintenance expenses.

7. The vinyl systems, particularly those including the zinc-rich undercoat, are resistant to damage by supplementary cathodic protection if the applied current is carefully limited to the minimum required for protection of holidays in the film.

8. Aluminum and aluminum alloy surfaces subject to extended continuous immersion lose the protective

oxide coating and allow pitting corrosion to progress rapidly. Surfaces may be protected by abrasive blasting and applying a vinyl paint system employing V-766E as the first and second coats. Third and subsequent coats may be of V-766, V-102, V-103, or V-106, depending on the desired durability or color. Systems No. 3 and 4 may be specified without alteration to provide aluminum or gray colors, respectively; black and red colors may be obtained by modifying System No. 5-A-Z and 5-D, respectively, so that the first and second coats are V-766. (When paint systems are altered in this manner, the existing system number should not be used).

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Apply paint by spray to an average dry film thickness of a minimum of 150 microns 6.0 mils for the completed system with a minimum thickness at any spot of not less than 125 microns 5.0 mils. Build up approximately 75 microns 3.0 mils with no spot less than 64 microns 2.5 mils of the total dry film thickness with Formula V-766E paint. The specified film thickness must be attained in any event, and any additional coats needed to attain specified thickness must be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided the heavier applications do not cause pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat or more than 25 microns 1.0 mil per single spray pass typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.5 System No. 3-A-Z

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NOTE: See Note for System 3 above.

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Apply paint by spray to an average dry film thickness of a minimum of 165 microns 6.5 mils for the completed system, and a thickness at any spot of not be less than 138 microns 5.5 mils. The dry film thickness of the zinc-rich coat must be approximately 63 microns 2.5 mils with no spot less than 51 microns 2.0 mils. The thickness of the V-766E mid coat must be sufficient to completely hide the primer. Specified film thickness, including the prescribed total, must be attained in any event, and any extra coats needed to attain specified thickness must be applied at no additional cost to the Government. Attaining of the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat or more than 25 microns 1.0 mil per single spray pass of nonzinc paint typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.6 System No. 4

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NOTE: See Note for System 3 above.

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Apply paint by spray applied to an average dry film thickness of a minimum of 190 microns 7.5 mils for the completed system, with a thickness at any spot of not less than 150 microns 6.0 mils. The specified total film thickness must be attained in any event, and additional coats needed to attain the specified thickness must be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat or more than 25 microns 1.0 mil per single spray pass of nonzinc paint typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.7 System No. 5-A-Z

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NOTE: See Note for System 3 above.
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Apply paint by spray to an average dry film thickness of a minimum of 165 microns 6.5 mils for the completed system with the thickness at any spot not be less than 125 microns 5.0 mils. The approximate dry film thickness after application of the first and second double spray coats must be 63 and 100 microns 2.5 and 4.0 mils, respectively. The zinc primer must not be less than 51 microns 2.0 mils at any spot. The specified film thickness must be attained in any event, and any additional coats needed to attain specified thickness must be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat or more than 25 microns 1.0 mil per single spray pass of nonzinc paint typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.8 System No. 5-C-Z

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NOTE: See Note for System 3 above.
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Apply paint by spray to an average dry film thickness of a minimum of 175 microns 7.0 mils for the completed system, and the thickness at any spot of not less than 140 microns 5.5 mils. The dry film thickness of the zinc-rich coat must be approximately 63 microns 2.5 mils with the thickness at any spot not less than 51 microns 2.0 mils. Specified film thickness, including the prescribed total, must be attained in any event, and any extra coats needed to attain specified thickness must be applied at no additional cost to the Government. Attaining of the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat or more than 25 microns 1.0 mil per single spray pass of nonzinc paint typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.9 System No. 5-D

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NOTE: See Note for System 3 above.
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Apply paint by spray to an average dry film thickness of a minimum of 190 microns 7.5 mils for the completed system, with the thickness at any spot of not be less than 150 microns 6.0 mils. The specified total film thickness must be attained in any event, and any additional coats needed to attain specified thickness must be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat or more than 25 microns 1.0 mils per single spray pass of nonzinc paint typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.10 System No. 5-E-Z

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NOTE: See Note for System 3 above.
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Apply paint by spray to an average dry film thickness of a minimum of 175 microns 7.0 mils for the completed system, with the thickness at any spot of not be less than 140 microns 5.5 mils. The dry film thickness of the zinc-rich primer must be approximately 63 microns 2.5 mils with no spot less than 51 microns 2.0 mils. The specified film thickness must be attained in any event, and any extra coats needed to attain the specified thickness must be applied at no additional cost to the Government. Attaining the specified film thickness by applying fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause pinholes, bubbles, blisters, or voids in the dried film. The application of more than 50 microns 2.0 mils (dry film thickness) per double spray coat nor more than 25 microns 1.0 mil per single spray pass of nonzinc paint typically indicates the paint is not being applied wet enough to properly flow out and must be avoided.

3.3.11 System No. 6

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NOTE K: This NOTE also applies to the next paragraph.

1. Systems No. 6 and 6-A-Z are suitable for steel surfaces subject to immersion in fresh waters and, to a degree, their usefulness in this environment overlaps the vinyl systems. However, the vinyl systems are considered to be more suitable for components that are intermittently immersed or are partly immersed and partly in exterior atmospheric exposure. Also, the vinyl systems, except those with aluminum or black vinyl topcoats, are considered to be appreciably more resistant to gouging and abrasion than the No. 6 and 6-A-Z systems. The vinyls are adaptable to use under a wider range of application and drying temperatures

than the coal tar-epoxy system. In addition, coal tar epoxy-coatings present more problems in application and inspection than vinyls. For interior surfaces of flooded compartments, spiral (turbine) cases, penstocks, and other large-diameter, low-to-moderate-velocity water conduits, and for exposed ferrous surfaces in dewatering and drainage sumps, the coal tar epoxy has excellent long-range performance capabilities and may be used (in place of vinyls) unless the specified application and curing temperature requirements would appear to unreasonably restrict construction progress. Also, while the vinyl systems perform very well in the great majority of fresh waters, Systems No. 6 and 6-A-Z may be better adapted to waters that have been made highly corrosive by intense industrial contamination, sewage, or mine waters. In general, system No. 6-A-Z is preferred to the No. 6 system by a margin wide enough to outweigh its additional cost.

2. Systems No. 6 and 6-A-Z are also recommended for exterior steel surfaces of buried tanks and pipe. The systems should not be specified indiscriminately for pipe since, in small-to-moderately large diameters and particularly in large quantities, pipe coated in the shop at reasonable cost with hot-applied coal tar enamel (AWWA C203), fusion bond epoxy coating (AWWA C213), or extruded polyethylene is easily obtainable, while coal tar epoxy is not widely available as mill-applied pipe coating. Where large quantities of underground pipe are involved, see coating and pipe materials information in the various guide specifications for underground utility lines. Steel pipe, shop coated with extruded polyethylene, and field joints, double wrapped with hot-applied coal tar tape (AWWA C203) or pressure-sensitive plastic tape (AWWA C209), warrant consideration for hydraulic and other lines subject to underwater immersion.

