

\*\*\*\*\*  
USACE / NAVFAC / AFCEA / NASA UFGS-09 97 02 (April 2006)  
-----  
Preparing Activity: USACE (CW) Replacing without change  
UFGS-09964 (August 2004)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009

\*\*\*\*\*

### SECTION TABLE OF CONTENTS

#### DIVISION 09 - FINISHES

#### SECTION 09 97 02

#### PAINTING: HYDRAULIC STRUCTURES

04/06

#### PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 LUMP SUM PRICE
  - 1.2.1 Painting: Hydraulic Structures
    - 1.2.1.1 Payment
    - 1.2.1.2 Unit of Measure
- 1.3 SUBMITTALS
- 1.4 QUALIFICATIONS
  - 1.4.1 Certified Professional
  - 1.4.2 Certified Laboratory
  - 1.4.3 Qualified Painting Contractor
  - 1.4.4 Qualified Hazardous Paint Removal Contractor
  - 1.4.5 Qualified Paint Applicator
    - 1.4.5.1 Test Plate
    - 1.4.5.2 Certification Test Procedure
    - 1.4.5.3 Certification Criteria
  - 1.4.6 Coating Thickness Gage Qualification
- 1.5 SAMPLING AND TESTING
- 1.6 SAFETY AND HEALTH PROVISIONS
  - 1.6.1 Abrasive Blasting
    - 1.6.1.1 Hoses And Nozzles
    - 1.6.1.2 Workers Other Than Blasters
  - 1.6.2 Cleaning with Compressed Air
  - 1.6.3 Cleaning with Solvents
    - 1.6.3.1 Ventilation
    - 1.6.3.2 Personal Protective Equipment
  - 1.6.4 Pretreatment of Metals and Concrete with Acids
    - 1.6.4.1 Personal Protective Equipment
    - 1.6.4.2 Emergency Equipment
  - 1.6.5 Mixing Epoxy and Polyurethane Resin Formulations
    - 1.6.5.1 Exhaust Ventilation
    - 1.6.5.2 Personal Protective Equipment
    - 1.6.5.3 Medical Precautions
    - 1.6.5.4 Emergency Equipment
  - 1.6.6 Paint Application

- 1.6.6.1 Ventilation
- 1.6.6.2 Explosion Proof Equipment
- 1.6.6.3 Further Precautions
- 1.6.6.4 Ignition Sources
- 1.6.7 Health Protection
  - 1.6.7.1 Air Sampling
  - 1.6.7.2 Respirators
  - 1.6.7.3 Protective Clothing and Equipment
- 1.7 MEDICAL STATUS
- 1.8 CHANGE IN MEDICAL STATUS
- 1.9 ENVIRONMENTAL PROTECTION
  - 1.9.1 Waste Classification, Handling, and Disposal
  - 1.9.2 Containment
  - 1.9.3 Visible Emissions Monitoring
  - 1.9.4 Air Quality Monitoring
    - 1.9.4.1 PM-10 Monitoring
    - 1.9.4.2 TSP Monitoring
  - 1.9.5 Water Quality
  - 1.9.6 Soil Quality
- 1.10 PAINT PACKAGING, DELIVERY, AND STORAGE

## PART 2 PRODUCTS

- 2.1 SPECIAL PAINT FORMULAS
- 2.2 PAINT FORMULATIONS
  - 2.2.1 Formula V-102e, Vinyl-Type Ready-Mixed Aluminum Impacted Immersion Coating
  - 2.2.2 Formula V-106d, Vinyl-Type Red Oxide (Light or Dark Color) Impacted Immersion Coating
  - 2.2.3 Formula V-766e, Vinyl-Type White (or Gray) Impacted Immersion Coating
  - 2.2.4 Formula V-103C, Vinyl-Type Black-Finish Impacted Immersion Coating
  - 2.2.5 Formula VZ-108d, Vinyl-Type Zinc-Rich Impacted Immersion Coating
  - 2.2.6 Formula C-200a, Coal Tar-Epoxy (Black) Paint
  - 2.2.7 Formula P-38, Aluminum Phenolic Finish Coat
    - 2.2.7.1 Quantitative Requirements
    - 2.2.7.2 Water Resistance
- 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 Diisodecyl Phthalate
    - 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
  - 3.1.3 Ferrous Surfaces Subject to Severe Exposure
  - 3.1.4 Damp and Wet Ferrous Metal Surfaces
  - 3.1.5 Galvanized, Aluminum, Aluminum Alloy, or Copper 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 Atmospheric and Surface Conditions
  - 3.2.4 Time Between Surface Preparation and Painting
  - 3.2.5 Method of Paint Application
  - 3.2.6 Coverage and Film Thickness
    - 3.2.6.1 Measurement on Ferrous Metal
    - 3.2.6.2 Measurements on Nonferrous Metal
  - 3.2.7 Progress of Painting Work
  - 3.2.8 Contacting Surfaces
  - 3.2.9 Drying Time Prior to Immersion
  - 3.2.10 Protection of Painted Surfaces
  - 3.2.11 Vinyl Paints
    - 3.2.11.1 General
    - 3.2.11.2 Vinyl Zinc-Rich Primer
    - 3.2.11.3 Vinyl Paints
  - 3.2.12 Coal Tar-Epoxy (Black) Paint (Formula C-200a)
    - 3.2.12.1 Mixing
    - 3.2.12.2 Application
    - 3.2.12.3 Subsequent Coats
    - 3.2.12.4 Ambient Temperature
    - 3.2.12.5 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. 2
  - 3.3.5 System No. 3
  - 3.3.6 System No. 3-A-Z
  - 3.3.7 System No. 4
  - 3.3.8 System No. 5-A-Z
  - 3.3.9 System No. 5-C-Z
  - 3.3.10 System No. 5-D
  - 3.3.11 System No. 5-E-Z
  - 3.3.12 System No. 6
  - 3.3.13 System No. 6-A-Z
  - 3.3.14 System No. 7
  - 3.3.15 System No. 8
  - 3.3.16 System No. 9
  - 3.3.17 System No. 10
  - 3.3.18 System No. 12
  - 3.3.19 System No. 13
  - 3.3.20 System No. 14

- 3.3.21 System No. 15
- 3.3.22 System No. 16
- 3.3.23 System No. 17
- 3.3.24 System No. 18
- 3.3.25 System No. 21
- 3.3.26 System No. 21-A-Z
- 3.3.27 System No. 22
- 3.3.28 Protection of Nonpainted Items and Cleanup
- 3.4 INSPECTION
- 3.5 PAINTING SCHEDULES

-- End of Section Table of Contents --

\*\*\*\*\*  
USACE / NAVFAC / AFCEA / NASA UFGS-09 97 02 (April 2006)  
-----  
Preparing Activity: USACE (CW) Replacing without change  
UFGS-09964 (August 2004)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009

\*\*\*\*\*

### SECTION 09 97 02

#### PAINTING: HYDRAULIC STRUCTURES 04/06

\*\*\*\*\*

NOTE: This guide specification covers the requirements for the preparation of surfaces and the application of paints for hydraulic structures and appurtenant items.

