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USACE / NAVFAC / AFCESA / NASA **UFGS-09 97 02 (November 2009)**

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

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2012
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SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 97 02

PAINTING: HYDRAULIC STRUCTURES

11/09

PART 1 GENERAL

1.1 LUMP SUM PRICE
1.1.1 Painting: Hydraulic Structures
1.1.1.1 Payment
1.1.1.2 Unit of Measure
1.2 REFERENCES
1.3 SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS
1.3.1 Safety
1.3.1.1 Abrasive Blasting
1.3.1.2 Workers Other Than Blasters
1.3.1.3 Cleaning Before and After Abrasive Blasting
1.3.1.4 Pretreatment of Metals and Concrete with Acids
1.3.1.5 Paint Mixing
1.3.1.6 Confined Spaces
1.3.1.7 Paint Spraying
1.3.1.8 Explosion Proof Equipment
1.3.1.9 Further Precautions
1.3.1.10 Ignition Sources
1.3.2 Health
1.3.2.1 Air Monitoring
1.3.2.2 Medical Status
1.3.2.3 Change in Medical Status
1.3.3 Environmental Protection
1.3.3.1 Waste Classification, Handling, and Disposal
1.3.3.2 Containment
1.3.3.3 Visible Emissions Monitoring
1.3.3.4 PM-10 Monitoring
1.3.3.5 TSP Monitoring
1.3.3.6 Water Quality
1.3.3.7 Soil Quality
1.4 SUBMITTALS
1.5 QUALIFICATIONS
1.5.1 Certified Environmental, Health, and Safety Professionals
1.5.2 Certified Lead Laboratory
1.5.3 Qualified Painting Contractor

1.5.4 Qualified Hazardous Paint Removal Contractor
1.5.5 Qualified Paint Applicator
1.5.5.1 Test Plate
1.5.5.2 Certification Test Procedure
1.5.5.3 Certification Criteria
1.5.6 Coating Thickness Gage Qualification
1.6 DELIVERY, STORAGE, AND HANDLING
1.7 AMBIENT CONDITIONS

PART 2 PRODUCTS

2.1 SPECIAL PAINT FORMULAS
2.2 PAINT FORMULATIONS
2.2.1 Formula V-102e
2.2.2 Formula V-106d
2.2.3 Formula V-766e
2.2.4 Formula V-103C
2.2.5 Formula VZ-108d
2.2.6 Formula C-200a, Coal Tar-Epoxy (Black) Paint
2.3 INGREDIENTS FOR SPECIAL PAINT FORMULAS
2.3.1 Pigments and Suspending Agents
2.3.1.1 Aluminum Powder
2.3.1.2 Carbon Black
2.3.1.3 Zinc Dust
2.3.1.4 Iron Oxide
2.3.1.5 Titanium Dioxide
2.3.1.6 Suspending Agent E
2.3.1.7 Suspending Agent F
2.3.2 Resins, Plasticizer, and Catalyst
2.3.2.1 Plasticizer
2.3.2.2 Vinyl Resin, Type 3
2.3.2.3 Vinyl Resin, Type 4
2.3.2.4 Ortho-phosphoric Acid
2.3.3 Solvent and Thinners
2.3.3.1 Methanol
2.3.3.2 Methyl Ethyl Ketone
2.3.3.3 Methyl Isobutyl Ketone
2.3.3.4 Methyl Isoamyl Ketone
2.3.3.5 Toluene
2.3.4 Silane B
2.3.5 Propylene Oxide
2.4 TESTING
2.4.1 Chromatographic Analysis
2.4.2 Vinyl Paints

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED
3.1.1 General Requirements
3.1.2 Ferrous Surfaces Subject to Atmospheric Exposures
3.1.2.1 Coated Ferrous Surfaces Subject to Atmospheric Exposures
3.1.3 Ferrous Surfaces Subject to Severe Exposure
3.1.4 Damp and Wet Ferrous Metal Surfaces
3.1.5 Non-Ferrous Metal Surfaces
3.1.6 Concrete Surfaces
3.1.7 Plaster Surfaces
3.2 PAINT APPLICATION
3.2.1 General
3.2.2 Mixing and Thinning

3.2.3 Time Between Surface Preparation and Painting
3.2.4 Method of Paint Application
3.2.5 Coverage and Film Thickness
3.2.5.1 Measurement on Ferrous Metal
3.2.5.2 Measurements on Nonferrous Metal
3.2.6 Progress of Painting Work
3.2.7 Contacting Surfaces
3.2.8 Drying Time Prior to Immersion
3.2.9 Protection of Painted Surfaces
3.2.10 Vinyl Paints
3.2.10.1 General
3.2.10.2 Vinyl Zinc-Rich Primer
3.2.10.3 Vinyl Paints
3.2.11 Coal Tar-Epoxy (Black) Paint (Formula C-200a)
3.2.11.1 Mixing
3.2.11.2 Application
3.2.11.3 Subsequent Coats
3.2.11.4 Ambient Temperature
3.2.11.5 Safety
3.3 PAINT SYSTEMS APPLICATION
3.3.1 Fabricated and Assembled Items
3.3.2 Surface Preparation
3.3.3 System No. 1
3.3.4 System No. 3
3.3.5 System No. 3-A-Z
3.3.6 System No. 4
3.3.7 System No. 5-A-Z
3.3.8 System No. 5-C-Z
3.3.9 System No. 5-D
3.3.10 System No. 5-E-Z
3.3.11 System No. 6
3.3.12 System No. 6-A-Z
3.3.13 System No. 7
3.3.14 System No. 8
3.3.15 System No. 10
3.3.16 System No. 12
3.3.17 System No. 17
3.3.18 System No. 18
3.3.19 System No. 21
3.3.20 System No. 21-A-Z
3.3.21 System No. 22
3.3.22 System No. 23-A-Z
3.3.23 System No. 23-B-Z
3.3.24 System No. 23-C-Z
3.3.25 System No. 23-D
3.3.26 System No. 23-E
3.3.27 Protection of Nonpainted Items and Cleanup
3.4 INSPECTION
3.5 PAINTING SCHEDULES

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCESA / NASA | **UFGS-09 97 02 (November 2009)**

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

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SECTION 09 97 02

PAINTING: HYDRAULIC STRUCTURES
11/09

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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 items(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 22 00.00 10 MEASUREMENT AND PAYMENT 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 22 00.00 10.
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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 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 D1045	(2008) Sampling and Testing Plasticizers Used in Plastics
ASTM D1152	(2006) Methanol (Methyl Alcohol)
ASTM D1153	(2006) Methyl Isobutyl Ketone
ASTM D1200	(2010) Viscosity by Ford Viscosity Cup
ASTM D1210	(2005; R 2010) Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
ASTM D153	(1984; R 2008) Specific Gravity of Pigments
ASTM D235	(2002; R 2007) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

ASTM D281	(1995; R 2007) Oil Absorption of Pigments by Spatula Rub-Out
ASTM D2917	(2007) Methyl Isoamyl Ketone
ASTM D3465	(2000; R 2007e1) Standard Test Method for Purity of Monmeric Plasticizers by Gas Chromatography
ASTM D3721	(2005; R 2011) Synthetic Red Iron Oxide Pigment
ASTM D4417	(2003) Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM D561	(1982; R 2008) Carbon Black Pigment for Paint
ASTM D7091	(2005) 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 D740	(2011) Methyl Ethyl Ketone
ASTM D841	(2011) Nitration Grade Toluene
ASTM D962	(1981; R 2008e1) Aluminum Powder and Paste Pigments for Paints
ASTM E1347	(2006; R 2011) Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	(2009) American National Standard for Emergency Eyewash and Shower Equipment
ANSI/ISEA Z87.1	(2010) Occupational and Educational Personal Eye and Face Protection Devices

MASTER PAINTERS INSTITUTE (MPI)

MPI 114	(Oct 2009) Interior Latex, Gloss, MPI Gloss Level 6
MPI 212	(Oct 2009) Floor Coating, Thin Film, for Aircraft Maintenance Facilities
MPI 46	(Oct 2009) Interior Enamel Undercoat
MPI 47	(Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5

MPI 48	(Oct 2009) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	(Oct 2009) Interior Alkyd, Flat, MPI Gloss Level 1
MPI 50	(Oct 2009) Interior Latex Primer Sealer
MPI 51	(Oct 2009) Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	(Oct 2009) Interior Latex, MPI Gloss Level 3
MPI 53	(Oct 2009) Interior Latex, Flat, MPI Gloss Level 1
MPI 54	(Oct 2009) Interior Latex, Semi-Gloss, MPI Gloss Level 5