3. System No. 6 or 6-A-Z should be used for coating (prior to driving) of underground, underwater, and incidental atmospheric exposed sections of inland steel piling where protection is considered necessary. Piling in undisturbed soils will not in general require protection; see National Bureau of Standards Journal of Research (Vol. 66C, No. 3, July-September 62) paper, Corrosion of Steel Pilings in Soils, and Lower Mississippi Valley Division Report (December 1969) concerning same subject distributed to all districts and divisions.

4. System No. 6-A-Z may be used for sector gates, steel piling etc., immersed in seawater and diluted seawater. It is suitable also for the tidal zone, splash zone, and incidental weather-exposed sections of such structures. The coal tar-epoxy coating becomes quite hard and is not significantly damaged

by fouling organisms; therefore, anti-fouling coats are not considered necessary except possibly for operations reasons, e.g., prevention of weight increase and surface roughness due to fouling and reduction of repainting difficulties. There is presently no thoroughly proven anti-fouling paint for use over the coal tar-epoxy coating. Contact the Paint Technology Center, U.S. Army Construction Engineering Research Laboratory, ATTN: ERDC-CERL-EM, Champaign, IL.

5. The fact that C-200A paint adheres well to clean, sound concrete and also has good resistance to many chemicals indicates the use of a system similar to System No. 6 on concrete surfaces in contact with sewage and other materials tending to cause chemical damage. When used for concrete exposed to such environments, the surface preparation instructions for System No. 6 should be changed to read blast clean to etch surfaces and remove contaminants. Obviously, the use of coatings to upgrade the chemical resistance of concrete has limitations and should not be relied on to solve an exposure situation in which uncoated concrete would be quickly damaged to a gross degree.

6. SSPC PS 26.00 may be employed as aluminum finish coats for C-200A when such a finish is desired. It adheres well to the C-200A in all except constant immersion applications.

7. System No. 6-A-Z and, to a lesser extent, System No. 6 are suitable for use in conjunction with cathodic protection provided the potential of the steel is kept at the minimum required for protection of holidays in the film.

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Apply paint by spray or brush with a minimum of two coats to provide a minimum total thickness at any spot of 400 microns 16 mils. Any spot having an excess of coal tar paint, here defined as more than 500 microns 20 mils in a single coat or 875 microns 35 mils in multiple coats must be repaired by sanding, grinding or abrasive blasting the excess material from the surface and reapplying the coatings to the above specified requirements. The specified film thickness must be attained in any event, and any additional (beyond two) coats needed to attain specified thickness must be applied at no additional cost to the Government.

3.3.12 System No. 6-A-Z

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NOTE: See Note in above paragraph.

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Apply epoxy zinc-rich primer 19C in accordance with the manufacturer's directions in two single, half-lapped spray coats to an average dry film thickness of a minimum of 75 microns 3.0 mils. The thickness at any spot must not be less than 63 microns 2.5 mils or greater 200 microns 6 mils for the primer. After a minimum drying period of 6 hours and no more than

96 hours, apply at least two coats of coal tar epoxy paint to provide a minimum thickness at any spot of 400 microns 16 mils for the completed system. Any spot having an excess of coal tar paint, here defined as more than 500 microns 20 mils in a single coat or 875 microns 35 mils in multiple coats must be repaired by sanding, grinding or abrasive blasting the excess material from the surface and reapplying the coatings to the above specified requirements. If the epoxy zinc-rich paint has been applied in the shop or otherwise has been permitted to cure for longer than 96 hours, it must be abraded and recoated with an additional thin tack coat of the zinc-rich paint, which in turn must be overcoated within 96 hours with the first coat of coal tar-epoxy paint. The specified film thicknesses must be attained in any event, and any additional coats needed to attain specified thickness must be applied at no additional cost to the Government.

3.3.13 System No. 7

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NOTE L: 1. The system is included specifically for use on local protection projects and is not to be used on other types of projects in place of vinyl or coal tar-epoxy systems. It may be used for coating the ferrous surfaces of equipment located below the operating floor of pump stations (in the station sump), in gate wells, in surge chambers, etc. It may be used on both inside and outside discharge pipes with diameters of 20 inches and greater. The items usually involved are storm water and sanitary pumps, slide gates, flap gates, etc. The coating, when applied to equipment and other manufactured items, should generally be permitted to be applied in the shop. Final touch-up painting should be done after installation is completed.

2. Pump discharge lines, except when located wholly within the station sump, should be protected as stipulated in Section 9 of EM 1110-2-3105. Discharge lines wholly within the station sump should be considered as part of the pump. Items of fabricated structural steel used in pump stations and on other features of local protection projects are usually of small size and are generally hot dipped galvanized after fabrication. Only those items fabricated of structural steel of such a large size that galvanizing would be impracticable or unduly expensive would be painted.

3. Cleaning of the metal surfaces can be accomplished by (1) SSPC SP 6/NACE No.3 Commercial Blast Cleaning or (2) by SSPC SP 3 Power Tool Cleaning or SSPC 7/NACE No.4 Brush-Off Blast Cleaning. Only one of the alternative methods should be specified. Although the Commercial blast cleaning assures better performance of the coating, it is considered that it should only be used where large pumping units are used. For the smaller pumping units, that is, size 900 mm 36 inch and below, power tool or brush-off blast cleaning is considered adequate since it will, in all

probability, be more in keeping with the standard practice of the industry for equipment of the above-mentioned size. For the cleaning of sluice gates, flap gates, and other similar items, power tool or brush-off blast cleaning should be used. For touch-up paints, cleaning should be by the solvent and wire-brush method.

****

Apply a special primer under the coal tar-based paint only if/as recommended by the coating manufacturer. The materials must be heavily applied by brush or with heavy-duty spray equipment at a coverage rate that will give a minimum total dry film thickness of 500 microns 20 mils at any spot for the completed system. The paint must not be thinned unless recommended by the manufacturer. If brushed, the final strokes must be at right angles to those of the preceding coat. Comply with the manufacturer's recommendations regarding the application and drying time between coats.

3.3.14 System No. 8

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NOTE M: The Commercial Item Description describes commercially available coating systems for application to wet and damp surfaces. These are very unusual coatings and their use should be limited to only those locations where the surface cannot be made sufficiently dry for more typical coating systems.

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Mix and apply the coating in accordance with the manufacturer's written instructions. The coating must be applied in one or more coats to achieve an average dry film thickness of a minimum of 305 microns 12 mils. Minimum thickness at any spot must be not less than 228 microns 9 mils. Roller application is preferred. Application to vertical surfaces by airless spray may be performed provided all condensed water droplets are removed by wiping with a terry cloth towel immediately prior to spray application. Application to horizontal surfaces or surfaces otherwise covered by standing or running water must be by roller. Brush application must be limited to inside corners, bolt heads and other surface irregularities that are difficult to coat by roller. Apply subsequent coats in the shortest recommended recoat interval. Comply with all manufacturer's recommendations regarding ambient and surface temperatures during application and curing of the coating.