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 and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

This guide specification includes tailoring options for Lead Paint Removal, Containment, TSP Monitoring, PM-10 Monitoring, Visible Emissions Monitoring, Confined Space Work, QP-1 Qualified Painting Contractor, QP-2 Hazardous Paint Removal Contractor, Qualified Paint Applicator, Surface Prep - Atmospheric, Surface Prep - Immersion, Painting - Nonferrous Surfaces, Painting - Damp and Wet Surfaces, Painting - Concrete & Plaster Surfaces, Paints - Normal Atmospheric Service, Paints - Severe Atmospheric Service, Paint - P-38 Aluminum Finish, Paint - SSPC paint 20 Zinc Primer, Paint Cold Applied Coal Tar, Paint - Vinyl Zinc, Paint - Vinyl Gray and White, Paint - Vinyl Red, Paint - Vinyl Black, Paint - Vinyl Aluminum, Paint - Vinyl General Requirements, Paint - Epoxy Zinc, Paint - Epoxy Colors, Paint - Epoxy Coal Tar. Selection or

deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

\*\*\*\*\*

## PART 1 GENERAL

### 1.1 REFERENCES

\*\*\*\*\*

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.

\*\*\*\*\*

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.

#### AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE Z87.1 (2003) Standard for Occupational and Educational Eye and Face Protection

#### ASTM INTERNATIONAL (ASTM)

ASTM D 1045 (2008) Sampling and Testing Plasticizers Used in Plastics

ASTM D 1152 (2006) Methanol (Methyl Alcohol)

ASTM D 1153 (2006) Methyl Isobutyl Ketone

ASTM D 1200 (1994; R 2005) Viscosity by Ford Viscosity Cup

ASTM D 1210 (2005) Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage

ASTM D 1308 (2002; R 2007) Effect of Household Chemicals on Clear and Pigmented Organic Finishes

ASTM D 1475	(1998; R 2008) Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D 153	(1984; R 2008) Specific Gravity of Pigments
ASTM D 1640	(2003) Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
ASTM D 235	(2002; R 2008) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 2369	(2007) Volatile Content of Coatings
ASTM D 281	(1995; R 2007) Oil Absorption of Pigments by Spatula Rub-Out
ASTM D 2917	(2007) Methyl Isoamyl Ketone
ASTM D 304	(2005) n-Butyl Alcohol (Butanol)
ASTM D 3721	(2005) Synthetic Red Iron Oxide Pigment
ASTM D 4206	(1996; R 2007) Sustained Burning of Liquid Mixtures Using the Small Scale Open-Cup Apparatus
ASTM D 4417	(2003) Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D 520	(2000; R 2005) Zinc Dust Pigment
ASTM D 561	(1982; R 2008) Carbon Black Pigment for Paint
ASTM D 7091	(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 D 740	(2005) Methyl Ethyl Ketone
ASTM D 841	(2002e1; R 2008) Nitration Grade Toluene
ASTM D 962	(1981; R 2008e1) Aluminum Powder and Paste Pigments for Paints
ASTM E 1347	(2006) Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry

#### INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ISEA Z358.1	(2004) Emergency Eyewash and Shower Equipment
-------------	---

MASTER PAINTERS INSTITUTE (MPI)

MPI 114	(Jan 2004) Interior Latex, Gloss, MPI Gloss Level 6
MPI 46	(Jan 2004) Interior Enamel Undercoat
MPI 47	(Jan 2004) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 48	(Jan 2004) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	(Jan 2004) Interior Alkyd, Flat, MPI Gloss Level 1
MPI 50	(Jan 2004) Interior Latex Primer Sealer
MPI 51	(Jan 2004) Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	(Jan 2004) Interior Latex, MPI Gloss Level 3
MPI 53	(Jan 2004) Interior Latex, Flat, MPI Gloss Level 1
MPI 54	(Jan 2004) Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 9	(Jan 2004) Exterior Alkyd, Gloss, MPI Gloss Level 6

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007; AMD 1 2008) National Electrical Code - 2008 Edition
---------	--

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 98-119	(1998; 4th Ed) Supplement 2 to NIOSH Manual of Analytical Methods
--------------	---

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 6	(2004) Guide for Containing 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) Paint Specification No. 16 Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC Paint 20	(2002; E 2004) Paint Specification No. 20 Zinc-Rich Coating Type I Inorganic and



Type II Organic

SSPC Paint 25	(1997; E 2004) Paint Specification No. 25 Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II
SSPC Paint 27	(1982; E 2004) Paint Specification No. 27 Basic Zinc Chromate-Vinyl Butyral Wash Primer
SSPC Paint 33	(2006) Paint Specification No. 33 Coal Tar Mastic, Cold-Applied
SSPC QP 1	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC QP 2	(2000; E 2004; E 2007) 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	(2004; E 2004) Power Tool Cleaning
SSPC SP 5	(2007) White Metal Blast Cleaning
SSPC SP 6	(7) Commercial Blast Cleaning
SSPC SP 7	(2007) Brush-Off Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008) Safety and Health Requirements Manual
------------	--

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441	(Rev C; Supp 1; INT Amd 1) Paint, Epoxy-Polyamide
---------------	---

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-3130	(Rev A) Paint (For Application to Wet Surfaces)
CID A-A-3132	(Basic) Coating System: Epoxy Primer/Urethane Topcoat for Minimally Prepared Atmospheric Steel
CID A-A-50542	(Rev A) Coating System: Reflective, Slip-Resistant, Chemical-Resistant Urethane for Maintenance Facility Floors
FED-STD-595	(Rev B; Am 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	Safety and Health Regulations for Construction
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

## 1.2 LUMP SUM PRICE

\*\*\*\*\*  
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.  
\*\*\*\*\*

### 1.2.1 Painting: Hydraulic Structures

#### 1.2.1.1 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.

#### 1.2.1.2 Unit of Measure

Unit of measure: lump sum.

## 1.3 SUBMITTALS

\*\*\*\*\*  
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. Submittals should be kept to the minimum required for adequate quality control.  
  
A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" 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.  
\*\*\*\*\*

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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

##### Safety and Health Provisions[; G][; G, [\_\_\_\_\_]]

An Accident Prevention Plan in accordance with the requirements of Section 01 of EM 385-1-1. The plan shall include, but is not limited to, each of the topic areas listed in Appendix A therein and the specified requirements; each topic shall be developed in a concise manner to include management and operational aspects.

##### Confined Spaces[; G][; G, [\_\_\_\_\_]]

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.

##### Respirators[; G][; G, [\_\_\_\_\_]]

A comprehensive written respiratory protection program in accordance with 29 CFR 1910.134, 29 CFR 1926.62, and Section 05.E of EM 385-1-1.

##### Certified Laboratory[; G][; G, [\_\_\_\_\_]]

An Airborne Sampling Plan detailing the NIOSH 98-119, 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.

##### Ventilation[; G][; G, [\_\_\_\_\_]]

A plan to provide ventilation assessment.

Medical Status[; G][; G, [\_\_\_\_]]

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.

Lead-Based Paint Removal[; G][; G, [\_\_\_\_]]

\*\*\*\*\*  
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.  
\*\*\*\*\*

A Worker Protection Plan in accordance with the requirements of 29 CFR 1926.62. The plan shall address all necessary aspects of worker protection and shall include activities emitting lead, means to achieve compliance, alternative technologies considered, air monitoring program, implementation schedule, work practice program, administrative controls, multiContractor site arrangements, and jobsite inspections.