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

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

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 6	(2004) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
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	(2006) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC Paint 20	(2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC Paint 27	(1982; E 2004) Basic Zinc Chromate-Vinyl Butyral Wash Primer
SSPC Paint 33	(2006) Coal Tar Mastic, Cold-Applied
SSPC Paint 36	(2006) Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based

SSPC Paint 38	(2006) Single-Component Moisture-Cure Weatherable Aliphatic Polyurethane Topcoat, Performance-Based
SSPC Paint 40	(2007) 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	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC QP 2	(2009) Standard Procedure for the Qualification of Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 3	(1982; E 2004) 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 7/NACE No.4	(2007) Brush-Off Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441	(2009; Rev D) Paint, Epoxy-Polyamide, General Specification for

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-3130	(Rev A) Paint (For Application to Wet Surfaces)
FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

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

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.146	Permit-required Confined Spaces

29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1910.94	Ventilation
29 CFR 1926.62	Lead
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
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 50.12	National Primary and Secondary Ambient Air Quality Standards for Lead
40 CFR 50.6	National Primary and Secondary Ambient Air Quality Standards for PM10
40 CFR 58	Ambient Air Quality Surveillance
40 CFR 60	Standards of Performance for New Stationary Sources
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 shall apply. This paragraph supplements the health, safety, and environmental requirements of EM 385-1-1.

1.3.1 Safety

Submit a Safety 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.H 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. Hose lengths shall be joined together by approved couplings of a material and type designed to prevent erosion and weakening of the couplings. The couplings and nozzle attachments shall fit on the outside of the hose and 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, by utilizing MSHA/NIOSH-approved half-face or full-face air purifying respirators equipped with high-efficiency particulate air (HEPA) filters, eye protection meeting or exceeding ANSI/ISEA Z87.1 and 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. Personal protective equipment shall be provided 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 shall be in accordance with Section 20.B.5 of EM 385-1-1 and personnel shall be 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 shall be in accordance with 29 CFR 1910.94, paragraph (c)(5).

1.3.1.4 Pretreatment of Metals and Concrete with Acids

Personnel shall 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

Local exhaust ventilation shall be provided in the area where coatings are mixed. This ventilation system shall be capable of providing at least 100 linear fpm of capture velocity in the mixing zone. Exposure of skin and eyes shall be avoided by wearing appropriate chemically resistant gloves, apron, safety goggles, and face shields meeting or exceeding the requirements of ANSI/ISEA Z87.1. A combination unit, comprised of an eyewash and deluge shower, within close proximity to the mixing operation shall be provided in accordance with ANSI/ISEA Z358.1, paragraph (9). Individuals who have a history of, or develop a sensitivity to epoxy or polyurethane resin systems, shall 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. Means of egress shall not be blocked. 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. The effectiveness of the ventilation shall be checked by using ventilation smoke tubes and making frequent oxygen and combustible gas readings during painting operations. Exhaust ducts shall 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 6I. The procedures shall include:

a. Certificates of calibration for all testing and monitoring equipment. The certificates of calibration shall 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. Work practices and other engineering controls designed to reduce airborne hazardous chemical exposures to a minimum.

d. Specification of the design and installation of ventilation systems which shall provide adequate oxygen content and provide for the dilution of paint solvent vapor, lead, and other toxic particulates within the confined space. In addition, 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 Section 05.E of EM 385-1-1. During all spray painting operations, spray painters shall use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations that are compatible with air-purifying respirator Assigned Protection Factor (APF). Persons with facial hair that interferes with the sealing surface of the facepiece to face seal or interferes with respirator valve function shall not be allowed to perform work requiring respiratory protection. Air-purifying chemical cartridge/canister half- or full-facepiece 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 cleaning (using solvents). 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, shall be used.

1.3.1.8 Explosion Proof Equipment

Electrical wiring, lights, and other equipment located in the paint spraying area shall 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, shall not spark and shall conform to the provisions for Class I, Division 2, Group D, hazardous locations. Electric motors used to drive exhaust fans shall not be placed inside spraying areas or ducts. Fan blades and portable air ducts shall be constructed of nonferrous materials. Motors and associated control equipment shall be properly maintained and grounded. The metallic parts of air-moving devices, spray guns, connecting tubing, and duct work shall be electrically bonded and the bonded assembly shall be grounded.

1.3.1.9 Further Precautions

a. Workers shall wear nonsparking safety shoes.

b. Place and ground solvent drums, taken into the spraying area, on nonferrous surfaces. 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. Cables shall be further inspected to 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, to include lighted cigarettes, cigars, pipes, matches, or cigarette lighters shall be prohibited in area 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.
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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 shall 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. Reports shall be submitted 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), to 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 Medical Status Report including records of medical tests. Medically evaluate all Contractor 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. Maintain medical records as required by 29 CFR 1910.20. The evaluation shall 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 90 dBA.

b. Vision screening (employees who use full-facepiece respirators shall not wear contact lenses).

c. Medical evaluation shall include, but shall not be 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, and Physician's statements for individual employees that medical status would permit specific task performance.

****
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.
****

(5) For lead-based paint removal, the medical requirements of 29 CFR 1926.62 shall also be included. Prepare and submit a Worker Protection Plan in accordance with the requirements of 29 CFR 1926.62, addressing all necessary aspects of worker protection and including 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 shall 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. Submit a Change in Medical Status Report detailing any negative changes in employee medical status and the results of the physicians reevaluation statement.

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 20.00 10 ENVIRONMENTAL PROTECTION, 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 shall 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. Waste generated from abrasive blasting, lead-containing paints with recyclable steel or iron abrasives shall be disposed of as a hazardous waste or shall be stabilized with proprietary pre-blast additives regardless of the results of 40 CFR 261 App II, Mtd 1311. 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 shall be cause for immediate shutdown of the project until corrective action is taken. Store nonhazardous waste in closed containers separate from hazardous waste storage areas. All hazardous waste shall be transported by a licensed transporter in accordance with 40 CFR 263 and 49 CFR 171, Subchapter C. All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation. In addition to the number of copies required by 40 CFR 262.22, one copy of each Waste Manifest shall be supplied 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, including 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 shall 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 shall 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. In no case shall visible emissions extend greater than 45 m 150 feet in any direction horizontal from the containment. In no case shall visible emissions be observed in the area of any sensitive receptor. If such emissions occur the job shall be shut down immediately and corrective action taken. Notify the foreman whenever visible emissions exceed [40] [200] seconds in a 1 hour period. The foreman shall be notified and the job shall be shut down and corrective action taken whenever visible emissions exceed [75] [300] seconds in a 2 hour period. Total observed visible emissions from the containment shall not exceed [1] [5] percent of the work day. Shutdown and corrective action shall be taken to prevent such an occurrence. Document each time that the work is halted due to a violation of the visible emissions criteria. Documentation shall 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. A soon to be adopted order of magnitude reduction in the NAAQS for lead will result in an increased number of noncompliant air monitoring regions. This will likely spur the imposition of TSP-Pb air monitoring by a growing number of localities nationwide as these entities struggle to meet the new standard.