3.3.15 System No. 10

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NOTE N: 1. System No. 10 consists of 2 coats of inorganic zinc paint. SSPC Guide 12.00 discusses applications and limitations to the use of zinc-rich coatings. Use of this system within the Corps is anticipated to be limited to 2 basic applications: (a) For applications as a high temperature paint where exhaust stacks and other surfaces are to be protected from corrosion at dry heat temperatures up to 399 degrees C 750 degrees F; and, (b) To protect atmospheric steel exposed to high levels of

condensation or salt air and where the appearance of an untopcoated zinc coating is acceptable.

2. Conventional good-quality alkyd enamels will withstand temperatures up to about 120 degrees C 250 degrees F. Heat resisting paints are available that provide many colors capable of withstanding 215 degrees C 400 degrees F. System No. 10 is resistant to temperatures up to 400 degrees C 750 degrees F maximum. It is not to be expected that any paint system will exhibit long life on surfaces operating for long periods at very high temperatures (in excess of about 400 degrees C 750 degrees F)), particularly when combined with exterior weathering. As an alternative to conventional high temperature coatings, thermal-sprayed metals such as System No. 8-A found in Section 09 97 10.00 10 METALLIC COATINGS FOR HYDRAULIC STRUCTURES may be used. System No. 8-A will withstand temperatures up to 900 degrees C 1650 degrees F.

3. Surface preparation for inorganic zinc is critical; mill scale, rust or other coatings remaining on the surface will result in poor adhesion and ineffective protection. Application by spray is most common; application of excessive thickness per coat often results in mudcracking. Topcoating of inorganic zinc with non-zinc organic coatings is not recommended.

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Apply the paint in accordance with the manufacturer's recommendations to a minimum average dry film thickness of 125 microns 5 mils with a thickness at any spot of not less than 100 microns 4.0 mils. The specified film thickness may be obtained in a single coat provided this is allowed by manufacturer's recommendations and provided this does not result in improper cure or result in the development of mud cracking or other film defects.

3.3.16 System No. 12

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NOTE O: 1. The inclusion of galvanizing provisions in the painting section of project specification may or may not be desirable and is not mandatory. A principal purpose here is to draw attention to certain information concerning galvanizing versus paint for protection of steel surfaces.

2. Galvanizing of open-mesh-type floor grating (without paint overcoats) is more effective than painting.

3. There would appear to be a mistaken belief that galvanizing is a cure-all method of protection. While very suitable for steel in rural and mildly industrialized atmospheres, galvanizing does not

have a greatly extended life in highly industrialized atmospheres, particularly where the air contains sulphur compounds. Galvanizing is not as effective as the best of paint coatings for steel exposed to cold, fresh water, and in warm and hot waters, galvanizing may result in pitting of the steel deeper than with no coating at all. The performance of galvanized pipe buried in the ground is not consistently good, and it cannot be considered to be equivalent to a high-quality organic pipe coating, particularly since the latter can be supplemented by cathodic protection.

4. The use of galvanizing appears to be economically justified in aboveground structures exposed to mildly corrosive atmospheres, constructed of lightweight structural steel members, and presenting difficult-to-paint and inaccessible surfaces, e.g., transmission towers. The feasibility and economy of galvanizing on structures that are more massive and more easily painted is open to question, but its use on such surfaces is growing. To be considered also is the amount and nature of field erection work that results in destruction of the galvanizing, since satisfactory repair of such damage is difficult and expensive. It should be kept in mind that galvanizing generally has a poor record as a paint-receiving surface, requiring special measures for reliable and permanent adhesion.

5. Other hot-dipped coatings exist that contain various ratios of zinc and aluminum. Some of these coatings may perform better than galvanizing in some exposures. For example, aluminum hot-dipped coatings of pure aluminum are recommended for chloride environments. The specifier may also review ASTM A780 or SSPC Guide 14 for other repair procedures for hot dip galvanized surfaces.

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Wash galvanized surfaces to expose damaged areas. Clean mars and breaks in the galvanized coating by hand or power tool to remove all corroded substrate. Touch up the damaged areas with two coats of SSPC Paint 20, Type II.

3.3.17 System 16-A

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NOTE: See Note I.
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Brush or spray the first coat in the shop or field as indicated. Touch up the coating in the field as necessary to maintain its integrity at all times. Apply the second and third coats in the field. Procure all materials from the same coating manufacturer and apply each coat in accordance with the manufacturer's written instructions. The finish color must be as indicated. Do not apply paint to running surfaces of bearings and machinery. Remove pipe-threading and cutting compounds by solvent

washing prior to application of paint to pipe surfaces.

3.3.18 System No. 17

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NOTE P: This Note applies to System 18 also.

1. Systems No. 17 and 18 are intended primarily for interior surfaces of wood, concrete, masonry, plaster, wallboard, and incidental surfaces within interior painted spaces. System No. 17 provides an all latex system; System No. 18 provides paint systems with oil based alkyd finish coats. The latex system typically has less odor during and immediately after application. Latexes are compatible with alkaline surfaces but may be less durable when subjected to frequent cleaning with abrasive cleansers. Repainting of aged latex paints presents fewer intercoat adhesion problems than when repainting aged semigloss and gloss oil based paints. Additional systems intended for similar surfaces are shown in guide specification Section 09 90 00 PAINTS AND COATINGS.

2. System 17 provides options for the specifier to select finish coats which are MPI 114 (high gloss), MPI 54 (semigloss), MPI 52 (egg shell), or MPI 53 (flat). See paragraph 4 below for guidance in selection of the proper finish coat. When multiple gloss levels are to be used in a contract the specifier should develop alternate systems using an additional letter (System No. 17A, vs. System No. 17B) and clearly identify the items to be coated with each system.

3. System 18 requires the specifier to select both the appropriate primer and the appropriate finish coats. MPI 46 primer is an alkyd. Products meeting this specification typically have superior adhesion to wood and existing oil based enamel coatings. They may be applied directly to clean ferrous surfaces but should not be applied directly onto sheet rock, masonry, galvanized metal, or other alkaline surfaces. MPI 50 primer is latex. Products meeting this specification are commonly applied to a wide range of sheet rock, masonry, and wood surfaces; however, they should not be applied directly to unprimed ferrous or aluminum surfaces. All finish coats are compatible with either primer. The options for finish coats include MPI 49 (Flat), MPI 47 (Semigloss), MPI 51 (Eggshell) and MPI 48 (Gloss). See paragraph 4 below for guidance in selection of the proper gloss. When multiple gloss levels are to be used on a contract the specifier should develop alternate systems using an additional letter (System No. 18A vs. System No. 18B) and clearly identify the items to be coated with each system.