Environmental Protection[; G][; G, [\_\_\_\_]]

\*\*\*\*\*  
NOTE: An Environmental Compliance Plan for jobs involving removal of lead-containing coatings serves to demonstrate the Contractors 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.  
\*\*\*\*\*

An Environmental Compliance Plan. The plan shall incorporate the submittals for Water Quality Plan, Soil Quality Plan, Ambient Air 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.

Waste Classification, Handling, and Disposal[; G][; G, [\_\_\_\_]]

A Waste Classification, Handling, and Disposal Plan in accordance with the requirements of 40 CFR 261 and 40 CFR 262 and paragraph Waste Classification, Handling, and Disposal.

Containment[; G][; G, [\_\_\_\_]]

\*\*\*\*\*  
NOTE: A Containment Plan should also be required  
for nonlead jobs where containment is specified.  
\*\*\*\*\*

A plan for containing debris generated during paint removal operations. The plan shall include drawings, load-bearing capacity calculations, and wind load calculations. When the design is such that the spent abrasive is allowed to accumulate in quantities greater than 453 kg 1,000 pounds, and/or impart a significant wind load on the structure, the Contractor shall 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.

Visible Emissions Monitoring[; G][; G, [\_\_\_\_]]

\*\*\*\*\*  
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. See NOTE for paragraph Containment.  
\*\*\*\*\*

A Visible Emissions Monitoring Plan. The plan shall include 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.

PM-10 Monitoring[; G][; G, [\_\_\_\_]]

\*\*\*\*\*  
NOTE: It is the specifier's responsibility to  
contact the local 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. If the National Ambient Air Quality Standard  
for lead [total suspended particulate (TSP) lead]  
monitoring is invoked on lead paint removal  
projects, include paragraph TSP MONITORING PLAN. In  
either case, the plan 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. PM-10 monitoring is  
not recommended for lead or other paint removal jobs  
where it is not required. It is 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 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 paragraph PM-10 Monitoring. The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur. Submit a plan for monitoring emissions of Total Suspended Particulates (TSP). The plan shall comply with the requirements of EPA regulation 40 CFR 50.12 and paragraph TSP Monitoring. The plan shall also include provisions for halting work and correcting the containment in the event unacceptable emissions occur.

Water Quality[; G][; G, [\_\_\_\_\_]]

\*\*\*\*\*

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

\*\*\*\*\*

A Water Quality Plan for all job sites where lead-containing or other hazardous paint will be removed. The plan shall include 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.

Soil Quality[; G][; G, [\_\_\_\_\_]]

\*\*\*\*\*

NOTE: If the work is near exposed ground (e.g., soil, sand, clay, etc.), require the submittal of the SOIL QUALITY PLAN.

\*\*\*\*\*

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.

#### SD-04 Samples

Special Paint Formulas[; G][; G, [\_\_\_\_\_]]

Paint Formulations[; G][; G, [\_\_\_\_\_]]

Samples of all special paint formula, Military, Master Painter Institute, Commercial Item Description, and SSPC paints. For products that are specified to be applied in accordance with the manufacturer's recommendations also submit the paint producers product data sheet or other written instructions for those

products.

Solvent and Thinners[; G][; G, [\_\_\_\_\_]]

Samples of the thinners or solvents used to reduce the viscosity of the paint.

#### SD-06 Test Reports

PM-10 Monitoring[; G][; G, [\_\_\_\_\_]]

Reports of the PM-10 monitoring tests.

TSP Monitoring[; G][; G, [\_\_\_\_\_]]

Reports of the TSP monitoring tests.

Certified Laboratory[; G][; G, [\_\_\_\_\_]]

Reports of airborne sampling tests.

Soil Quality[; G][; G, [\_\_\_\_\_]]

Results of the prework and post work soil quality tests.

Inspection[; G][; G, [\_\_\_\_\_]]

Records of inspections and operations performed. Submittals shall be made on a daily basis.

#### SD-07 Certificates

Qualifications[; G][; G, [\_\_\_\_\_]]

Certification for all job sites. Submittal of the qualifications and experience of any additional qualified and competent persons employed to provide on-site environmental, safety, and health shall also be provided. Acceptance of this submission must be obtained prior to the submission of other required environmental, safety, and health submittal items.

Qualified Painting Contractor[; G][; G, [\_\_\_\_\_]]

A copy of their current SSPC QP 1 certification.

Qualified Hazardous Paint Removal Contractor[; G][; G, [\_\_\_\_\_]]

A copy of their current SSPC QP 2 certification.

Coating Thickness Gage Qualification[; G][; G, [\_\_\_\_\_]]

Documentation of manufacturer's certification shall be submitted for all coating thickness gages.

### 1.4 QUALIFICATIONS

\*\*\*\*\*

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.

\*\*\*\*\*

Qualifications and experience shall comply with the following.

#### 1.4.1 Certified Professional

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 on-site 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. Certify that the Certified Industrial Hygienist (CIH) holds current and valid certification from the American Board of Industrial Hygiene (ABIH), that the IH is considered board eligible by written confirmation from the ABIH, or that the CSP holds current and valid certification from the American Board of Certified Safety Professionals. 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.

#### 1.4.2 Certified 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.

#### 1.4.3 Qualified Painting Contractor

\*\*\*\*\*

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.

\*\*\*\*\*

The Contractor shall be a certified SSPC-QP 1 Painting Contractor.

#### 1.4.4 Qualified Hazardous Paint Removal Contractor

\*\*\*\*\*

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.

\*\*\*\*\*

The Contractor shall be a certified SSPC-QP 2 Painting Contractor.

#### 1.4.5 Qualified Paint Applicator

\*\*\*\*\*

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.

\*\*\*\*\*

Documentation of certification shall be submitted for all paint applicators. 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.

##### 1.4.5.1 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.

##### 1.4.5.2 Certification Test Procedure

Certification testing of paint applicators shall be conducted at the job site in coordination with the Contracting Officer. Supply the fabricated test plates to be used for the tests and shall 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. Abrasive blasting shall be performed 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.

#### 1.4.5.3 Certification Criteria

The paint applicator shall be evaluated 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 applicators performance.

#### 1.4.6 Coating Thickness Gage Qualification

Documentation of certification shall be submitted for all coating thickness gages. Magnetic flux thickness gages as described in ASTM D 7091 shall be used to make all coating thickness measurements on ferrous metal substrates.

Eddy current thickness gages as described in ASTM D 7091 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.

### 1.5 SAMPLING AND TESTING

\*\*\*\*\*

NOTE: US Army Construction Engineering Research  
Laboratory provides paint testing services on a  
reimbursable basis. Samples may be submitted to US  
Army CERL, ATTN: Paint Laboratory, 2902 Farber  
Drive, Champaign, IL 61821.

\*\*\*\*\*

Allow at least 30 days for sampling and testing. 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 shall be witnessed by the Contracting Officer unless otherwise specified or directed. A 1 L 1-quart sample of paint and thinner shall be submitted 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.

### 1.6 SAFETY AND HEALTH PROVISIONS

Work shall be performed in accordance with the requirements of 29 CFR 1910, 29 CFR 1926, EM 385-1-1, and other references as listed herein. Matters of interpretation of the standards shall be submitted to the Contracting Officer for resolution before starting work. Where the regulations conflict, the most stringent requirements shall apply. Paragraph SAFETY AND HEALTH PROVISIONS supplements the requirements of EM 385-1-1, paragraph (1). In any conflict between Section 01 of EM 385-1-1 and this paragraph, the provisions herein shall govern.