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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). The plan shall

comply with the requirements of EPA regulation 40 CFR 50.6 and this paragraph. The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur. The positioning of air monitoring equipment shall be in accordance with 40 CFR 58, App E, Subpart (8). In addition, a minimum of two PM-10 monitors shall be used at the project site, one down wind 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 shall be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, monitoring shall be performed 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. Failure to meet air quality regulatory limits shall require air monitoring to be repeated immediately after corrective actions have been taken. Also conduct preproject PM-10 monitoring. The preproject PM-10 monitoring shall be conducted a minimum of 2 weeks prior to the beginning of the project. The monitoring shall continue for a minimum of 3 days to establish background levels. A PM-10 Test Report shall be submitted to the Contracting Officer within 48 hours and shall include:

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). The plan shall comply with the requirements of EPA regulation 40 CFR 50.12 and this paragraph. The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur. The positioning of air monitoring equipment shall be in accordance with 40 CFR 58, App E, Subpart (8). In addition, use a minimum of two TSP monitors at the project site, one down wind from the project and one in the area of greatest public access (e.g. playground, school yard, or homeowner's yard). Conduct TSP-lead monitoring in accordance with 40 CFR 50, App B. When the project is in an area where

there are critical receptors nearby, monitoring shall be conducted throughout the entire period that abrasive blasting and cleanup operations are performed. Otherwise, monitoring shall be performed 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. Failure to meet air quality regulatory limits shall require air monitoring to be repeated immediately after corrective actions have been taken. Also conduct preproject TSP monitoring. The preproject TSP monitoring shall be conducted a minimum of 2 weeks prior to the beginning of the project. 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.
****

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 shall 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. In the event that there are any releases of lead paint debris into the waterways, with reportable quantities of hazardous substances designated pursuant to Section 311 of the Clean Water Act, they shall be reported to the EPA in accordance with 40 CFR 117 and 40 CFR 355. Releases or spills that carry into waterways or storm sewers shall be thoroughly documented. The documentation shall 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. Releases shall also be reported 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 shall 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 shall be 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. Soil sampling and testing shall be conducted 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 shall be selected for soil analysis. Two locations shall be selected beneath or immediately adjacent to the structure being prepared, and additional samples shall be taken 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 shall be sufficient to adequately characterize the soil contaminant levels within and around the project area. Five composite samples shall be collected at each location. Each of the five samples shall be comprised of five individual plugs of soil combined in a single bag. The composite samples at each location shall be collected using the following procedure:

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) shall be sampled in the precise locations.

Three samples collected at each location shall be analyzed. One of the remaining two samples shall be maintained by the Contractor for the duration of the project and the other by the Contracting Officer in the event reanalysis is required. Lead-containing samples shall be analyzed 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 will be employed to determine if the soil shall 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 would 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 shall 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. The documentation shall be provided to the Contracting Officer and shall also include 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 to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation 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][; G, [_____]]
Safety Plan[; G][; G, [_____]]
Confined Spaces Plan[; G][; G, [_____]]
Respiratory Protection Plan[; G][; G, [_____]]
Airborne Sampling Plan[; G][; G, [_____]]
Ventilation Assessment Plan[; G][; G, [_____]]
Medical Surveillance Plan[; G][; G, [_____]]
Worker Protection Plan[; G][; G, [_____]]
Environmental Protection Plan[; G][; G, [_____]]
Waste Manifest[; G][; G, [_____]]
Waste Disposal Plan[; G][; G, [_____]]
Containment Plan[; G][; G, [_____]]
Visible Emissions Monitoring Plan[; G][; G, [_____]]
PM-10 Monitoring Plan[; G][; G, [_____]]
TSP Monitoring Plan[; G][; G, [_____]]
Water Quality Plan[; G][; G, [_____]]
Soil Quality Plan[; G][; G, [_____]]

SD-03 Product Data

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

SD-04 Samples

Product Samples[; G][; G, [_____]]
Special Paint Formulas[; G][; G, [_____]]
Solvent and Thinners[; G][; G, [_____]]

SD-06 Test Reports

PM-10 Test Report[; G][; G, [_____]]
TSP Test Report[; G][; G, [_____]]

Soil Quality Test Report[; G][; G, [_____]]
Inspection Reports[; G][; G, [_____]]
Medical Status Report[; G][; G, [_____]]
Change in Medical Status Report[; G][; G, [_____]]
Air Monitoring Test Plan[; G][; G, [_____]]
Air Monitoring Test Report[; G][; G, [_____]]

SD-07 Certificates

Certified EHS Professional[; G][; G, [_____]]
Certified Lead Laboratory[; G][; G, [_____]]
SSPC QP 1 Certificate[; G][; G, [_____]]
SSPC QP 2 Certificate[; G][; G, [_____]]
Qualified Hazardous Paint Removal Contractor[; G][; G, [_____]]
Coating Thickness Gage Qualification[; G][; G, [_____]]
Qualified Paint Applicator[; G][; G, [_____]]

1.5 QUALIFICATIONS

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NOTE: Some districts, having experienced poor paint performance due to poorly qualified Contractors or inexperienced painters, are adding precertification requirements to their painting contracts. Contractor certification can simply require industry certification such as by SSPC: THE SOCIETY FOR PROTECTIVE COATINGS (SSPC-QP1, QP2, or QP3), or by drafting requirements similar to those used by industry. At this time there are no industry certification programs for painters but procedures have been developed by some districts. Developing specific prequalification requirements places a burden on the district to have the technical resources to properly evaluate the submitted or demonstrated capabilities. 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.
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Qualifications and experience shall comply with the following.

1.5.1 Certified Environmental, Health, and Safety 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 Section 01 of EM 385-1-1 to develop the required safety and health submittal and to provide onsite safety and health services during the contract period. The person shall 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 shall have successfully completed an EPA or state accredited lead-based paint abatement Supervisor course specific to the work to be performed and shall 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 shall 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 shall 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 9,300 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 Qualification Procedure No. 1, Standard Procedure for Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures). There are a sufficient number of qualified Contractors available to provide adequate competition for most painting contracts that fall into these categories.
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Provide a certified SSPC QP 1 Painting Contractor. Submit a copy of the SSPC QP 1 Certificate.

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 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 No. 2, Standard Procedure for Evaluating The Qualifications of Painting Contractors To Remove Hazardous Paint. QP 2 provides four categories of qualification. Category A qualifies the Contractor for all types of lead paint removal. Categories B and D qualify the Contractor for power tool cleaning in Class 2P and 3P containments. Category C qualifies the Contractor for power tool cleaning in Class 1P, 2P, and 3P containments. The specifier should select the necessary qualification category. 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. There are a sufficient number of qualified Contractors available to provide adequate competition for most painting contracts of these types.

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Provide a certified SSPC QP 2 Painting Contractor. Provide a copy of the SSPC QP 2 Certificate.

1.5.5 Qualified Paint Applicator

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NOTE: The specifier should decide whether the work is of sufficient complexity or size that the use of Qualified Paint Applicators is warranted. In general, very large jobs of moderate complexity or small but very complex painting work should be performed by Qualified Paint Applicators. Very complex work includes steel structures that will be painted and exposed in immersion. Large jobs are work where more than 9,300 square m (100,000 square feet) will be painted. The Qualification program utilizes an independent third party auditing firm to evaluate and certify the painters. In 1999 the cost of qualifying a painter was approximately $1000.

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Submit records of qualification tests and third party certification for each Qualified Paint Applicator. Prior to the initiation of any work all paint applicators shall be tested and certified as meeting the requirements of the qualified paint applicator. Certification shall be administered by the government approved independent third party Test Agency. Applicators failing the certification test shall not be permitted to apply any paint on the project.

1.5.5.1 Test Plate

The test plate shall consist of a 1.8 by 1.8 m 6 by 6 feet steel plate with a 10 mm 3/8 inch minimum thickness. The test plate shall have at least six bolts, three with bolt heads exposed and three with threads exposed, a 300 mm 12-inch wide flange and a 150 mm 6-inch diameter pipe each 450 mm 18 inches long welded perpendicular to the test panel and a 150 mm 6-inch deep T-beam with sealed ends welded horizontal across the test panel one foot up from the bottom all within the area to be painted on one side. Bolts shall be 25 mm 1 inch minimum diameter.

1.5.5.2 Certification Test Procedure

Conduct certification testing of paint 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. In preparation, clean and prepare the test plates 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 shall be the Contractor supplied materials and shall be those previously tested and approved for use on the contract. Paints shall be applied as specified in the contract. The painter being tested shall mix and thin the paints to be used in the test and shall set up and adjust the application equipment for use. Each painter shall apply each of the types of paint comprising the specified system. The test plate shall be painted in a near vertical position.

1.5.5.3 Certification Criteria

Evaluate the paint applicator based on the conformance of the applied paint system to the requirements of the specifications. Deficiencies in the coatings, improper mixing or improper application methods are basis for failure. The Test Agency shall be the sole judge as to the acceptability of each paint applicator's performance.

1.5.6 Coating Thickness Gage Qualification

Submit Coating Thickness Gage Qualification documentation of manufacturer's certification for all coating thickness gages. Magnetic flux thickness gages as described in ASTM D7091 shall be used to make all coating thickness measurements on ferrous metal substrates. Eddy current thickness gages as described in ASTM D7091 shall be used to measure coating thickness on all nonferrous metal substrates. Gages shall have an accuracy of +/- 3 percent or better. Gages to be used on the job shall be certified by the manufacturer as meeting these requirements.