4. Flat finishes tend to hide surface irregularities but are often more difficult to clean. They should be used for walls and ceilings constructed of concrete, block, plaster, or wallboard where no unusual soiling problems exist. Egg shell finishes are sometimes specified where flat finishes are desired but a higher level of cleanability is required. Semigloss finishes are specified on smooth plaster, wood, or other high quality surfaces when appearance requirements are above average. Semigloss and high gloss finishes should generally be used on wainscot areas, stairwells, washrooms, workrooms, etc., subject to moisture, soiling, or staining problems. Avoidance of very light colors on wainscots and other areas subject to high degree of soiling is suggested. Semigloss and high gloss finishes are frequently applied over an alkyd primer on interior wood and steel doors, windows, frames, etc.

5. The use of the systems for finishing complex spaces (such as in powerhouses) involving numerous ceiling, wall, wainscot, door, and trim colors and varying degrees of gloss in numerous rooms is more easily specified by preparing a separate room and door finish schedule.

6. Attention is directed to the absence of any requirements in this guide for rubbing, sacking, fin removal, etc., to improve the paintability or appearance of painted concrete surfaces; such requirements, if needed, should be included in the concrete section. Also, if coated interior concrete block surfaces are intended to be substantially free of surface voids, they should be first treated with MPI 4 Interior/Exterior Latex Block Filler.

7. System No. 18 with MPI 46 primer and semigloss or gloss finish coats is adequate for battery rooms in some divisions. However, System No. 21 conforms to the requirements of EM 1110-2-3001.

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Except as otherwise required, apply the same finish paint to all metal ductwork, conduit, pipe, radiators, grilles, louvers, pull boxes, and exposed surfaces of miscellaneous embedded metalwork as is applied to adjacent ceilings or walls provided that:

a. The coat of MPI 50 may be omitted on metal surfaces primed with a shop or field coat of metal priming paint.

b. On bare ferrous surfaces and wood replace the coat of MPI 50 with a coat of MPI 46.

c. Solvent clean all galvanized and other nonferrous metal surfaces in accordance with SSPC SP 1 and prime with SSPC Paint 41 in place of the MPI 50 coat.

3.3.19 System No. 18

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NOTE: See NOTE for System 17 above.
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Thin oil based alkyd paints using only odorless mineral spirits (ASTM D235). Except as otherwise required, finish all metal ductwork, conduit, pipe, radiators, grilles, louvers, pull boxes, and exposed surfaces of miscellaneous embedded metalwork the same as adjacent ceilings or walls provided that:

a. The coat of MPI 46 or MPI 50 may be omitted on metal surfaces primed with a shop or field coat of metal priming paint.

b. Prime all bare ferrous surfaces with MPI 46.

c. Clean all galvanized and other nonferrous metal surfaces in accordance with SSPC SP 1 and prime with SSPC Paint 41 in place of MPI 46 or MPI 50.

3.3.20 System No. 21

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NOTE Q: This NOTE applies to the next paragraph also.

1. MIL-DTL-24441 consists of a general specification for a two-component epoxy-polyamide paint and detail specification sheets numbered MIL-DTL-24441/19C through MIL-DTL-24441/40B. Each specification sheet contains the formulation and requirements for a specific coating. Variations include high-build and regular build types for various primers and topcoat colors. Type IV high-build topcoats may be used over the 19C primer in System 21-A-Z; however, Type III products offer superior performance in immersion. Any of the type III or Type IV topcoats may be used directly on concrete or wood surfaces. Primer 29B should be specified for aluminum substrates or steel surfaces that are not primed with zinc-rich primer 19C. The designer must specify the specific coatings desired.

2. System No. 21 is suggested for concrete and other incidental surfaces of battery rooms and other rooms where resistance to chemical fumes is desired and/or which will be subjected to heavy soils necessitating frequent cleaning. It may be used on interior concrete floors; however, System No. 22 is specifically designed for this purpose.

3. Attention is directed to the absence in this guide of any requirements such as sacking, fin removal, etc., that would improve the paintability or appearance of painted concrete surfaces; such requirements should be included in the concrete section.

4. System No. 21-A-Z can be used on steel sector

gates, steel piling, etc., immersed in seawater and diluted seawater. It is suitable also for the tidal zone, splash zone, and incidental weather exposed sections of such structures. The system is satisfactory in applications subject to low-to-moderate water velocities and abrasion. System No. 6-A-Z should be specified for applications where more severe abrasion is anticipated.

5. Systems No. 21 and 21-A-Z are suitable for steel surfaces subject to immersion in fresh waters and to a degree their usefulness in the environment overlaps vinyl Systems No. 3 through 5-E-Z and Epoxy Systems 6 and 6-A-Z. However, the vinyl Systems are more suitable for components that are intermittently immersed or are partly immersed and partly in exterior atmospheric exposure. Also, the vinyl Systems, except those topcoated with aluminum vinyl, are more resistant to gouging and abrasion than the epoxy systems, with vinyl Systems No. 5-C-Z and 5-E-Z being the best in this respect. Finally, the vinyls are adaptable to use under a wider range of applications and drying temperatures than the epoxy systems. In general, System No. 21-A-Z is preferred to System No. 21 by a margin wide enough to outweigh its additional cost.

6. System No. 21-A-Z is suitable for use on exterior steel exposed to a marine (salt) atmosphere.

7. Systems No. 21 and 21-A-Z are suitable for use on hydraulic piping immersed in fresh water and may be considered equivalent to Systems No. 6 and 6-A-Z in this exposure.

8. Generally, entire surface areas of items such as miter gates, crest gates, etc., should receive the selected epoxy system even though only a portion will be subjected to atmospheric weathering. Epoxy coatings subject to atmospheric weathering may erode by as much as 25 µm 1 mil per year. In such cases where systems No. 21 and 21-A-Z will be exposed to normal atmospheric weathering, it is recommended that one or two coats of polyurethane meeting SSPC Paint 36, Level 3, or MIL-PRF 85285 be applied over the final coat of the epoxy system. The polyurethane should be applied only to the portion of the item generally exposed to atmospheric weathering and not to the entire item. It should be specified in a color similar to that of the immersed area. The polyurethane should be applied in the number of coats and at the dry film thickness recommended by the manufacturer. Products marketed by many manufacturers for compliance with SSPC Paint 36 are not suitable for immersion and Level 3 performance is not available in safety and designer colors. For greater water resistance and color retention MIL-PRF-85285, Type IV should be specified.

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Apply the paint in a minimum of two single coats to produce an average dry film thickness totaling 150 microns 6.0 mils with no less than 5.0 mils at any spot. No individual coat may be more than 150 microns 6.0 mils at any point. Apply MIL-DTL-24441 in compliance with the manufacturer's recommendations regarding type of thinner, amount of thinning, and required induction time. The drying time between coats must not be less than 8 hours nor more than 96 hours.

3.3.21 System No. 21-A-Z

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NOTE: See NOTE in preceding paragraph.

