UFC 3-190-06
1 March 2021

UNIFIED FACILITIES CRITERIA (UFC)

PROTECTIVE COATINGS AND PAINTS

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PROTECTIVE COATINGS AND PAINTS

Indicate the preparing activity beside the Service responsible for preparing the document.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 3-190-06, dated 16 January 2004.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01 for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 3-190-06, *Protective Coatings and Paints*

Superseding: UFC 3-190-06, dated 16 January 2004

Description: This UFC provides requirements and technical guidance for the effective use of paint-type coatings to protect metal, concrete, gypsum board, and wooden structures at military activities from deterioration. This UFC applies to all Navy, Air Force, and Army service elements and contractors.

Reasons for Document:

- This version updates the current UFC documents from a MIL-HDBK to the current requirements for a UFC and updates technologies to the latest industry standards for surface preparation and coatings.

Impact:

- The requirements in this version should not impact initial cost for coatings and paints; however, the requirements should have a positive impact on life cycle costs through extended life of the coatings.

Unification Issues

In addition to OSHA standards for these topics, the Navy adheres to an additional set of OPNAVINST policies for safety and health issues.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

UFC 3-190-06 provides requirements and technical guidance for the effective use of paint-type coatings to protect common materials such as metal, concrete, pavements, gypsum board and wooden structures at military activities from deterioration. The words "paint" and "coating" are used interchangeably in this UFC. In the industry, the word "paint" is sometimes used to describe an architectural coating material while “coating” describes a protective “industrial” coating material.

1-2 APPLICABILITY.

This UFC applies to all Navy, Air Force, and Army service elements and contractors. All other DoD and Government agencies may also use this UFC unless explicitly directed otherwise. This UFC does not cover painting of ships, aircraft, or motor vehicles.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance, and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-3.1 Environmental Severity Classifications and Humid Locations.

Provide paints and coatings that are durable and minimize the need for preventative and corrective maintenance over the expected service life of the component or system. Different materials will be used based on local environmental conditions. UFC 1-200-01, section titled “Corrosion Prone Locations” identifies corrosive environments and humid locations requiring special attention. Corrosive environments, which require additional corrosion protection, are those project locations which have an Environmental Severity Classification (ESC) of C3, C4 or C5. To determine ESC for specific project locations, refer to UFC 1-200-01 Appendix titled “Environmental Severity Classifications (ESC) for DoD Locations”. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C, and 5C (as identified in ASHRAE 90.1).

1-4 GLOSSARY.

Appendix B includes acronyms and definitions of terms used in this document.

1-5 REFERENCES.

Appendix C contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

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CHAPTER 2 SURFACE PREPARATION

2-1 INTRODUCTION.

Prior to coating application, prepare the surface as required by the project UFGS and as recommended by the coating manufacturer. In case of conflict between the two, use the more stringent requirement. Surface preparation includes:

- Treat and repair surface irregularities including cracks, holes, sharp edges, weld spatter, and other defects that may lead to premature coating failure.
- Remove visible and non-visible surface contaminants (such as mill scale, oil, grease, salts and dirt) and deteriorated substrate surface layers (such as rust, chalk, and sunlight-degraded wood) that hinder coating adhesion.
- Produce a surface profile (texture) that promotes tight adhesion of the primer to the substrate.

2-1.1 Selection Factors.

Determine the type and degree of surface preparation based on these factors:

- Type of substrate
- Surface condition
- Type of exposure (service conditions)
- Desired life of the coating or structure
- Coating to be applied
- Environmental constraints
- Aesthetic requirements
- Desired finish
- Life-cycle cost considerations

2-1.2 Specification Procedure.

Use an industry surface preparation standard applicable to and compatible with the material, existing surface condition, and the selected coating. If an industry standard is not available, provide a performance-based requirement to achieve an acceptable level of surface preparation for the applied coating. Surface preparation methods and associated standards are summarized in Table 2-1.

Table 2-1 Commonly Used Methods of Surface Preparation for Coatings

(IMPORTANT NOTE: Methods may require modification or special control when existing paint or coating contains lead, cadmium, chromium, or other hazardous materials. For Navy projects, refer to UFC 3-810-01N Navy and Marine Corps Environmental Engineering for Facility Construction.)