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, shall be packaged in standard containers not larger than 20 L 5 gal, with removable friction or lug-type covers. Containers for vinyl-type paints shall 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 shall 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 shall be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather shall be stored in ventilated, heated shelters. All paints shall be stored under cover from the elements and in locations free from sparks and flames.

1.7 AMBIENT CONDITIONS

Paint shall be applied only to surfaces that are above the dew point temperature and that are completely free of moisture as determined by sight and touch. Paint shall not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, the temperature of the surfaces to be painted and of air in contact therewith shall be not less than 9 degrees C 45 degrees F during paint application nor shall paint be applied 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 applying artificial heat, provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint shall 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

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NOTE: US Army Construction Engineering Research Laboratory provides paint testing services on a reimbursable basis. Testing costs vary based on the type of paint and range from $475 to $800 per paint sample and $100 per solvent sample. Samples may be submitted to US Army CERL, ATTN: Paint Laboratory, 2902 Newmark Drive, Champaign, IL 61822.

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Product Samples of each batch of thinner, solvent, and paint shall be submitted to the Government for testing. Submit Manufacturer's Product Data Sheet 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 or other written instructions for those products. Submit samples of all special paint formula, Military, Master Painter Institute, and SSPC paints and samples of solvents or thinners used to reduce the viscosity of the paint. Allow at least 30 days for sampling and testing of samples of paints and thinners. Sampling may be at the jobsite or source of supply. Notify the Contracting Officer when the paint and thinner are available for sampling. Sampling of each batch will be witnessed by the Contracting Officer unless otherwise specified or directed. Submit a 1 L 1-quart sample of paint and thinner for each batch proposed for use. The sample shall 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.

2.1 SPECIAL PAINT FORMULAS

Special paints shall have the composition as indicated in the formulas

listed herein. Where so specified, certain components of a paint formulation shall be packaged in separate containers for mixing on the job. If not specified or otherwise prescribed, the color shall be that naturally obtained from the required pigmentation.

2.2 PAINT FORMULATIONS

Special paint formulas shall comply with the following:

2.2.1 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
Diisodecyl Phthalate	3.1
Methyl Isobutyl Ketone	33.8
Toluene	36.6
Total	100.0

a. The paint shall be furnished with the aluminum pigment mixed into the vehicle.

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

2.2.2 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
Diisodecyl Phthalate	2.90
Methyl Isobutyl Ketone	31.00
Toluene	33.54

INGREDIENTS	PERCENT BY MASS
Propylene Oxide	0.06
Total	100.00

a. The pigment shall be dispersed 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. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods.

b. The viscosity of the paint shall be 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 shall reasonably approximate color 10076 of FED-STD-595, and light colored paint shall be readily distinguishable in the field from the dark. Furnish the two shades in the volume ratio designated by the purchaser.

2.2.3 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
Diisodecyl Phthalate	2.9
Methyl Isobutyl Ketone	32.0
Toluene	34.7
Ortho-Phosphoric Acid	0.2
Total	100.0

a. The dispersion of pigment shall be accomplished 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. The paint shall show the proper

proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods. The ortho-phosphoric acid shall be measured accurately and diluted with at least four parts of ketone to one part of acid and it shall be slowly incorporated into the finished paint with constant and thorough agitation.

b. The viscosity of the paint shall be between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup.

c. The white and gray paints shall be furnished in the volume ratio designated by the purchaser. The gray paint shall contain no pigments other than those specified. Enough carbon black shall be included to produce a dry paint film having a reflectance of 20-24 (ASTM E1347). The resulting gray color shall approximate color 26231 of FED-STD-595.

2.2.4 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
Diisodecyl Phthalate	3.4
Methyl Isobutyl Ketone	36.0
Toluene	39.1
Total	100.0

a. The carbon black shall be dispersed 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 shall 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 viscosity of the paint shall be between 60 and 90 seconds using ASTM D1200 and a No. 4 Ford cup. The paint shall show the proper proportions of specified materials when analyzed by chromatographic and/or spectrophotometric methods.

2.2.5 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

INGREDIENTS	PERCENT BY WEIGHT	KILOGRAMSPOUNDS	LITERSGALLONS
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
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	4.1	1.780.47
COMPONENT C			
Zinc Dust	100.0	550.0	35.669.42
		Total Volume	378.54100.00 (mixed paint)

a. The iron oxide and suspending agents shall be dispersed 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 shall not be permitted. The paint shall 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 adjustment are made in the additions of Type 3 resin and methyl isobutyl ketone. The finished product with zinc dust added shall produce a paint which has a red tone upon drying and a reflectance of not more than 16 (ASTM E1347).

b. VZ-108d paint shall be supplied as a kit. Each kit shall 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. The bottle of silane shall be placed on the zinc dust in the 4 L 1-gal pail. In addition to standard labeling requirements, each container of each component shall be properly identified as to component type and each container label of Component A shall 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. The mixed paint shall at some point be strained through a 30-60 mesh screen to prevent zinc dust slugs from reaching the spray gun nozzle. The paint shall be stirred continuously during application

at a rate that will prevent settling. If spraying is interrupted for longer than 15 minutes, the entire length of the hose shall be whipped vigorously to redisperse the zinc. If the spraying is to be interrupted for more than 1 hour, the hose shall be emptied 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.

2.2.6 Formula C-200a, Coal Tar-Epoxy (Black) Paint

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

2.3 INGREDIENTS FOR SPECIAL PAINT FORMULAS

The following ingredient materials and thinners apply only to those special paints whose formulas are shown above in detail.

2.3.1 Pigments and Suspending Agents

2.3.1.1 Aluminum Powder

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

2.3.1.2 Carbon Black

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

2.3.1.3 Zinc Dust

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

2.3.1.4 Iron Oxide

Iron oxide, (Dry) synthetic (red), shall conform to ASTM D3721. In addition, the pigment shall 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 shall have color approximating FED-STD-595 color 10076 (dark red paint), and shall show no evidence of incompatibility or reaction between pigment and other components after 6 months storage.

2.3.1.5 Titanium Dioxide

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

2.3.1.6 Suspending Agent E

Suspending Agent E shall be a light cream colored finely divided powder having a specific gravity of 2 to 2.3. It shall 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.

2.3.1.7 Suspending Agent F

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

2.3.2 Resins, Plasticizer, and Catalyst

2.3.2.1 Plasticizer

The plasticizer shall be either Di 2-propyl Heptyl Phthalate (DPHP) or Diisodecyl Phthalate (DIDP). DPHP shall have an ester content of not less than 99.5 percent (ASTM D3465), shall contain not more than 0.1 percent water, and shall have an acid number (ASTM D1045) of not more than 0.07.DIDP shall have a purity of not less than 99.0 percent, shall contain not more than 0.1 percent water, and shall have an acid number (ASTM D1045) of not more than 0.10.

2.3.2.2 Vinyl Resin, Type 3

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

2.3.2.3 Vinyl Resin, Type 4

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

2.3.2.4 Ortho-phosphoric Acid

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

2.3.3 Solvent and Thinners

2.3.3.1 Methanol

Methanol (methyl alcohol) shall conform to ASTM D1152.

2.3.3.2 Methyl Ethyl Ketone

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

2.3.3.3 Methyl Isobutyl Ketone

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

2.3.3.4 Methyl Isoamyl Ketone

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

2.3.3.5 Toluene

Toluene shall conform to ASTM D841.

2.3.4 Silane B

Silane B for Formula VZ-108d shall 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.

2.3.5 Propylene Oxide

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

2.4 TESTING

2.4.1 Chromatographic Analysis

Solvents in vinyl paints and thinners shall be 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 shall take cognizance of the degree of purity of the individual solvents as commercially produced for the paint industry.