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Apply the epoxy zinc-rich paint 19C in two single half-lapped spray coats to an average dry film thickness of a minimum of 100 microns3.0 mils and a thickness at any spot of not less than 64 microns2.5 mils or greater than 200 microns6.0 mils. After a drying period of not less than 6 hours or more than 96 hours, apply at least two coats of epoxy polyamide paint to produce an average dry film thickness totaling 305 microns 12 mils and a thickness at any spot of not less than 254 microns 10 mils. If the epoxy zinc-rich paint has been applied in the shop or otherwise has been permitted to cure for longer than 96 hours, it must be abraded and recoated with an additional thin tack coat of the zinc-rich paint, which in turn must be overcoated within 96 hours with the first coat of the epoxy polyamide paint. Apply MIL-DTL-24441 in accordance with the manufacturer's recommendations regarding type of thinner, amount of thinning, and required induction time. The drying time between non-zinc coats must not be less than 12 hours nor more than 96 hours..

3.3.22 System No. 22

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NOTE R: MPI Paint 212 describes commercially available floor coating systems suitable for concrete floors of maintenance and other similar facilities. Specifier should consult manufacturers for guidance and availability in specifying color, hardness, level of reflectance, level of slip resistance. and warranty necessary for specific application.

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Apply the floor coating system MPI 212 in accordance with the manufacturer's written instructions. It must be a multi-coat system with the dry film thickness per coat as recommended by the manufacturer.

3.3.23 System No. 23-A-Z

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NOTE S:

1. Paint System No. 23-A-Z is comprised of three-coats of moisture cure urethane. The primer is a zinc-rich coating conforming to SSPC Paint 40, Type II. The primer may be packaged as a single component paint containing the zinc or a two

component material where the zinc must be incorporated into the liquid paint. The intermediate coat is a single component aromatic moisture cure urethane conforming to SSPC Paint 41. The topcoat is a single component aliphatic moisture cure urethane conforming to SSPC Paint 38. The specifier must specify a color. Gray topcoat should have a reflectance of 20-24 (ASTM E1347). The resulting gray color should approximate color 26231 of SAE AMS-STD-595A. Red topcoat should approximate SAE AMS-STD-595A color 10076. White and black may also be specified.

2. The usefulness of System 23-A-Z overlaps to a certain extent with the vinyl systems. However, System 23-A-Z is not as durable as the vinyl systems because it is less abrasion and water resistant. In locations where it has been determined that vinyl paints do not meet air pollution requirements, System 23-A-Z is a suitable alternative to vinyls for use on ferrous metal surfaces subject to fresh water immersion and adjoining atmospheric exposed surfaces.

****

Apply the coating system in accordance with the manufacturer's written instructions. It must be a 3-coat system plus an additional stripe coat applied by brush to all edges, corners, welds, fasteners, and other surface irregularities. Allow the stripe coat to dry as recommended by the manufacturer, prior to the application of the first full coat. Application of the system in less than three coats will not be accepted. Procure all materials from the same coating manufacturer. The individual paints comprising the system must have been tested and passed all requirements of the applicable SSPC standards. SSPC Paint 38 topcoat must meet the requirements of Accelerated Weathering Level 3. Apply the coatings by spray in accordance with the manufacturer's written instructions. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved. Comply with the manufacturer's recommendations regarding mixing and thinning requirements, and pot life requirements, dry film thickness per coat and minimum and maximum dry time between coats. Do not use coating material that has thickened appreciably. Areas of bubbling noted upon curing of any individual coat must be removed by sanding or screening, the edges feathered, and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.24 System No. 23-B-Z

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NOTE T:

1. Paint System No. 23-B-Z is comprised of three-coats of moisture cure urethane. The primer is a zinc-rich coating conforming to SSPC Paint 40, Type II. The primer may be packaged as a single component paint containing the zinc or a two component material where the zinc must be incorporated into the liquid paint. The second and third coats are a single component aromatic moisture

cure urethane conforming to SSPC Paint 41 and containing coal tar pitch resin.

2. Coating System 23-B-Z is recommended for application on ferrous metal surfaces subject to fresh water and brackish water immersion, atmospheric, and buried environments. In fresh water immersion its usefulness overlaps with the vinyl systems. However, System 23-B-Z is not as durable as the vinyl systems because it is less abrasion resistant. In locations where it has been determined that vinyl paints do not meet air pollution requirements, System 23-B-Z is a suitable alternative to vinyls for use on ferrous metal surfaces subject to fresh water immersion and adjoining atmospheric exposed surfaces. In brackish or dilute salt water immersion and buried applications the system is comparable to System No. 6-A-Z. Its chief advantage over epoxy system 6-A-Z is that it can be applied at lower temperatures and higher humidity.

****

Apply the coating system in accordance with the manufacturer's written instructions. It must be a 3-coat system plus an additional stripe coat applied by brush to all edges, corners, welds, fasteners, and other surface irregularities. Allow the stripe coat to dry as recommended by the manufacturer, prior to the application of the first full coat. Procure all materials from the same coating manufacturer. The individual paints comprising the system must have been tested and passed all requirements of the applicable SSPC standards. SSPC Paint 41 must be modified with coal tar pitch. Apply the coatings by spray in accordance with the manufacturer's written instructions. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved. Comply with the manufacturer's recommendations regarding mixing and thinning requirements, and pot life requirements, dry film thickness per coat and minimum and maximum dry time between coats. Do not use coating material that has thickened appreciably. Areas of bubbling noted upon curing of any individual coat must be removed by sanding or screening, the edges feathered, and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.25 System No. 23-C-Z

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NOTE U: Paint System No. 23-C-Z is comprised of three-coats. The primer is a moisture cure zinc-rich urethane coating conforming to SSPC Paint 40, Type II. The primer may be packaged as a single component paint containing the zinc or a two component material where the zinc must be incorporated into the liquid paint. The zinc-rich primer provides excellent corrosion resistance in atmospheric exposures. Type II is an immersion grade primer and is recommended because surfaces coated with this system could be subject to intermittent immersion and the Type II primer offers an added degree of security. The second coat and third coats are a two-component aliphatic

polyurethane conforming to MIL-PRF-85285 Type IV. This product provides the ultimate color and gloss retention but is only available in gray and white and is quite costly. Where custom colors are desired, SSPC Paint 36 may be substituted. In addition to the excellent corrosion resistance afforded by the primer the MIL-PRF-85285 Type IV topcoat will also provide a very high degree of resistance to UV-induced color change, dulling, and chalking, making an excellent choice for highly visible items such as handrails. The SSPC Paint 36 topcoat provides a wide range of colors including safety colors but will exhibit moderate chalking. The specifier must select a finish coat color..