#### 1.6.1 Abrasive Blasting

Comply with the requirements in Section 06.H of EM 385-1-1.

#### 1.6.1.1 Hoses And Nozzles

In addition to the requirements in Section 20 of EM 385-1-1, hoses and hose connections of a type to prevent shock from static electricity shall be used. 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 shall be designed to prevent accidental disengagement.

#### 1.6.1.2 Workers Other Than Blasters

Workers other than blasting operators working in close proximity to abrasive blasting operations shall be protected 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 ASSE/SAFE 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.

#### 1.6.2 Cleaning with Compressed Air

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.

#### 1.6.3 Cleaning with Solvents

##### 1.6.3.1 Ventilation

Ventilation shall be provided 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).

##### 1.6.3.2 Personal Protective Equipment

Personal protective equipment shall be provided where required by 29 CFR 1910.146 and in accordance with 29 CFR 1910, Subpart I.

#### 1.6.4 Pretreatment of Metals and Concrete with Acids

##### 1.6.4.1 Personal Protective Equipment

Personnel shall be protected in accordance with 29 CFR 1910, Subpart I.

##### 1.6.4.2 Emergency Equipment

In addition to the requirements of Section 05 of EM 385-1-1, provide an eyewash in accordance with ISEA Z358.1, paragraph (6).

#### 1.6.5 Mixing Epoxy and Polyurethane Resin Formulations

##### 1.6.5.1 Exhaust Ventilation

Local exhaust ventilation shall be provided in the area where the curing agent and resin are mixed. This ventilation system shall be capable of providing at least 100 linear fpm of capture velocity measured at the point where the curing agent and resin contact during mixing.

#### 1.6.5.2 Personal Protective Equipment

Exposure of skin and eyes to epoxy resin components shall be avoided by wearing appropriate chemically resistant gloves, apron, safety goggles, and face shields meeting or exceeding the requirements of ASSE/SAFE Z87.1.

#### 1.6.5.3 Medical Precautions

Individuals who have a history of sensitivity to epoxy or polyurethane resin systems shall be medically evaluated before any exposure can occur. Individuals who are medically evaluated as exhibiting a sensitivity to epoxy resins shall not conduct work tasks or otherwise be exposed to such chemicals. Individuals who develop a sensitivity shall be immediately removed from further exposure and medically evaluated.

#### 1.6.5.4 Emergency Equipment

A combination unit, comprised of an eyewash and deluge shower, within close proximity to the epoxy or polyurethane resin mixing operation shall be provided in accordance with ISEA Z358.1, paragraph (9).

#### 1.6.6 Paint Application

##### 1.6.6.1 Ventilation

When using solvent-based paint in confined spaces, ventilation shall be provided 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. All air-moving devices shall be located and affixed to an opening of the confined space in a manner that assures that the airflow is not restricted or short circuited and is supplied in the proper direction. Means of egress shall not be blocked. Ventilation shall be continued 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), painting shall be stopped and spaces evacuated until such time that adequate ventilation is provided. An audible alarm that signals system failure shall be 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.

##### 1.6.6.2 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.

#### 1.6.6.3 Further Precautions

- a. Workers shall wear nonsparking safety shoes.
- b. Solvent drums taken into the spraying area shall be placed on nonferrous surfaces and shall be grounded. Metallic bonding shall be maintained between containers and drums when materials are being transferred.
- c. Insulation on all power and lighting cables shall be inspected 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.

#### 1.6.6.4 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.

#### 1.6.7 Health Protection

##### 1.6.7.1 Air Sampling

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 test results from the laboratory within five working days of the sampling date and shall provide results from direct-reading instrumentation on the same day the samples are collected.

##### 1.6.7.2 Respirators

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

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 such as lead, cadmium, chromium, or other toxic particulates 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.

#### 1.6.7.3 Protective Clothing and Equipment

All workers shall wear safety shoes or boots, appropriate gloves to protect against the chemical to be encountered, and breathable, protective, full-body covering during spray-painting applications. Where necessary for emergencies, protective equipment such as life lines, body harnesses, or other means of personnel removal shall be used during confined-space work.

#### 1.7 MEDICAL STATUS

Prior to the start of work and annually thereafter, 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 shall be medically evaluated for the particular type of exposure they may encounter. Medical records shall be maintained 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.
  - (5) For lead-based paint removal, the medical requirements of



29 CFR 1926.62 shall also be included.

#### 1.8 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. Notify the Contracting Officer in writing of any negative changes in employee medical status and the results of the physicians reevaluation statement.

#### 1.9 ENVIRONMENTAL PROTECTION

In addition to the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION comply with the following environmental protection criteria.

##### 1.9.1 Waste Classification, Handling, and Disposal

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. Hazardous waste shall be placed in properly labeled closed containers and shall be 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. Nonhazardous waste shall be stored 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 manifest copies required by 40 CFR 262.22, one copy of each manifest will be supplied to the Contracting Officer prior to transportation.

##### 1.9.2 Containment

\*\*\*\*\*

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.

\*\*\*\*\*

Contain debris generated during paint removal operations in accordance with the requirements of **SSPC Guide 6**, Class [\_\_\_\_]. Where required the containment air pressure shall be verified [by instrument] [visually]. Where required the minimum air movement velocity shall be **30 m/min 100 fpm** for cross-draft ventilation or **18 m/min 60 fpm** for downdraft ventilation.

### 1.9.3 Visible Emissions Monitoring

\*\*\*\*\*

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.

\*\*\*\*\*

The time of emissions shall be measured in accordance with 40 CFR 60, App A, Mtd 22. Visible emissions shall be monitored for not less than 15 minutes of every hour. Visible emissions for each hour shall be calculated 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. The foreman shall be notified 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 by the Contractor 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.

#### 1.9.4 Air Quality Monitoring

\*\*\*\*\*

NOTE: It is the specifier's responsibility to contact the local authorities to determine if PM-10 (particulate matter less than 10 microns in size) monitoring is required. If so, include paragraph PM-10 MONITORING. If the National Ambient Air Quality Standard for lead [total suspended particulate (TSP) lead] monitoring is invoked 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. 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.

\*\*\*\*\*

##### 1.9.4.1 PM-10 Monitoring

Perform PM-10 monitoring. 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 report of the results shall be submitted to the Contracting Officer within 48 hours and shall include:

- (1) Name and location of jobsite.
- (2) Date of monitoring.
- (3) Time of monitoring (i.e., time monitoring begins and ends each day).
- (4) Identification and serial number of monitoring units.
- (5) Drawing showing specific location of monitoring units.
- (6) Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.
- (7) Wind direction and velocity.
- (8) A flow chart verifying the rate of air flow across the filter throughout the sampling period.
- (9) Name and address of laboratory.
- (10) Laboratory test procedure.
- (11) Laboratory test results.
- (12) Signatures of field and laboratory technicians conducting the work.