2.4.2 Vinyl Paints

Vinyl paints shall be subject to the following adhesion test. When V-766 or V-106 formulations are tested, 125 to 175 microns 5 to 7 mils (dry) shall be spray applied to mild steel panels. The steel panels shall be essentially free of oil or other contaminants that may interfere with coating adhesion. The test panels shall be dry blast cleaned to a White Metal grade which shall be in compliance with SSPC SP 5/NACE No. 1. The surface shall 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, they shall be spray applied 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 shall 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 shall be top coated with a V-766 known to pass this test. In all cases, the complete system shall 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, the panel shall be dried in a vertical position for 16 hours at 50 degrees C 120 degrees F. After cooling for 1 hour, the panel shall be immersed in tap water at 30 to 32 degrees C 85 to 90 degrees F for 48 to 72 hours. Immediately upon removal, the panel shall be dried with soft cloth and examined for adhesion as follows: With a pocket knife or other suitable instrument, two parallel cuts at least 25 mm 1 inch long shall be made 6 to 10 mm 1/4 to 3/8 inch apart through the paint film to the steel surface. A third cut shall be

made perpendicular to and passing through the end of the first two. With the tip of the knife blade, the film shall be loosened 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, the free end of the paint film shall be grasped between the thumb and forefinger and pulled vertically in an attempt to remove the film as a strip from between the first two cuts. The strip of paint film shall be removed at a rate of approximately 2 mm 1/10 inch per second and shall be maintained 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 shall exhibit no 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. Solvent cleaning shall be accomplished 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. Machinery shall be protected against entry of blast abrasive and dust into working parts. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces, and surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum; paint damaged by welding operations shall be restored to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed shall 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 the preceding and 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. Experimental work has shown that the practice of purposely allowing steel to weather and rust is not desirable. Mill scale, if tight, is a better surface for receiving paint than a rusted surface that has been only superficially cleaned by methods short of high-grade blasting.

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 1 and 23-C-Z. Paint System 23-C-Z should only be specified in conjunction with SP 6.

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Ferrous surfaces that are to be continuously in exterior or interior atmospheric exposure and other surfaces as directed shall be cleaned by means of [power tools or by dry blasting to the brush-off grade] [dry blasting to a commercial grade]. Cleaning and priming shall be done in the shop unless otherwise directed or permitted. [Power tool cleaning shall conform to the requirements of SSPC SP 3. Brush-off blast cleaning shall conform to the requirements of SSPC SP 7/NACE No.4.] [Commercial blast cleaning shall conform to the requirements of SSPC SP 6/NACE No.3.] Welds and adjoining surfaces within a few inches (centimeters) thereof shall be cleaned 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, will be required unless the latter is carried out with thoroughness to remove all soluble alkaline deposits. Wetting of the surfaces during water-washing operations shall be limited to the weld area required to be treated, and such areas shall be 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 shall be removed with impact or grinding tools. All surfaces shall be primed as soon as practicable after cleaning and in all cases prior to contamination or deterioration of the prepared surfaces. To the greatest degree possible, steel surfaces shall be cleaned (and primed) 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 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.

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Coated ferrous surfaces to be overcoated shall be power tool cleaned 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 and loose paint. Power tool prepared surfaces shall be further cleaned by power washing using a rotating tip and pressures of 1500 to 5000 PSI. Water pressure shall be adjusted such that all chalk is removed without significantly eroding the existing coating. After drying, all surfaces shall be spot primed 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.

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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Ferrous surfaces subject to extended periods of immersion or as otherwise required shall be dry blast-cleaned to SSPC SP 5/NACE No. 1. The blast profile, unless otherwise specified, shall be 38 to 63 microns 1.5 to 2.5 mils as measured by ASTM D4417, Method C. Appropriate abrasive blast media shall be used to produce the desired surface profile and to give an angular anchor tooth pattern. If recycled blast media is used, an appropriate particle size distribution shall be maintained so that the specified profile is consistently obtained. Steel shot or other abrasives that do not produce an angular profile shall not be used. Weld spatter not dislodged by blasting shall be removed with impact or grinding tools and the areas reblasted prior to painting. Surfaces shall be dry at the time of blasting. Blast cleaning to SSPC SP 5/NACE No. 1 shall be done 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, all ferrous surfaces shall be cleaned of dust and abrasive particles by brush, vacuum cleaner, and/or blown down with clean, dry, compressed air, and given the first coat of paint. 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. The surfaces, if shop blasted, shall be shop coated with the first and second coats of the specified paint system except that moisture cure urethane and epoxy zinc-rich primed surfaces shall receive an extra single spray coat of the zinc primer at the time field painting is started, as specified in the paint system instructions. The shop coating shall be maintained in good condition by cleaning and touching up of areas damaged during the construction period. If pinpoint or general rusting appears, surfaces shall be reblasted and repainted at no added cost to the Government. Prior to the field application of subsequent coats, soiled areas of the shop coating shall be thoroughly cleaned and all welds or other unpainted or damaged areas shall 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 adherence of the coating in the severe application and exposure conditions involved.

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Ferrous surfaces that are wet with condensation or standing or running water, shall be blast-cleaned to SSPC SP 5/NACE No. 1. The blast profile, unless otherwise specified, shall be 38 to 76 microns 1.5 to 3.0 mils as measured by ASTM D4417, Method C. Appropriate abrasive blast media shall be used to produce the desired surface profile and to give an angular anchor tooth pattern. Steel grit or shot media shall not be used. Weld spatter not dislodged by blasting shall be removed with impact or grinding tools and the areas reblasted prior to painting. Surfaces shall be as dry as possible at the time of blasting. Immediately after cleaning and prior to the formation of extensive corrosion products, all ferrous surfaces blast cleaned to SSPC SP 5/NACE No. 1 shall be cleaned of residual abrasive particles, and given the first coat of paint. A slightly visible rust bloom shall be permitted on surfaces to be painted.

3.1.5 Non-Ferrous Metal Surfaces

Non-ferrous metal surfaces to be painted shall be abrasive blasted to roughen the surface and promote adhesion. Before blast cleaning surfaces, visible deposits of oil, grease, and other contaminants shall be removed in accordance with SP 1. The entire surface shall be abrasive blasted so as to produce a dense and uniform surface profile. The blasted surface shall exhibit a continuous pattern with no smooth areas. Clean, dry compressed air shall be used for abrasive blasting. Select an abrasive size and type based on the surface to be cleaned. The abrasive shall be dry and free of oil, grease, and other contaminants. Only non-metallic abrasives shall be used. An abrasive shall be selected that minimizes particle embedment in the surface. The blast cleaned metal surface shall have a minimum profile of 0.0025 mm 0.75 mils, when measured in accordance with ASTM D4417. Dust, dirt and loose residues shall be removed from blasted surfaces by brushing; blowing off with clean, dry air; or vacuuming. All surfaces shall be primed as soon as practicable after cleaning and in all cases prior to contamination or deterioration of the prepared surfaces.

3.1.6 Concrete Surfaces

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NOTE E: If painting of concrete is contemplated, the concrete section of the specifications should be checked to see that the surfaces will be free enough from voids, fins, and other defects to produce the desired appearance in the finished paint job. Sacking, fin removal, grinding, etc., have not herein been considered as a part of surface preparation of concrete for painting. Avoid curing compounds and steel troweling on concrete surfaces to be painted. Painting of concrete floors should be employed sparingly. For curing requirements of concrete before painting, see supplementary application instructions for paint systems No. 17

through 20. For additional information regarding inspection procedures prior to surface preparation, surface preparation, inspection and classification of prepared surfaces, and acceptance criteria of concrete surfaces prepared for painting the specifier is referred to Joint Surface Preparation Standard SSPC-SP 13 Surface Preparation of Concrete.

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New concrete surfaces, including concrete floors, shall be permitted to age for a minimum of 30 days prior to painting. Grease and oil removal shall be accomplished by solvent cleaning and/or detergent washing followed by rinsing. Loosely adherent materials such as dirt, dust, laitance, efflorescence, bleed water residues, or other foreign substances shall be removed by wire or fiber brushing, scrapers, light sandblasting, or other approved means. For interior walls and floors, sandblasting, unless otherwise specifically authorized, shall be restricted to the wet or vacuum type. Surface glaze, if present, shall be removed by light blasting or by scrubbing with a 5-percent solution of phosphoric acid. The texture of the surface after etching shall be roughly equivalent to the texture of an 80-120 grit sandpaper. If acid etching is used, the surface shall be thoroughly rinsed with clean water to remove all traces of the acid. Prior to painting, the concrete shall be dry. Adequate dryness shall be determined visually at the time of application by performing the following test. Tape 600 mm 2-foot squares of polyethylene to the surface at random locations. The test patches shall remain in place overnight. Coatings shall only be applied if there are no traces of moisture and surfaces are dry beneath the polyethylene the following day.

3.1.7 Plaster Surfaces

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NOTE F: Where necessary, applicable provisions from Section 09 90 00 PAINTS AND COATINGS may be included in project specifications to cover surface preparation and painting of items not covered by this guide specification.