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Apply the coating system in accordance with the manufacturer's written instructions. It must be a 3-coat system plus an additional stripe coat applied by brush to all edges, corners, welds, fasteners, and other surface irregularities. Allow the stripe coat to dry as recommended by the manufacturer, prior to the application of the first full coat. Procure all materials from the same coating manufacturer. The individual paints comprising the system must have been tested and passed all requirements of the applicable standards. Apply the coatings by spray in accordance with the manufacturer's written instructions. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved. Comply with the manufacturer's recommendations regarding mixing and thinning requirements, and pot life requirements, dry film thickness per coat and minimum and maximum dry time between coats. Do not use coating material that has thickened appreciably. Areas of bubbling noted upon curing of any individual coat must be removed by sanding or screening, the edges feathered, and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.26 System No. 23-D

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NOTE V:

1. This system is comprised of three coats of moisture cure urethane paint conforming to SSPC Paint 41. The second and third coats may either be aluminum or a color such as grey. The choice of aluminum or color finish is the specifier' s option. Light colors may tend to yellow when exposed to sunlight. See Systems 23-A-Z and 23-C-Z for more light stable topcoat colors.

2. This system is used for three distinctly different applications. Surface preparation Alternate 1 in the painting schedule is to be used for overcoating existing coatings as a means of extending their economic life. This approach may be particularly cost effective if the existing coating contains lead or other hazardous constituents. Coating System 23-D is well suited for maintaining degraded coatings. Overcoating is performed with a significant degree of risk, which refers to the chance that the overcoated system may either fail

catastrophically or will not provide the desired period of protection. The applicability of overcoating is limited by the condition of the existing coating and underlying substrate and the severity of the exposure environment. If the existing coating is too thick, brittle, or poorly adherent, then overcoating should not be performed. If the degree of substrate corrosion is significant, then the level of effort needed to prepare the substrate may indicate that overcoating is not economically viable. Overcoating is not recommended for severe exposure environments because an all new paint system would last significantly longer than overcoating and is more cost effective. For additional information on overcoating contact the Paint Technology Center.

3. System 23-D is specified for coating ferrous metal surfaces that are cleaned in accordance with surface preparation Alternate 2, SSPC SP 3 Power Tool Cleaning. SSPC Paint 41 is generally quite tolerant of minimally prepared surfaces. When used on SP 3 cleaned surfaces System 23-D is generally adequate for mild atmospheric exposures. For more severe atmospheric exposures it generally is worth the added cost to specify System No. 23-B-Z which uses the more expensive zinc-rich primer and more expensive commercial blast cleaning. Where an aluminum finish is specified in conjunction with Alternate 2, System No. 23-D is roughly equivalent to System No. 1 which employs two coats of aluminum pigmented epoxy. The chief advantage of System No. 23-D over System No. 1 is that it can be applied at lower temperatures and higher humidity.

4. System 23-D is specified for coating non-ferrous metal surfaces using surface preparation Alternate 3 shown in the Painting Schedule. Surface preparation for Alternate 3 uses SSPC SP 16 surface preparation for non-ferrous surfaces. Galvanized surfaces and other hot-dip coated surfaces will not generally be painted. However, in exterior industrial and marine exposures or in below grade galleries and passageways subject to high humidity and condensation, painting to extend the protective life of galvanizing is sometimes advisable. Also galvanized ductwork, conduit, piping, etc., in finished spaces is generally painted for appearance purposes. System No. 23-D aluminum color is intended generally for galvanized handrail, pipe, conduit, etc., subject to exterior or interior exposure for the purpose of extending the life of the zinc coating and/or matching the appearance of adjacent painted structural steel. If preferred, System No. 23-D in gray or other suitable color may be used for this purpose. Aluminum and aluminum alloy surfaces will not generally be painted; however, System No. 23-D may be desirable for isolating aluminum in contact with mortar or

concrete. System No. 23-D can be used for protection in salt (marine) atmospheres and for those situations where the aluminum surfaces may be in contact with damp wood, leaves, mud, etc., that tend to prevent free access of oxygen to the surfaces, thus causing possible loss of the metal's protective oxide film. Copper and brass surfaces will rarely be painted except for the purpose of appearance, e.g., gutters, exposed flashing, exposed piping in finished spaces, etc. Paint System No. 23-D can be used to paint copper and brass.

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Apply the coating system in accordance with the manufacturer's written instructions. It must be a 3-coat system plus an additional stripe coat applied by brush to all edges, corners, welds, fasteners, and other surface irregularities. Allow the stripe coat to dry as recommended by the manufacturer, prior to the application of the first full coat. The aluminum pigmented topcoat will not meet the SSPC Paint Procure all materials from the same coating manufacturer. The individual paints comprising the system must have been tested and passed all requirements of the applicable SSPC standards. [The first coat of the overcoat system must be applied by brush or roller to those areas where power tool cleaning exposed the steel substrate. The second coat of the overcoat system must also be applied by brush or roller to those areas that received a first coat of paint as well as any area where power tool cleaning or power washing removed the old topcoat. The final coat of the overcoat system must be applied to the entire surface by spray, brush, or roller.] [Application must be by spray. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved.] [Application must be by spray, brush, or roller.] Comply with the manufacturer's recommendations regarding mixing and thinning requirements, and pot life requirements, dry film thickness per coat and minimum and maximum dry time between coats. Do not use coating material that has thickened appreciably. Areas of bubbling noted upon curing of any individual coat must be removed by sanding or screening, the edges feathered, and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.27 System No. 23-E

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NOTE W:

1. The system is intended for interior structural steel and other interior ferrous surfaces not otherwise specified with respect to painting. The category includes structural and miscellaneous steel exposed to view in unfinished spaces, concealed structural framework of buildings, and other ferrous surfaces that will be inaccessible for painting after construction, all of which are enclosed within a weather-tight structure. Care should be taken that requirements in this section are not in conflict with other painting requirements.

2. Where steelwork is permanently assured after erection of freedom from weathering, wind-driven rain, high humidity, condensation, etc.,

consideration should be given to limiting the painting (exclusive of decorative coats in finished areas) to the shop-applied first coat.

3. The specification provisions relative to substitution of finish paints for the second coat of primer in painted spaces is intended only to inform the Contractor that the second coat of primer is not always required. The details of the substitute finish painting should be taken care of elsewhere, e.g., in connection with painting of room walls and ceilings.

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Apply the coating system in accordance with the manufacturer's written instructions. It must be a 2-coat system. Application of the system in less than two coats will not be accepted. Procure all materials from the same coating manufacturer. The individual paints comprising the system must have been tested and passed all requirements of the applicable SSPC standards. Application must be by spray, brush, or roller in accordance with the manufacturer's written instructions. Comply with the manufacturer's recommendations regarding mixing and thinning requirements, and pot life requirements, dry film thickness per coat and minimum and maximum dry time between coats. Do not use coating material that has thickened appreciably. Areas of bubbling noted upon curing of any individual coat must be removed by sanding or screening, the edges feathered, and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.28 System No. 23-F-Z

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NOTE X:

1. Paint System No. 23-F-Z is comprised of three-coats of moisture cure urethane. The primer is a zinc-rich coating conforming to SSPC Paint 40, Type II. The primer may be packaged as a single component paint containing the zinc or a two component material where the zinc must be incorporated into the liquid paint. The second and third coats are a single component aromatic moisture cure urethane conforming to SSPC Paint 41 and containing aluminum.