#### 1.9.4.2 TSP Monitoring

Perform TSP monitoring. The positioning of air monitoring equipment shall be in accordance with 40 CFR 58, App E, Subpart (8). In addition, a minimum of two TSP 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). TSP-lead monitoring shall be conducted 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. The monitoring shall continue for a minimum of 3 days to establish background levels. A report of the results shall be submitted to the Contracting Officer within 48 hours and shall include:

- (1) Name and location of jobsite.
- (2) Date of monitoring.
- (3) Time of monitoring (i.e., time monitoring begins and ends each day).

- (4) Identification and serial number of monitoring units.
- (5) Drawing showing specific location of monitoring units.
- (6) Drawing showing specific location of paint removal operation and the method of removal or work activity being performed.
- (7) Wind direction and velocity.
- (8) A flow chart verifying the rate of air flow across the filter throughout the sampling period.
- (9) Name and address of laboratory.
- (10) Laboratory test procedure.
- (11) Laboratory test results.
- (12) Signatures of field and laboratory technicians conducting the work.

#### 1.9.5 Water Quality

\*\*\*\*\*  
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.  
\*\*\*\*\*

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.

#### 1.9.6 Soil Quality

\*\*\*\*\*  
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.

\*\*\*\*\*

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) must 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 must be handled and disposed of as a hazardous waste. The initial sampling of the soil for total lead content does not establish whether the

soil 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 results of laboratory testing.

#### 1.10 PAINT PACKAGING, DELIVERY, AND STORAGE

Paints shall be processed and packaged 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 gallons, 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.

### PART 2 PRODUCTS

#### 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, Vinyl-Type Ready-Mixed Aluminum Impacted Immersion Coating

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

# INGREDIENTS

PERCENT BY MASS  
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 D 1200** and a No. 4 Ford cup.

## 2.2.2 Formula V-106d, Vinyl-Type Red Oxide (Light or Dark Color) Impacted Immersion Coating

### 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
Propylene Oxide	0.06
	<hr/>
	100.00

a. The pigment shall be dispersed by means of pebble mills or other approved methods to produce a fineness of grind (**ASTM D 1210**) of not less than 7 on the Hegman scale. Grinding in steel-lined or steel-ball mills will not be permitted. No grinding aids, antissettling agents, or any other materials, other than those listed in the formula, will be permitted.

b. The viscosity of the paint shall be between 60 and 90 seconds using **ASTM D 1200** and a No. 4 Ford cup.

c. The paint shall be furnished 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. The two shades shall be furnished in the volume ratio designated by the purchaser.

## 2.2.3 Formula V-766e, Vinyl-Type White (or Gray) Impacted Immersion Coating

### 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
	<hr/>
	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 D 1210**) of not less than 7 on the Hegman scale. Grinding in



steel-lined or steel-ball mills will not be permitted. No grinding aids, antissettling 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 D 1200** 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 E 1347**). The resulting gray color shall approximate color 26231 of **FED-STD-595**.

#### 2.2.4 Formula V-103C, Vinyl-Type Black-Finish Impacted Immersion Coating

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
	<hr/> 100.0

a. The carbon black shall be dispersed to a fineness of grind (**ASTM D 1210**) 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, antissettling 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 D 1200** and a No. 4 Ford cup.

#### 2.2.5 Formula VZ-108d, Vinyl-Type Zinc-Rich Impacted Immersion Coating

INGREDIENTS	PERCENT BY WEIGHT	POUNDS	GALLONS
COMPONENT A			
Vinyl Resin, Type 3	16.6	109.2	9.65
Methyl Isobutyl Ketone	80.6	528.9	79.30
Suspending Agent E	0.7	4.6	0.28
Suspending Agent F	0.4	2.7	0.19
Methanol	0.5	3.3	0.50
Synthetic Iron Oxide (Red)	1.2	7.9	0.19
	<hr/> 100.0	<hr/> 656.6	<hr/> 90.11
COMPONENT B			

INGREDIENTS	PERCENT BY WEIGHT	POUNDS	GALLONS
Silane B	100.0	4.1	0.47
COMPONENT C			
Zinc Dust	100.0	550.0	9.42
			100.00
			(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 D 1210). Grinding in steel-lined containers or using steel-grinding media shall not be permitted. 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 E 1347).

b. VZ-108d paint shall be supplied as a kit. Each kit shall consist of 17 L 4.5 gallons (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-gallon 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-gallon 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.

### 2.2.7 Formula P-38, Aluminum Phenolic Finish Coat

This material shall be a ready-mixed aluminum paint. The pigment shall be leafing aluminum powder or paste conforming to the requirements of **ASTM D 962** Types I or II, Class B, Medium. The vehicle shall be a phenolic resin varnish of 33-gallon oil length. The resin portion of the vehicle shall be a dry granular phenol-formaldehyde resin made from aliphatic para-substituted phenols with substituting groups containing four to eight carbon atoms. The oil portion of the vehicle shall consist of not less than 80% tung oil and the remainder shall be alkali refined linseed oil. The vehicle shall not contain rosin derivatives. Paint solvents shall consist of aliphatic and aromatic hydrocarbons as necessary. The paint shall meet the requirements of paragraphs Quantitative Requirements and Water Resistance.

#### 2.2.7.1 Quantitative Requirements

The paint shall have the following properties.

Characteristics	Requirement (minimum/maximum)
Pigment, percent by weight of paint	13 / --
Volatile, percent by weight of paint, <b>ASTM D 2369</b>	-- / 45
Nonvolatile vehicle, percent by weight of paint	42 / --
Viscosity, seconds, <b>ASTM D 1200</b>	35 / 45
Flash point, Degrees F (C), <b>ASTM D 4206</b>	86 (30) / --
Leafing, percent	50 / --
Density, pounds per gallon, <b>ASTM D 1475</b>	8 / --
Dry, set-to-touch, hours, <b>ASTM D 1640</b>	0.5 / 2
Dry, to recoat, hours, <b>ASTM D 1640</b>	-- / 16

#### 2.2.7.2 Water Resistance

Prepare a test panel by spray applying two coats of paint to a 70 by 150 mm 3 by 6 inch solvent cleaned matte-finish steel test plate. Each coat shall have a dry film thickness of approximately 50 microns 2.0 mils. Allow 24 hours dry time between coats. Air dry the prepared panel 72 hours and immerse in distilled water at 23 +/- 1 degree C 73 +/- 2 degree F for 72 hours in accordance with **ASTM D 1308**. The test paint shall exhibit no wrinkling or blistering immediately upon removal of the panel from the water. The paint shall be no more than slightly affected when examined two hours after removal and after 24 hours shall show no more than a slight visible whitening or dulling in comparison to the unexposed film.

### 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 D 962**, Type 1, Class B.

##### 2.3.1.2 Carbon Black

Carbon black shall conform to **ASTM D 561**, Type I or II.

#### 2.3.1.3 Zinc Dust

Zinc dust pigment shall conform to ASTM D 520, Type II.

#### 2.3.1.4 Iron Oxide

Iron oxide, (Dry) synthetic (red), shall conform to ASTM D 3721. 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 D 281 and ASTM D 153, 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 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. MPA-14, produced by RHEOX, Inc., 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 RHEOX, Inc., has these properties.