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At the time of painting, plaster surfaces shall be thoroughly dry and clean and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with approved patching materials, properly keyed to the existing surfaces, and sand-papered smooth. Plaster shall be permitted to age a minimum of 30 days before painting.

3.2 PAINT APPLICATION

3.2.1 General

The finished coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Application of initial or subsequent coatings shall not commence until the Contracting Officer has verified that atmospheric conditions and the surfaces to be coated are satisfactory. Each paint coat shall be applied in a manner that will produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint. Spray equipment shall be equipped with

traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall 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. Airless-type equipment shall not be used for the application of vinyl paints.

3.2.2 Mixing and Thinning

Paints shall be thoroughly mixed, strained where necessary, and kept at a uniform composition and consistency during application. Dry-powder pigments specified to be added at the time of use shall, with the aid of powered stirrers, be incorporated into the vehicle or base paint 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 shall generally be limited to the addition of not more than 125 mL/L 1 pint per gal of the proper thinner; this general limitation shall not apply when more specific thinning instructions are provided. Paint that has been stored at low temperature, shall be brought up to at least 21 degrees C 70 degrees F before being mixed and thinned, and its temperature in the spray tank or other working container shall not fall below 15 degrees C 60 degrees F during the application. 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 shall not be used and shall be removed from the project site. Paint and thinner that is more than 1 year old shall be resampled and resubmitted for testing to determine its suitability for application. Moisture cure urethane paint shall be resampled and resubmitted for testing to determine its suitability for application whenever the paint is more than six months old as indicated by the date of manufacture on the container.

3.2.3 Time Between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting shall 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 shall be applied by brush, roller, or spray to ferrous and nonferrous metal surfaces. Special attention shall 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 shall be subject to the specific approval of the Contracting Officer. Paint on plaster, concrete, or other nonmetallic surfaces shall be applied by brush, roller, and/or spray.

3.2.5 Coverage and Film Thickness

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

color.

3.2.5.1 Measurement on Ferrous Metal

Where dry film thickness requirements are specified for coatings on ferrous surfaces, measurements shall be made with a gage qualified in accordance with paragraph Coating Thickness Gage Qualification. They shall be calibrated and used in accordance with ASTM D7091. Prior to each use the Base Metal Reading (BMR) shall be established for the gage as specified in the test method. Accuracy of the gage shall be verified using plastic shims as specified by the test method both prior to and following each set of measurements. Frequency of measurements shall be as recommended for field measurements by ASTM D7091, except that measurements shall be performed on all areas of the structure being coated. Thickness measurements shall be reported as the mean for each spot determination.

3.2.5.2 Measurements on Nonferrous Metal

Where dry film thickness requirements are specified for coatings on nonferrous surfaces, measurements shall be made with a gage qualified in accordance with paragraph Coating Thickness Gage Qualification. Gages shall be calibrated and used in accordance with ASTM D7091. Prior to each use the Base Metal Reading (BMR) shall be established for the gage as specified in the test method. Accuracy of the gage shall be verified using plastic shims as specified by the test method both prior to and following each set of measurements. Frequency of measurements shall be as recommended for field measurements by ASTM D7091, except that measurements shall be performed on all areas of the structure being coated. Thickness measurements shall be reported as the mean for each spot determination.

3.2.6 Progress of Painting Work

Where field painting on any type of surface has commenced, the complete painting operation, including priming and finishing coats, on that portion of the work shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating, and this period shall be modified as necessary to suit adverse weather conditions. Paint shall be 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 shall be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease, overspray, or foreign matter by means of airblast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, shall be brush-off blast cleaned and completely repainted as required. Undercoats of high gloss shall, if necessary for establishment of good adhesion, be scuff sanded, solvent wiped, or otherwise treated prior to application of a succeeding coat. Field coats on metal shall be applied after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.7 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 shall subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections shall 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 shall be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, shall not be painted.

3.2.8 Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion shall be: 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. Minimum drying periods shall be increased twofold if the drying temperature is below 18 degrees C 65 degrees F and/or if the immersion exposure involves considerable abrasion.

3.2.9 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures shall be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. All metalwork coated in the shop or field prior to final erection shall be stored 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, and damaged areas of paint on such metalwork shall be cleaned and touched up without delay. The first field coat of paint shall be applied within a reasonable period of time after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.2.10 Vinyl Paints

3.2.10.1 General

Vinyl paints shall be spray applied, except that areas inaccessible to spraying shall be brushed. All of the vinyl paints require thinning for spray application except the zinc-rich vinyl paint (Formula VZ 108d) which will normally require thinning only under certain weather conditions. Thinners for vinyl paints shall be as follows:

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

The amount of thinner shall be varied to provide a wet spray and avoid deposition of particles that are semidry when they strike the surface. Vinyl paints shall not be applied 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 spray coat of vinyl paint shall consist of a preliminary extra spray pass 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 shall consist 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 shall receive sprayed paint from every direction to ensure complete coverage of all faces. Pits, cracks, and crevices shall be filled with paint insofar as practicable, but in any event, all pit surfaces shall be thoroughly covered and all cracks and crevices shall be sealed off against the entrance of moisture. Fluid and atomization pressures shall be kept as low as practicable consistent with good spraying results. Unless otherwise specified, not more than 50 microns 2.0 mils, average dry film thickness, of vinyl paint shall be applied per double spray coat. 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 shall cause film defects such as sags, runs, air bubbles, air craters, or poor intercoat adhesion. Neither the prime coat nor any other coat shall be walked upon or be subjected to any other abrading action until it has hardened sufficiently to resist mechanical damage.

3.2.10.2 Vinyl Zinc-Rich Primer

Primer shall be field mixed combining components A, B, and C. Mixing shall be in accordance with label instructions. After mixing, the paint shall be kept covered at all times to avoid contamination and shall be applied within 8 days after it is mixed. 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 shall 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 shall 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 shall be whipped vigorously until any settled zinc is redispersed. Long periods of permitting the paint to remain stagnant in the hose shall be avoided by emptying the hoses whenever the painting operation is to be suspended for more than 1 hour. The material (paint) hoses shall be kept as short as practicable, preferably not more than 15 m 50 feet in length. Equipment used for spraying this zinc primer shall 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; no type of hot spray shall be used. An average dry film thickness of up to 63 microns 2.5 mils may be applied in one double-spray coat. Unless specifically authorized, not more than 8 days shall elapse after application of a VZ-108d zinc-rich coat before it receives a succeeding coat.

3.2.10.3 Vinyl Paints

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 shall 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.

3.2.11 Coal Tar-Epoxy (Black) Paint (Formula C-200a)

3.2.11.1 Mixing

Component B shall be added to previously stirred Component A and thoroughly mixed 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 will be 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. The mixed material shall be applied before unreasonable increases in viscosity take place.

3.2.11.2 Application

Spray guns shall be of the conventional type equipped with a fluid tip of approximately 2.3 mm 0.09 inch in diameter and external atomization, seven-hole air cap. Material shall be supplied to the spray gun from a bottom withdrawal pot or by means of a fluid pump; hose shall be 13 mm 1/2 inch in diameter. Atomization air pressure shall not be less than 551.6 kPa 80 psi. High-pressure airless spray equipment may be used only on broad, simply configured surfaces. Brush application shall be with a stiff-bristled tool 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-coat system. The paint shall flow together and provide a coherent, pinhole-free film. The direction of the spray passes (or finish strokes if brushed) of the second coat shall be at right angles to those of the first where practicable.

3.2.11.3 Subsequent Coats

Except at the high temperatures discussed later in this paragraph, the drying time between coal tar-epoxy coats shall 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 shall be shaded by overhead cover or the interval between coats shall be 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, the drying time between coats shall not exceed 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 of curing at normal temperatures, 10 hours at extreme conditions, or where the undercoat develops a heavy blush, it shall 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 sand, 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 solvents may be applied to the surface by fog spraying followed by wiping, but any puddles of solvent shall 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.

3.2.11.4 Ambient Temperature

Coal tar-epoxy paint shall not be applied when the receiving surface or the ambient air is below 10 degrees C 50 degrees F nor unless 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.

3.2.11.5 Safety

In addition to the safety provisions in paragraph SAFETY, HEALTH, AND ENVIRONMENT, other workmen as well as painters shall 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 shall 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 G: 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 shall be accomplished in accordance with detailed requirements previously described.

3.3.3 System No. 1

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NOTE H: This NOTE applies to System No. 1, 23-C-Z, and 23-D.