2. Coating System 23-F-Z is recommended for general use on atmospheric steel applications where an aluminum color is desired. Typical applications include service bridges, exterior of penstocks, lifting machinery, cranes, motors, and similar miscellaneous items located at civil works navigation, flood control or hydropower installations. If applied over a white metal blast cleaned surface, the system does withstand long term fresh water immersion where its usefulness overlaps with the vinyl systems. However, System 23-F-Z is not as durable as the vinyl systems because it is less abrasion resistant.

3. The usefulness of this system also overlaps with System No.1, a two-coat aluminum epoxy mastic system. However, System No. 23-F-Z is superior to System No. 1 when systems are applied to a commercial blast cleaned surfaces. System No. 23-F-Z is more expensive than System No. 1.

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Apply the coating system in accordance with the manufacturer's written instructions. It must be a 3-coat system plus an additional stripe coat applied by brush to all edges, corners, welds, fasteners, and other surface irregularities. Allow the stripe coat to dry as recommended by the manufacturer, prior to the application of the first full coat. Procure all materials from the same coating manufacturer. The individual paints comprising the system must have been tested and pass all of the requirements of the applicable SSPC standards. Apply the coatings by spray in accordance with the manufacturer's written instructions. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved. Comply with the manufacturer's recommendations regarding mixing and thinning requirements, and pot life requirements, dry film thickness per coat and minimum and maximum dry time between coats. Do not use coating material that has thickened appreciably. Areas of bubbling noted upon curing of any individual coat must be removed by sanding or screening, the edges feathered, and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.29 Protection of Nonpainted Items and Cleanup

Maintain walls, equipment, fixtures and all other items in the vicinity of the surfaces being painted free from damage by paint or painting activities. Promptly repair any paint spillage and painting activity damage.

3.4 INSPECTION

Surface preparation and painting inspections must be conducted by an inspector certified as meeting one of the following designations: SSPC-PCI Level 2, NACE-CIP Level 2. The inspector will inspect and document all work phases and operations on a daily basis and submit daily Inspection Reports. As a minimum the daily report must contain the following:

a. Inspections performed, including the area of the structure involved and the results of the inspection.

b. Surface preparation operations performed, including the area of the structure involved, the mode of preparation, the kinds of solvent, abrasive, or power tools employed, and whether contract requirements were met.

c. Thinning operations performed, including thinners used, batch numbers, and thinner/paint volume ratios.

d. Application operations performed, including the area of the structure involved, mode of application employed, ambient temperature, substrate temperature, dew point, relative humidity, type of paint with batch numbers, elapsed time between surface preparation and application, elapsed time for recoat, condition of underlying coat, number of coats applied, and if specified, measured dry film thickness or spreading

rate of each new coating.

3.5 PAINTING SCHEDULES

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NOTE Y: In the case of formulations in which the type and amount of pigment are fixed, the manufacturer may be limited in the latitude of shades and colors that can be obtained. Colors should be selected in advance and designated in the project specifications or in the drawings. Insofar as practicable, colors must be designated by making use of SAE AMS-STD-595A color designations. When a proprietary or SSPC paint is specified, colors can be specified as approximating those not necessarily as matching the SAE AMS-STD-595A color designation.

1. The number assigned to each paint system should not be changed locally even though on specific projects some systems are omitted. If other systems are added locally, they should be assigned numbers other than those used in this guide. See also final general note below for instructions relative to numbering other systems.

2. For maintenance of existing paint systems use System No. 23-D. For further guidance in maintenance painting, see EM 1110-2-3400.

3. For quick guidance to the first choice coating systems for steel surfaces from each of several exposure conditions frequently incurred on civil works projects, the following will be helpful:

a. Normal exterior atmospheric exposure - System No. 23 D or 23-F-Z.

b. Prolonged condensation, high humidity, coastal structures not subject to immersion, System No. 23-C-Z (colors) or 23-F-Z (aluminum).

c. Immersion in relatively quiet, minimally abrasive waters - System No. 3-A-Z.

d. Immersion in moderately-to-highly turbulent, abrasive waters - System No. 5-C-Z or 5-E-Z.

e. Immersion in very turbulent, ice- and debris-laden waters - System No. 6-Z-A of Section 09 97 10.00 10 METALLIC COATINGS FOR HYDRAULIC STRUCTURES.

f. Immersion in sea water or other extremely corrosive waters - System No. 6-A-Z (coal tar) or 21-A-Z (colors).

g. Immersion in fresh water where protection from zebra mussel fouling is deemed critical - System No. 6-Z-A of Section 09 97 10.00 10 METALLIC COATINGS

FOR HYDRAULIC STRUCTURES.

4. For further information regarding system selection refer to the notes in the following general index.

GENERAL INDEX: (Substrate/Environment)	Refer to Note No.
Aluminum	J8, P3, Q1, V4
Battery Rooms	P7, Q2
Bridges	I1, X
Concrete	
Exposed to chemicals or sewage	K5, Q2
Interior	P1, P4
Floors	E, Q2, L, R
Copper	U4
Dewatering and drainage sumps	K1, L1, L2
Doors, wood or steel	P4, P5
Flooded compartments	K1
Floor grating	O2
Galvanized materials	I2, O2, V4
Galvanized Interior:	
High condensation	V4, O3
Nonexposed	I2, O3
Gantries	I1
Gates	J1, J2, J3, J4, J5, J6, K4, I1, M3, Q4, Q8
Gate wells	L1
Light standards	I1
Local protection projects	K1, L2
Painted Steel	B, I2, V2

GENERAL INDEX: (Substrate/Environment)	Refer to Note No.
Penstocks	I4, J4, K1, U
Piling, steel	K3, K4, Q4
Pipe and conduit	I1, I2, J4, J5, K1, K2, O3, Q7, V4
Pumps and machinery	I1, L1, L2, L3, U
Spiral (turbine) case	J4, K1
Stairwells	P4
Steel:	
Corrosive	J3, K1, O4
Damp or wet	M
Freshwater immersion:	
Low velocity	J3, K1, Q4
Med high velocity	J4
Intermittent immersion	J2, J3, K1, Q5, U
High condensation	D, H, I4, J1, J3, N1, V4, W
High temperature	I1, N1, N2
Normal exposure	A, H, Q8
Salt water immersion	A, T
Severe industrial	I4, K1, O3, V4
Tidal splash zones	J2, K4, Q4
Stop logs	J3
Structural framework	W1
Surge chambers	J4, L1
Tanks:	
Exterior	I1, K2
Interior	J3, J4
Trash rack	J4

GENERAL INDEX: (Substrate/Environment)	Refer to Note No.
Valves	J1, J4, J5
Walls (High-maintenance areas)	P4
Wall protection, corner	I1
Window frames	P4
Zebra mussel	Y4 (g)

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SYSTEM NO. 1	
Items or surfaces to be coated:	[_____]
SURFACE PREPARATION	PAINT SYSTEM
Alternate 1: Power tool or brush-off blast cleaning	SSPC PS 26.00 Type II
Alternate 2: Commercial blast cleaning	SSPC PS 26.00 Type I

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NOTE: The above alternatives are not intended to be a Contractor option. Type II coating should be specified for minor touch up and repair of previously painted surfaces that are in generally good condition. Type I coating should be used to prepare previously painted surfaces that are in poor condition or steel that has never been painted. See Note to Paragraph titled "System No. 1" above.