### 2.3.2 Resins, Plasticizer, and Catalyst

#### 2.3.2.1 Diisodecyl Phthalate

Diisodecyl Phthalate 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 D 1045) 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 to 88 percent vinyl chloride and 12 to 15 percent vinyl acetate by weight. The resin shall have film-forming properties and shall, in specified formulations, produce results equal to Vinylite resin VYHH, as manufactured by the Union Carbide Corporation.

#### 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 dibasic acid, 84 to 87 percent vinyl

chloride, and 12 to 15 percent vinyl acetate. The resin shall have film-forming properties and shall, in the specified formulations, produce results equal to Vinylite resin VMCH, as manufactured by the Union Carbide Corporation.

#### 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 D 1152.

##### 2.3.3.2 Methyl Ethyl Ketone

Methyl ethyl ketone (MEK) shall conform to ASTM D 740.

##### 2.3.3.3 Methyl Isobutyl Ketone

Methyl isobutyl ketone (MIBK) shall conform to ASTM D 1153.

##### 2.3.3.4 Methyl Isoamyl Ketone

Methyl isoamyl ketone (MIAK) shall conform to ASTM D 2917.

##### 2.3.3.5 Toluene

Toluene shall conform to ASTM D 841.

#### 2.3.4 Silane B

Silane B for Formula VZ-108d shall be N-beta-(aminoethyl)-gamma-aminopropyltrimethoxy silane. Silane A-1120, produced by the C.K. Witco Corporation, 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 of 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. The surface shall have an angular profile of 50 to 63 microns 2.0 to 2.5 mils as measured by ASTM D 4417, 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

\*\*\*\*\*  
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.  
\*\*\*\*\*

#### 3.1.1 General Requirements

Surfaces to be painted shall be cleaned before applying paint or surface treatments. Deposits of grease or oil shall be removed 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. Clean cloths and clean fluids shall be used to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Items not to be prepared or coated shall be

protected 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

\*\*\*\*\*

NOTE: 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 based on vehicles containing a large portion of free linseed oil (such as SSPC Paint 25) or certain epoxy coatings are used. Such primers 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, 2, 15, and 16. Paint Systems 2 and 15 are also sometimes specified using SP 6 for improved performance.

\*\*\*\*\*

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.] [Commercial blast cleaning shall conform to the requirements of SSPC SP 6.] 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 but 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.

### 3.1.3 Ferrous Surfaces Subject to Severe Exposure

\*\*\*\*\*

NOTE: 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 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.



\*\*\*\*\*

Ferrous surfaces subject to extended periods of immersion or as otherwise required shall be dry blast-cleaned to **SSPC SP 5**. The blast profile, unless otherwise specified, shall be **38 to 63 microns 1.5 to 2.5 mils** as measured by **ASTM D 4417**, 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** shall be done in the field and, unless otherwise specifically authorized, after final erection. Within 8 hours after cleaning, prior to the deposition of any detectable moisture, contaminants, or corrosion, all ferrous surfaces blast cleaned to **SSPC SP 5** 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 Nos. 6-A-Z and 21-A-Z employing the epoxy 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 the 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

\*\*\*\*\*

**NOTE: 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.**

\*\*\*\*\*

Ferrous surfaces that are wet with condensation or standing or running water, shall be blast-cleaned to **SSPC SP 5**. The blast profile, unless otherwise specified, shall be **38 to 76 microns 1.5 to 3.0 mils** as measured by **ASTM D 4417**, 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 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 Galvanized, Aluminum, Aluminum Alloy, or Copper Surfaces

Where surfaces are specified to be painted, they shall be first washed with clean mineral spirits and then pretreated with a primer conforming to SSPC Paint 27 in accordance with the following instructions. The pretreatment primer shall be mixed by adding one volume of acid component (diluent) to four volumes of resin component (base solution) slowly and with constant stirring. After mixing, the material shall be used within 8 hours. The pretreatment primer shall be spray applied at a coverage rate of 6.1 to 7.4 square meters/L 250 to 300 square feet/gallon (of resin component) to give a dry film thickness of 7 to 12 microns 0.3 to 0.5 mil. Small areas may be coated by brush or swab. Care shall be exercised in spray application to avoid the deposition of dry particles on the surface. A wet spray shall be maintained at all times by additional thinning with Normal Butanol ASTM D 304. The acid component (diluent), over and above the amount prescribed above, shall not be used for thinning purposes. Surfaces shall receive the first coat of paint after at least 1 but not more than 24 hours drying of the pretreatment primer film.

### 3.1.6 Concrete Surfaces

\*\*\*\*\*

NOTE: 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.

\*\*\*\*\*

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

\*\*\*\*\*  
NOTE: Where necessary, applicable provisions from  
UFGS 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.  
\*\*\*\*\*

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. Paste or 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 gallon 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.

### 3.2.3 Atmospheric and Surface 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.

### 3.2.4 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.

### 3.2.5 Method of Paint Application

Unless otherwise specified, paint shall be applied by brush 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.

### 3.2.6 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 normal for the type of material being used. 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.

#### 3.2.6.1 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 D 7091](#). They shall be calibrated using plastic shims with metal practically identical in composition and surface preparation to that being coated, and of substantially the same thickness (except that for measurements on metal thicker than 6 mm 1/4 inch, the instrument may be calibrated on metal with a minimum thickness of 6 mm 1/4 inch). Frequency of measurements shall be as recommended for field measurements by [ASTM D 7091](#) and reported as the mean for each spot determination. The instruments shall be calibrated or calibration verified prior to, during, and after each use.

#### 3.2.6.2 Measurements on Nonferrous Metal

Where dry film thickness requirements are specified for coatings applied to nonferrous metal surfaces, measurements shall be made using a gage qualified in accordance with paragraph Coating Thickness Gage Qualification. They shall be calibrated and used in accordance with [ASTM D 7091](#). Calibration shall be on metal identical in composition and surface preparation to that being coated and of substantially the same thickness (except that for measurements on metal thicker than 6 mm 1/4 inch, the instrument may be calibrated on metal with a minimum thickness of 6 mm 1/4 inch). Frequency of measurements shall be as recommended for field measurements by [ASTM D 7091](#) and reported as the mean for each spot determination. The instruments shall be calibrated or calibration verified prior to, during, and after each use.

#### 3.2.7 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.

#### 3.2.8 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition,

such surfaces will not be required to be painted, but any resulting crevices 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.

### 3.2.9 Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion shall be: epoxy 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.

### 3.2.10 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.

### 3.2.11 Vinyl Paints

#### 3.2.11.1 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 F [Degrees C])

Below 50 [Below 10]	MEK
50 - 70 [10 - 21]	MIBK
Above 70 [Above 21]	MIAC

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.

#### 3.2.11.2 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.

#### 3.2.11.3 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.

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

#### 3.2.12.1 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 gallon 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.

#### 3.2.12.2 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/gallon 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.

#### 3.2.12.3 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 must be mopped up immediately after they form. The subsequent coat shall be applied in not less than 15 minutes or more than 3 hours after the solvent treatment.

#### 3.2.12.4 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.

#### 3.2.12.5 Safety

In addition to the safety provisions in paragraph SAFETY AND HEALTH PROVISIONS, 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

\*\*\*\*\*  
NOTE: 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.  
\*\*\*\*\*

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

\*\*\*\*\*

NOTE: This NOTE applies to System No. 2 below, and to Paragraphs titled "System No. 15" and "System No. 16".