1. System Nos. 1, 23-C-Z, and 23-D 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. Systems No. 1 and 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 and 23-D provide an aluminum finish; System No. 23-D provides a wide choice of colors.

2. System No. 23-D is an easy to apply single component paint. It 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. 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.

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 performance.

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 shall have been tested and passed all the test requirements of SSPC PS 26.00. Application shall be by spray, brush or roller in accordance with the manufacturer's written instructions. Dry film thickness per coat shall be within plus or minus 20 percent of that recommended by the manufacturer. Application of the system in less than two coats shall not be accepted. The epoxy coating shall be mixed and thinned in accordance with the manufacturers written directions. Mixed coating material that has exceeded the manufacturers pot life shall not be applied. Materials that have been mixed for more than 8 hours or that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met.

3.3.4 System No. 3

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NOTE I: 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 is 450 g/L and for Impacted Immersion Coatings is 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 falls into a category called "miscellaneous metal parts". 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. 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, interior of water tanks except those subject to severe debris and ice action, and for surfaces subject to prolonged condensation. 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 and should 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 01.00 10 METALIZING: HYDRAULIC STRUCTURES, should be considered.

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 such as No. 2 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). Systems No. 1, 13, and 14 may also be used on aluminum surfaces where exposures are not as severe.

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Paint shall be spray applied to an average dry film thickness of a minimum of 150 microns 6.0 mils for the completed system and the thickness at any point shall not be less than 125 microns 5.0 mils. Approximately 75 microns 3.0 mils of the total dry film thickness shall be built up with Formula V-766e paint. The specified film thickness shall be attained in any event, and any additional coats needed to attain specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not 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 shall be applied at one time.

3.3.5 System No. 3-A-Z

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NOTE: See Note for System 3 above.

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Paint shall be spray applied to an average dry film thickness of a minimum of 165 microns 6.5 mils for the completed system, and the thickness at any point shall not be less than 138 microns 5.5 mils. The dry film thickness of the zinc-rich coat shall be approximately 63 microns 2.5 mils. Specified film thickness, including the prescribed total, shall be attained in any event, and any extra coats needed to attain specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not 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 shall be applied at one time.

3.3.6 System No. 4

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NOTE: See Note for System 3 above.

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Paint shall be spray applied to an average dry film thickness of a minimum of 190 microns 7.5 mils for the completed system, and the thickness at any point shall not be less than 150 microns 6.0 mils. The specified total film thickness shall be attained in any event, and additional coats needed to attain the specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that no 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 shall be applied at one time.

3.3.7 System No. 5-A-Z

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NOTE: See Note for System 3 above.
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Paint shall be spray applied to an average dry film thickness of a minimum of 165 microns 6.5 mils for the completed system and the thickness at any point shall not be less than 125 microns 5.0 mils. The approximate dry film thickness after application of the first and second double spray coats shall be 63 and 100 microns 2.5 and 4.0 mils, respectively. The specified film thickness shall be attained in any event, and any additional coats needed to attain specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not 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 shall be applied at one time.

3.3.8 System No. 5-C-Z

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NOTE: See Note for System 3 above.
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Paint shall be spray applied to an average dry film thickness of a minimum of 175 microns 7.0 mils for the completed system, and the thickness at any point shall not be less than 140 microns 5.5 mils. The dry film thickness of the zinc-rich coat shall be approximately 63 microns 2.5 mils. Specified film thickness, including the prescribed total, shall be attained in any event, and any extra coats needed to attain specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not 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 shall be applied at one time.

3.3.9 System No. 5-D

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NOTE: See Note for System 3 above.
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Paint shall be spray applied to an average dry film thickness of a minimum of 190 microns 7.5 mils for the completed system, and the thickness at any point shall not be less than 150 microns 6.0 mils. The specified total film thickness shall be attained in any event, and any additional coats needed to attain specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not more than 50 microns 2.0 mils (dry film thickness) per double spray coat nor more than 25 microns 1.0 mils per single spray pass of nonzinc paint shall be

applied at one time.

3.3.10 System No. 5-E-Z

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NOTE: See Note for System 3 above.
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Paint shall be spray applied to an average dry film thickness of a minimum of 175 microns 7.0 mils for the completed system, and the thickness at any point shall not be less than 140 microns 5.5 mils. The dry film thickness of the zinc-rich primer shall be approximately 63 microns 2.5 mils. The specified film thickness shall be attained in any event, and any extra coats needed to attain the specified thickness shall 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 an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that not 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 shall be applied at one time.

3.3.11 System No. 6

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

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: CECER-FM, 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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Paint shall be spray or brush applied with a minimum of two coats to provide a minimum total thickness at any point of 400 microns 16 mils. The specified film thickness shall be attained in any event, and any additional (beyond two) coats needed to attain specified thickness shall 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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Epoxy zinc-rich primer 19B shall be applied 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 point shall not be less than 63 microns 2.5 mils or greater 200 microns 8 mils for the primer. After a minimum drying period of 6 hours and no more than 96 hours, at least two coats of coal tar epoxy paint shall be applied to provide a minimum thickness at any point of 400 microns 16 mils for the completed system. 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 shall be abraded and recoated with an additional thin tack coat of the zinc-rich paint, which in turn shall be overcoated within 96 hours with the first coat of coal tar-epoxy paint. The specified film thicknesses shall be attained in any event, and any additional coats needed to attain specified thickness shall be applied at no additional cost to the Government.

3.3.13 System No. 7

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NOTE K: 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. 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 SP 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.

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A special primer shall be used under the coal tar-base paint only if/as recommended by the coating manufacturer. The materials shall 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 point for the completed system. The paint shall not be thinned unless recommended by the manufacturer. If brushed, the final strokes shall be at right angles to those of the preceding coat. Application and drying time between coats shall be as recommended by the coating manufacturer.

3.3.14 System No. 8

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NOTE L: The Commercial Item Description describes commercially available coating systems for application to wet and damp surfaces.

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The coating shall be mixed and applied in accordance with the manufacturer's written instructions. The coating shall 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 point shall 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 shall be by roller. Brush application shall be limited to inside corners, bolt heads and other surface irregularities that are difficult to coat by roller. Subsequent coats shall be applied in the shortest recommended recoat interval. The minimum manufacturer recommended ambient and surface temperatures shall be maintained during application and curing of the coating.

3.3.15 System No. 10

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NOTE M: 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 (e.g., CID A-A-3054) 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 01.00 10 METALIZING: HYDRAULIC STRUCTURES may be used. System No. 8-A will withstand temperatures up to 900 degrees C (1,650 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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Paint shall be applied according to manufacturers recommendations to a

minimum average dry film thickness of 125 microns 5 mils and the thickness at any point shall not be less than 100 microns 4.0 mils. The specified film thickness may be obtained in a single coat provided this is allowed by manufacturers 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 N: 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. FS RR-G-661 for floor grating contains galvanizing provisions. Many standard specifications covering metal items which are adaptable to it do not contain galvanizing provisions, and in such cases galvanizing must be specified separately.

4. 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.

5. 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.

6. 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.

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Galvanized surfaces shall be washed to expose damaged areas. Mars and breaks in the galvanized coating shall be hand or power tool cleaned to remove all corroded substrate. The damaged areas shall be touched up with two coats of SSPC Paint 20, Type II.

3.3.17 System No. 17

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NOTE O: 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, metal ductwork, conduit, pipe, radiators, grilles, louvers, pull boxes, and exposed surfaces of miscellaneous

embedded metalwork shall be finish painted the same as 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 the coat of MPI 50 shall be replaced with a coat of either SSPC Paint 25 or a coat of MPI 46.

c. Galvanized and other nonferrous metal surfaces shall be solvent cleaned in accordance with SSPC SP 1 and pretreated with SSPC Paint 27 in place of the MPI 50 coat.

3.3.18 System No. 18

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NOTE: See NOTE for System 17 above.
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Oil based alkyd paints shall be thinned using only odorless mineral spirits (ASTM D235). Except as otherwise required, metal ductwork, conduit, pipe, radiators, grilles, louvers, pull boxes, and exposed surfaces of miscellaneous embedded metalwork shall be finished 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. All bare ferrous surfaces shall be primed with either MPI 46 or SSPC Paint 25.

c. Galvanized and other nonferrous metal surfaces shall be cleaned in accordance with SSPC SP 1 and pretreated with SSPC Paint 27 in place of MPI 46 or MPI 50.