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SYSTEM NO. 3				
Items or surfaces to be coated:		[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	White Vinyl V-766E (double spray coat)	Gray Vinyl V-766E (double spray coat)	Aluminum Vinyl V-102E (double spray coat)	Aluminum Vinyl V-102E (double spray coat)

SYSTEM NO. 3-A-Z				
Items or surfaces to be coated:		[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc-rich VZ-108D (double spray coat)	White Vinyl V-766E (double spray coat)	Aluminum Vinyl V-102E (double spray coat)	Aluminum Vinyl V-102E (double spray coat)

SYSTEM NO. 4					
Items or surfaces to be coated:			[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT	5th COAT
White metal blast cleaning	White Vinyl V-766E (double spray coat)	Gray Vinyl V-766E (double spray coat)	White Vinyl V-766E (double spray coat)	Gray Vinyl V-766E (double spray coat)	Gray Vinyl V-766E (double spray coat)

SYSTEM NO. 5-A-Z				
Items or surfaces to be coated:		[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc-rich VZ-108D (double spray coat)	White Vinyl V-766E (double spray coat)	Black Vinyl V-103C (double spray coat)	Black Vinyl V-103C (double spray coat)

SYSTEM NO. 5-C-Z				
Items or surfaces to be coated:		[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc-rich VZ-108D (double spray coat)	Dark Red Oxide Vinyl V-106D (double spray coat)	Light Red Oxide Vinyl V-106D (double spray coat)	Dark Red Oxide Vinyl V-106D (double spray coat)

SYSTEM NO. 5-D					
Items or surfaces to be coated:			[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT	5th COAT
White metal blast cleaning	Dark Red oxide Vinyl V-106D (double spray coat)	Light Red oxide Vinyl V-106D (double spray coat)	Dark Red oxide Vinyl V-106D (double spray coat)	Light Red oxide Vinyl V-106D (double spray coat)	Dark Red oxide Vinyl V-106D (double spray coat)

)

SYSTEM NO. 5-E-Z				
Items or surfaces to be coated:		[_____]		
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc-rich VZ-108D (double spray coat)	Gray Vinyl V-766E (double spray coat)	White Vinyl V-766E (double spray coat)	Gray Vinyl V-766E (double spray coat)

SYSTEM NO. 6			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
White metal blast cleaning	Coal tar epoxy C-200A (black)	Coal tar epoxy C-200A (black)	Coal tar epoxy C-200A (black) (if needed to attain required thickness)

SYSTEM NO. 6-A-Z			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st & 2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	MIL-DTL-24441/19C	Coal tar epoxy C-200A (black)	Coal tar epoxy C-200A (black)

SYSTEM NO. 7			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Alternate 1: Power tool or brush-off blast cleaning	SSPC Paint 33	SSPC Paint 33	SSPC Paint 33
Alternate 2: Commercial blast cleaning	SSPC Paint 33	SSPC Paint 33	SSPC Paint 33

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NOTE: ABOVE ALTERNATES ARE NOT INTENDED TO BE CONTRACTOR'S OPTIONS.

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SYSTEM NO. 8		
Items or surfaces to be coated:	[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT
White metal blast cleaning	Paint (for wet surfaces) CID A-A-3130	Additional coats as recommended by the manufacturer

SYSTEM NO. 10		
Items or surfaces to be coated:	[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT
White metal blast cleaning	SSPC Paint 20 Type I-B or I-C	SSPC Paint 20 Type I-B or I-C

SYSTEM NO. 12		
Items or surfaces to be coated:	[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT
Refer to paragraph SYSTEM NO. 12	SSPC Paint 20 Type II	SSPC Paint 20 Type II

SYSTEM NO. 17			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
As specified for each type of surface	MPI 50	[MPI 114][MPI 54][MPI 52][MPI 53]	[MPI 114][MPI 54][MPI 52][MPI 53]

SYSTEM NO. 18			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
As specified for each type of surface	[MPI 46][MPI 50]	[MPI 48][MPI 47][MPI 51][MPI 49]	[MPI 48][MPI 47][MPI 51][MPI 49]

SYSTEM NO. 21		
Items or surfaces to be coated:	[_____]	
SURFACE PREPARATION	1st & 2nd COAT	3rd COAT
As specified for each type of surface	MIL-DTL-24441, Sheet [_____], Color No. [_____]	as needed to obtain specified thickness

SYSTEM NO. 21-A-Z			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st & 2nd COAT	3rd & 4th COAT	5th COAT
As specified for each type of surface	MIL-DTL-24441/19C	MIL-DTL-24441, Sheet [_____], Color No. [_____]	as needed to obtain specified thickness

SYSTEM NO. 22	
Items or surfaces to be coated:	[_____]
SURFACE PREPARATION	COATING SYSTEM
As specified by manufacturer	MPI 212

SYSTEM NO. 23-A-Z			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
White metal blast cleaning	SSPC Paint 40 Type II	SSPC Paint 41	SSPC Paint 38 Finish color: [_____]

SYSTEM NO. 23-B-Z			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
White metal blast cleaning	SSPC Paint 40 Type II	SSPC Paint 41 with coal tar pitch	SSPC Paint 41 with coal tar pitch

SYSTEM NO. 23-C-Z			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Commercial blast cleaning	SSPC Paint 40 Type II	MIL-PRF-85285 Type IV Finish color: [_____]	MIL-PRF-85285 Type IV Finish color: [_____] as necessary for complete hiding

SYSTEM NO. 23-D Alternate 1			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Power tool clean and power wash	SSPC Paint 41	SSPC Paint 41 Finish color: [_____]	SSPC Paint 41 Finish color: [_____]

SYSTEM NO. 23-D Alternate 2			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Power tool clean	SSPC Paint 41	SSPC Paint 41 Finish color: [_____]	SSPC Paint 41 Finish color: [_____]

SYSTEM NO. 23-D Alternate 3			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
SSPC SP 16	SSPC Paint 41	SSPC Paint 41 Finish color: [_____]	SSPC Paint 41 Finish color: [_____]

SYSTEM NO. 23-E		
Items or surfaces to be coated:	[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT
Alternate 1: Power tool clean	SSPC Paint 41	SSPC Paint 41 Finish color: [_____]
Alternate 2: Brush-off clean	SSPC Paint 41	SSPC Paint 41 Finish color: [_____]

SYSTEM NO. 23-F-Z			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Commercial blast cleaning	SSPC Paint 40 Type II	SSPC Paint 41 with Aluminum	SSPC Paint 41 with Aluminum

-- End of Section --