1. System Nos. 1, 2, 15 and 16 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. All 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 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 2 provide an aluminum finish; Systems No. 15 and 16 provide a wide choice of colors.

2. Systems Nos. 2 and 16 are conventional oil-based paints. Oil based systems have a low material cost and can be easily applied and touched up by unskilled labor. They may be used to touch-up 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. Systems No. 13 and 14 should be specified for miscellaneous adjacent galvanized and other nonferrous surfaces.

3. Systems No. 1 and 15 are epoxy and epoxy/urethane commercial product coatings. These coatings have a higher material cost and require some skill for proper application. Greater performance usually

justifies the higher initial cost. The epoxies in both systems are heavy bodied products applied at a thickness somewhat greater than oil-based paints. Brush marks may not level resulting in an uneven appearance. 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 better than the oil-based systems. Immersion causes the urethane topcoat on System No. 15 to delaminate quickly. System No. 15 has better gloss and color retention than System No. 16. These systems may be applied to miscellaneous adjacent galvanized and other nonferrous surfaces.

4. Systems No. 1 and 15 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, should be specified.

\*\*\*\*\*

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. 2

\*\*\*\*\*

**NOTE: See Note for Paragraph above.**

\*\*\*\*\*

The first coat shall be brush or spray applied in the shop or field as indicated at a maximum spreading rate of **12.2 square meters/L** 500 square

feet/gallon and touched up in the field as necessary to maintain its integrity at all times. The second or third coats of the system shall be applied in the field at a maximum spreading rate of 11 square meters/L 450 square feet/gallon. Prior to applying field coats, all field welds, other bare metal, and damaged areas of the shop-primed surfaces shall be cleaned and primed as previously specified except that application shall be by brush.

### 3.3.5 System No. 3

\*\*\*\*\*

NOTE: 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 1999 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 and 21-A-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 UFGS 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.

\*\*\*\*\*

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.

### 3.3.6 System No. 3-A-Z

\*\*\*\*\*

NOTE: See Note for System 3 above.

\*\*\*\*\*

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.

### 3.3.7 System No. 4

\*\*\*\*\*  
NOTE: See Note for System 3 above.  
\*\*\*\*\*

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.

### 3.3.8 System No. 5-A-Z

\*\*\*\*\*  
NOTE: See Note for System 3 above.  
\*\*\*\*\*

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.

### 3.3.9 System No. 5-C-Z

\*\*\*\*\*  
NOTE: See Note for System 3 above.  
\*\*\*\*\*

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.

### 3.3.10 System No. 5-D

\*\*\*\*\*  
NOTE: See Note for System 3 above.  
\*\*\*\*\*

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.

### 3.3.11 System No. 5-E-Z

\*\*\*\*\*  
NOTE: See Note for System 3 above.  
\*\*\*\*\*

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.

### 3.3.12 System No. 6

\*\*\*\*\*  
NOTE: 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. P-38 or SSPC PS 26.00 may be employed as aluminum finish coats for C-200a when such a finish is desired. The former is less expensive, easier to apply, and produces a brighter finish than the latter but tends to lose adhesion and peel off of the C-200a in tidal and splash zone areas. The latter 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.

\*\*\*\*\*

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.

### 3.3.13 System No. 6-A-Z

\*\*\*\*\*  
NOTE: See Note in above paragraph.  
\*\*\*\*\*

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.

### 3.3.14 System No. 7

\*\*\*\*\*

NOTE: 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 Commercial Blast Cleaning or (2) by SSPC SP 3 Power Tool Cleaning or SSPC SP 7 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.

\*\*\*\*\*

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.

### 3.3.15 System No. 8

\*\*\*\*\*

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

\*\*\*\*\*

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.

### 3.3.16 System No. 9

\*\*\*\*\*

NOTE: 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. If the anticipated exposure conditions involve prolonged or frequent periods of high humidity and condensation, the addition of a coat of P-38 aluminum paint may be indicated, or in extreme situations, System No. 3 may be used. 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.

\*\*\*\*\*

The first coat shall be spray or brush applied in the shop at a maximum spreading rate of 12.2 square meters/L 500 square feet/gallon. The shop coat shall be touched up in the field as necessary to maintain its integrity at all times. The second coat shall be field applied at a minimum spreading rate of 11 square meters/L 450 square feet/gallon. Where directed, structural steel and miscellaneous ferrous surfaces in painted spaces shall, in lieu of the specified second primer coat, be finish painted to match adjacent painted surfaces.

### 3.3.17 System No. 10

\*\*\*\*\*

NOTE: 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 UFGS 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.

\*\*\*\*\*

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.

#### 3.3.18 System No. 12

\*\*\*\*\*

NOTE: 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.

\*\*\*\*\*

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.

### 3.3.19 System No. 13

\*\*\*\*\*

NOTE: This NOTE applies to System 14 also.

1. These systems and the following notes concern the painting of hot-dip coated steel, aluminum, aluminum alloy, and copper surfaces.

2. 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. 13 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. 14 in gray or other suitable color may be

used for this purpose.

3. Aluminum and aluminum alloy surfaces will not generally be painted; however, System No. 13 may be desirable for isolating aluminum in contact with mortar or concrete. System No. 13 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.

4. Copper surface will rarely be painted except for the purpose of appearance, e.g., gutters, exposed flashing, exposed piping in finished spaces, etc. Good adherence of any convenient paint system may be anticipated when applied over the SSPC Paint 27 pretreatment.

\*\*\*\*\*

Apply P-38 coats at a maximum spreading rate of 11 square meters/L 450 square feet/gallon.

#### 3.3.20 System No. 14

\*\*\*\*\*

NOTE: See NOTE for System 13 above.

\*\*\*\*\*

All products shall be applied in compliance with manufacturer's written instructions.

#### 3.3.21 System No. 15

\*\*\*\*\*

NOTE: See Note for Paragraph titled "System No. 1".

\*\*\*\*\*

This system shall consist of an epoxy primer and polyurethane topcoat passing all the test requirements of the Commercial Item Description. Application shall be by spray, brush or roller. Dry film thickness of each coat shall be within plus or minus 20 percent of that recommended by the manufacturer for the qualification testing. The epoxy and urethane coatings 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 manufacturers recommendations for minimum and maximum dry time between coats shall be met.

#### 3.3.22 System No. 16

\*\*\*\*\*

NOTE: See Note for Paragraph titled "System No. 1".

\*\*\*\*\*

The first coat shall be brush or spray applied in the shop or field as indicated at a maximum spreading rate of 12.2 square meters/L 500 square



feet/gallon and touched up in the field as necessary to maintain its integrity at all times. The second and third coats shall be applied in the field at a maximum spreading rate of 11 square meters/L 450 square feet/gallon. The finish color shall be as indicated. No paint shall be applied to running surfaces of bearings and machinery. Pipe-threading and cutting compounds shall be removed by solvent washing prior to application of paint to pipe surfaces.

### 3.3.23 System No. 17

\*\*\*\*\*

NOTE: 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 UFGS 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.

\*\*\*\*\*

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.

#### 3.3.24 System No. 18

\*\*\*\*\*  
NOTE: See NOTE for System 17 above.  
\*\*\*\*\*

Oil based alkyd paints shall be thinned using only odorless mineral spirits (ASTM D 235). 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.