3.3.19 System No. 21

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NOTE P: 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-24441/19B through MIL-DTL-24441/40A. 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 19B 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 29A should be specified for aluminum substrates or steel surfaces that are not primed with zinc-rich primer 19B. 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 micrometers (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 No. 36, Level 3, 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.

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Paint shall be applied with a minimum of two single coats to produce an average dry film thickness totaling 150 microns 6.0 mils. When applying MIL-DTL-24441, the type of thinner, amount of thinning, and required induction time shall be as recommended by the manufacturer. The drying time between coats shall not be less than 8 hours nor more than 96 hours.

3.3.20 System No. 21-A-Z

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NOTE: See NOTE in preceding paragraph.

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The epoxy zinc-rich paint 19B shall be applied in two singles half-lapped spray coats to an average dry film thickness of a minimum of 100 microns 4.0 mils, and a thickness at any point of not less than 63 microns 2.5 mils or greater than 200 microns 8.0 mils. After a drying period of not less than 6 hours nor more than 96 hours, at least two coats of epoxy polyamide paint shall be applied to produce an average dry film thickness totaling 305 microns 12 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 shall be abraded and recoated with an additional thin tack coat of the zinc-rich paint, which in turn shall be overcoated within 96 hours with the first coat of the epoxy polyamide paint. When applying MIL-DTL-24441, the type of thinner, amount of thinning, and required induction time shall be as recommended by the manufacturer. The drying time between non-zinc coats shall not be less than 12 hours nor more than 96 hours.

3.3.21 System No. 22

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NOTE Q: 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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The floor coating system MPI 212 shall be applied according to the manufacturer's written instructions. It shall be a multi-coat system. The dry film thickness per coat shall be that recommended by the manufacturer.

3.3.22 System No. 23-A-Z

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NOTE R:

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 FED-STD-595. Red topcoat should approximate FED-STD-595 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.

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The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all requirements of the applicable SSPC standards. SSPC Paint 38 topcoat shall meet the requirements of Accelerated Weathering Level 3. Application shall be 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. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.23 System No. 23-B-Z

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NOTE S:

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.

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.

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The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standards. SSPC Paint 41 shall be modified with coal tar pitch. Application shall be 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. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.24 System No. 23-C-Z

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NOTE T: 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 second coat and third coat are a two-component aliphatic

polyurethane conforming to SSPC Paint 36. 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. In addition to the excellent corrosion resistance afforded by the coating system it also will provide a very high degree of resistance to UV-induced color change, dulling, and chalking, making it an excellent choice for highly visible items such as handrails. The specifier must select a finish coat color. Finish coats are available in a variety of colors as well as aluminum. When pigmented with aluminum the usefulness of this system overlaps with System No. 1, a two-coat aluminum epoxy system. However, System No. 23-C-Z is superior to System No. 1 when both are applied to a commercial blast cleaned surface. System No. 23-C-Z is more expensive than System No. 1.

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The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standards. SSPC Paint 36 shall be qualified to Accelerated Weathering Level 3. Application shall be 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. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.25 System No. 23-D

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NOTE U:

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 both be aluminum or a color such as grey. The choice of aluminum or color finish is the specifier's option.

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 a brush-off or sweep blast technique. A standard for this type of surface preparation is currently under development in SSPC. The specifier should check to see if the standard has been completed, and if so it should be incorporated into this document, replacing the existing descriptive language. 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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The coating system shall be applied according to the manufacturer's written instructions. It shall be a 3-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standards. [The first coat of the overcoat system shall be applied by brush or roller to those areas where power tool cleaning exposed the steel substrate. The second coat of the overcoat system shall 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 shall be applied to the entire surface by spray, brush, or roller.] [Application shall be by spray. Limited use of brush and roller application is permitted provided the specified film thicknesses are achieved.] [Application shall be by spray, brush, or roller.] Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than three coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.26 System No. 23-E

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NOTE V: 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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The coating system shall be applied according to the manufacturer's written instructions. It shall be a two-coat system. All materials shall be procured from the same coating manufacturer. The individual paints comprising the system shall have been tested and passed all the requirements of the applicable SSPC standard. Application shall be by spray, brush, or roller in accordance with the manufacturer's written instructions. Dry film thickness per coat shall be that recommended by the manufacturer. Application of the system in less than two coats shall not be accepted. The coatings shall be mixed and thinned in accordance with the manufacturers written directions. Coating material that has exceeded the manufacturer's pot life shall not be applied. Materials that have thickened appreciably shall not be applied. The manufacturer's recommendations for minimum and maximum dry time between coats shall be met. Areas of bubbling noted upon curing of any individual coat shall be removed by sanding or screening. The edges of the repaired areas shall be feathered and the coat reapplied to the repaired areas before a subsequent coat is applied.

3.3.27 Protection of Nonpainted Items and Cleanup

Walls, equipment, fixtures and all other items in the vicinity of the surfaces being painted shall be maintained free from damage by paint or painting activities. Paint spillage and painting activity damage shall be promptly repaired.

3.4 INSPECTION

Inspect and document all work phases and operations on a daily basis. Submit daily Inspection Reports. As a minimum the daily report shall 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 W: 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 shall be designated by making use of FED-STD-595 color designations. When a proprietary or SSPC paint is specified, colors can be specified as approximating those not necessarily as matching the FED-ST-595 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.

b. Prolonged condensation, high humidity, coastal structures not subject to immersion, System No. 23-C-Z.

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 01.00 10 METALLIZING: HYDRAULIC STRUCTURES.

f. Immersion in sea water or other extremely corrosive waters - System No. 6-A-Z or 21-A-Z.

g. Immersion in fresh water where protection from zebra mussel fouling is deemed critical - System No. 6-Z-A of Section 09 97 01.00 10 METALLIZING: 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	I8, O3, P1, U4
Battery Rooms	C7, P2
Bridges	H1, I1
Concrete	
Exposed to chemicals or sewage	J5, P2
Interior	C1, C4
Floors	P2
Copper	U4
Dewatering and drainage sumps	J1, K1, K2
Doors, wood or steel	C4, C5
Flooded compartments	J1
Floor grating	N2, N3
Galvanized materials	H2, U4
Galvanized Interior:	
High condensation	U4
Nonexposed	H2, N2
Gantries	H1

GENERAL INDEX: (Substrate/Environment)	Refer to Note No.
Gates	I1,I2,I3,I4,I5,I6,J4,K1,K3,P4,P8
Gate wells	K1
Light standards	H1
Local protection projects	K1, K2
Painted Steel	B, U2
Penstocks	H4, J1
Piling, steel	J3, J4
Pipe and conduit	H1,H2,I4,J2,N4,U4
Pumps and machinery	H1,K1,K2,K3
Spiral (turbine) case	I4, J1
Stairwells	C4
Steel:	
Corrosive	I3, J1, N5
Damp or wet	L
Freshwater immersion:	
Low velocity	I3, J1
Med high velocity and/or high abrasion	I4
Intermittent immersion	I2, J1, P5, T
Zebra mussel	W3
High condensation	D,G,H4,I1,I3,M1,U4
High temperature	M1, M2
Normal exposure	A, G, P8
Salt water immersion	A, S
Severe industrial	H4, J1, N4, U4
Tidal splash zones	I2, J4, P4

GENERAL INDEX: (Substrate/Environment)	Refer to Note No.
Stop logs	I3
Structural framework	V1
Surge chambers	I4, K1
Tanks:	
Exterior	H1, J2
Interior	I3, I4
Trash rack	I4
Valves	I1, I4, I5
Walls (High-maintenance areas)	C4
Wall protection, corner	H1
Window frames	C4

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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 VZZ-108d (double spray coat)	White Vinyl V-766e (double spray coat)	Aluminum Vinyl V-102e (double spray coat)	Aluminum Vinyl V-102e (as needed to obtain the required thickness)

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 VZZ-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 VZZ-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)

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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 VZZ-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-24441/19B	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

SYSTEM NO. 7			
Items or surfaces to be coated:		[_____]	
SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Alternate 2: SSPC SP 6/NACE No. 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
SSPC SP 5/NACE No. 1	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-24441/19B	MIL-DTL-24441, Sheet [_____], Color No. [_____]	as needed to obtain specified thickness

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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	SSPC Paint 36 Finish color: [_____]	SSPC Paint 36 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
Non-ferrous brush blast	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
Alternat 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: [_____]

-- End of Section --