#### 3.3.25 System No. 21

\*\*\*\*\*  
NOTE: 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.

\*\*\*\*\*

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.

### 3.3.26 System No. 21-A-Z

\*\*\*\*\*

NOTE: See NOTE in preceding paragraph.

\*\*\*\*\*

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.

### 3.3.27 System No. 22

\*\*\*\*\*

NOTE: The Commercial Item Description describes commercially available floor coating systems having an epoxy primer and urethane topcoats. 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.

\*\*\*\*\*

The floor coating shall be applied according to the manufacturer's instructions. It shall be a 4 coat system having a minimum total dry film thickness at any point of not less than 228 microns 9 mils.

### 3.3.28 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, document, and report all work phases and operations on a daily basis. 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

\*\*\*\*\*

NOTE: 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 small quantities of paint are needed and a proprietary 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 in paragraph PAINTING SCHEDULES for instructions relative to numbering other systems.

2. For maintenance of existing paint systems, it is preferable to use the same paints or types of paints used for the original work. The exception to this rule is touch up with or reapplication of FS TT-P-86 should not be considered. 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. 2.

b. Prolonged condensation, high humidity, coastal structures not subject to immersion, System No. 1.

- c. Immersion in relatively quiet, nonabrasive 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 UFGS 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 UFGS 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	H8,M6,N3,P3
Battery Rooms	P7,Q2
Bridges	G1
Concrete:	
Exposed to chemicals or sewage	I5,Q2
Interior	P1,P6,R,Q2
Copper	N1,N4
Dewatering and drainage sumps	I1
Doors, wood or steel	P4,P5
Flooded compartments	I1
Floor grating	M2
Galvanized materials	M2,N2
Galvanized	N2
Interior:	
High condensation	K2
Nonexposed	K1,K2
Gantries	G1
Gates	H1,H6,I4,J1,J3,Q4,Q8
Gate wells	J1
Light standards	G1
Local protection projects	J1
Penstocks	G4,I1
Piling, steel	I3,I4,Q4
Pipe and conduit	G1,I1,I2,N2
Pumps and machinery	G1,J1
Spiral (turbine) case	H4,I1
Stairwells	P4
Steel:	
Corrosive	G4,I1,M5
Damp or Wet	T1
Freshwater immersion:	
Low velocity	H3,Q4

Med high velocity and/or high abrasion	H4,H5
Intermittent immersion	G1,G3
Zebra mussel	S3
High condensation	H3
High temperature	G1,L1,L2
Normal exposure	G1
Salt water immersion	H2,I4,Q4,Q6
Severe industrial	G4
Tidal splash zones	I4
Stop logs	H3
Structural framework	K1
Surge chambers	J1
Tanks:	
Exterior	G1,I2
Interior	H2,H3,H4
Trash rack	H4
Valves	H4
Walls (High-maintenance areas)	P4
Wall protection, corner	G1
Window frames	P3,P4

\*\*\*\*\*

#### 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

\*\*\*\*\*

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".

\*\*\*\*\*

#### SYSTEM NO. 2

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 25  
Type I or Type II

P-38  
(Aluminum)

P-38  
(Aluminum)



Alternate 2  
Commercial  
blast cleaning      **SSPC Paint 25**      P-38      P-38  
Type I or Type II      (Aluminum)      (Aluminum)

SYSTEM NO. 3

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	White Vinyl V-766e (double spray coat)	Gray Vinyl V-766e (double spray coat)	Aluminum Vinyl V-102e (double spray coat)	Aluminum Vinyl V-102e (double spray coat)

SYSTEM NO. 3-A-Z

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc- rich VZ-108d (double spray coat)	White Vinyl V-766e (double spray coat)	Aluminum Vinyl V-102e (double spray coat)	Aluminum Vinyl V-102e 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 VZ-108d (double spray coat)	White Vinyl V-766e (double spray coat)	Black Vinyl V-103c (double spray coat)	Black Vinyl V-103c (double spray coat)

SYSTEM NO. 5-C-Z

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc- rich VZ-108d (double spray coat)	Dark Red oxide Vinyl V-106d (double spray coat)	Light Red oxide Vinyl V-106d (double spray coat)	Dark Red oxide Vinyl V-106d (double spray coat)

SYSTEM NO. 5-D

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT	5th COAT
White metal blast cleaning	Dark Red oxide Vinyl V-106d (double spray coat)	Light Red oxide Vinyl V-106d (double spray coat)	Dark Red oxide Vinyl V-106d (double spray coat)	Light Red oxide Vinyl V-106d (double spray coat)	Dark Red oxide Vinyl V-106d (double spray coat)

SYSTEM NO. 5-E-Z

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT	4th COAT
White metal blast cleaning	Vinyl zinc- rich VZ-108d (double spray coat)	Gray Vinyl V-766e (double spray coat)	White Vinyl V-766e (double spray coat)	Gray Vinyl V-766e (double spray coat)

SYSTEM NO. 6

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
White metal blast cleaning	Coal tar- epoxy C-200a (black)	Coal tar- epoxy C-200a (black)	Coal tar- epoxy C-200a (black) (if needed to attain required thickness)

SYSTEM NO. 6-A-Z

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st & 2nd COAT	3rd COAT	4th COAT
------------------------	-------------------	----------	----------

White metal blast cleaning	MIL-DTL-24441 /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
Alternate 2 SSPC SP 6 Commercial blast cleaning	SSPC Paint 33	SSPC Paint 33	SSPC Paint 33

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

SYSTEM NO. 8

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT
SSPC SP 5	Paint (for wet surfaces) CID A-A-3130	Additional coats as recommended by the manufacturer

SYSTEM NO. 9

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE PREPARATION	1st COAT	2nd COAT
Power tool or brush-off blast cleaning	SSPC Paint 25 Type I or Type II	SSPC Paint 25 Type I or II

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. 13

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE  
PREPARATION

1st COAT

2nd COAT

Solvent clean  
and apply  
SSPC Paint 27  
pretreatment

P-38  
(Aluminum)

P-38  
(Aluminum)

SYSTEM NO. 14

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE  
PREPARATION

1st COAT

2nd COAT

Solvent clean  
and apply  
SSPC Paint 27  
pretreatment

MPI 9

MPI 9

SYSTEM NO. 15

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE  
PREPARATION

1st COAT

2nd COAT

Alternate 1  
Power tool or  
brush-off blast  
cleaning

Epoxy Primer  
CID A-A-3132

Urethane Topcoat  
CID A-A-3132

Alternate 2  
Commercial  
blast cleaning

Epoxy Primer  
CID A-A-3132

Urethane Topcoat  
CID A-A-3132

\*\*\*\*\*  
NOTE: The above alternatives are not intended to be  
a Contractor option. See NOTE to Paragraph titled  
"System No. 1".  
\*\*\*\*\*

SYSTEM NO. 16

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 25  
Type I or Type II

MPI 9

MPI 9

Alternate 2  
Commercial  
blast cleaning

SSPC Paint 25 MPI 9  
Type I or Type II

MPI 9

#### 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)

SYSTEM NO. 22

Items or surfaces to be coated: [\_\_\_\_\_]

SURFACE  
PREPARATION

COATING SYSTEM

As specified  
by manufacturer

CID A-A-50542

-- End of Section --