Cleaning Method	Equipment/Standard	Comments
Organic solvent	Solvents and applicators such as mineral spirits, sprayers, and rags SSPC-SP 1	Removes oil and grease not readily removed by other methods. Take precautions to avoid fires and environmental contamination. Local VOC regulations may restrict use.
Water cleaning with or without detergent or emulsion type cleaners / power washing	Pumps, chemicals, sprayers, brushes SSPC-SP 1	At pressures not exceeding 2,000 psi (14MPa), removes soil, chalk, mildew, grease, and oil, depending upon composition. Good for smoke, stain, chalk, and dirt removal.
Acid	Chemicals, sprayers, and brushes SSPC-SP 1	Removes residual efflorescence and laitance from concrete after dry brushing. Thoroughly rinse to remove acid cleaners.
Chemical paint strippers	Chemicals, sprayers, scrapers, washing equipment No standard	Remove coatings from most substrates, but can be slow, messy, and expensive. May degrade surface of wood substrates. Refer to SSPC-TU 6, Chemical Stripping of Organic Coatings from Steel Structures.
Steam	Heating system pump, lines, and nozzles SSPC-SP 1	Removes heavy oil, grease, and chalk. Usually used prior to other methods.
Low-pressure water cleaning	Low pressure water pumps, lines, and nozzles SSPC-SP 1	At pressures of 2,000 psi to 5,000 psi (14 MPa to 34 MPa), may remove loose paint from steel, concrete, and wood. Can damage wood or masonry unless care is taken. Flash rusting of steel may occur.

High-pressure water cleaning	High pressure water pumps, lines, and nozzles SSPC-SP 1	At pressures of 5,000 psi to 10,000 psi (34 MPa to 70 MPa), removes loose paint from steel, concrete and wood. Can damage wood or masonry unless care is taken. Flash rusting of steel may occur.
Hand tool	Wire brushes, chipping hammers, and scrapers SSPC-SP 2	Removes only loosely adhering contaminants. Used mostly for spot repair. Slow and inconsistent.
Power tool	Wire brushes, grinders, sanders, needle guns, and rotary peeners SSPC-SP 3 SSPC-SP 15 SSPC-SP-11	Faster and more thorough than hand tools because tightly adhering contaminants can be removed. Some tools give a near-white condition on steel but not an angular profile. Slower than abrasive blasting. Some tools are fitted with vacuum collection devices.
Heat	Electric heat guns No standard	Can be used to soften coatings on wood, masonry, or steel. Softened coatings are scraped away. DO NOT use torches.
Shot blasting	Metal shot propelled onto concrete floor by centrifugal force SSPC-SP 13 / NACE No. 6	Can be used to prepare concrete floors for coating. Used to remove laitance and other unsound cementitious material and to provide appropriate surface profile.
Waterjetting	High and Ultra High pressure water pumps, lines, and nozzles SSPC-SP WJ-1 / NACE WJ-1 SSPC-SP WJ-2 / NACE WJ-2 SSPC-SP WJ-3 / NACE WJ-3 SSPC-SP WJ-4 / NACE WJ-4	At pressures above 10,000 psi (70 MPa), removes all oil, grease, and paint. Generally used to remove paint and prepare steel and concrete surfaces. Specify allowable degree of steel flash rusting.

Abrasive blasting	Sand, metal shot, and metal or synthetic grit propelled onto metal by pressurized air, with or without water or centrifugal force SSPC-SP 5 / NACE No. 1 SSPC-SP 6 / NACE No. 3 SSPC-SP 7 / NACE No. 4 SSPC-SP 10 / NACE No. 2 SSPC-SP 16 SSPC-SP 17 SSPC-SP 5 (WAB) / NACE WAB-1 SSPC-SP 6 (WAB) / NACE WAB-3 SSPC-SP 7 (WAB) / NACE WAB-4 SSPC-SP 10 (WAB) / NACE WAB-2 SSPC-SP CAB-1 SSPC-SP CAB-2 SSPC-SP CAB-3	Typically used on metal and, with care, on masonry and soft metals such as aluminum, copper, and galvanizing. Recyclable abrasives can be used. Special precautions are needed when removing lead containing paint. Water may be added to control dust but may require use of inhibitors. Vacuum blasting reduces dust but is slower. Centrifugal blasting is a closed cycle system in which abrasive is thrown by a spinning vane wheel but is typically limited to shop application. Softer, lower density abrasives such as corn cobs, walnut shells, sodium bicarbonate, and plastics may be used but they do not produce a profile. They are primarily used for cleaning purposes such as decal removal from painted surfaces, paint removal from soft metals, or smoke cleanup after a fire.

2-2 TREATMENT AND REPAIR OF SURFACE IRREGULARITIES.

Repair surfaces before recoating. Replace or repair rotten wood, broken siding, and other deteriorated substrates prior to maintenance painting. Repair water-associated problems, such as deteriorated roofs and nonfunctioning drainage systems, and spaces with inadequate ventilation prior to coating. Repair cracks, holes, and other defects prior to painting.

Areas in need of repair can sometimes be identified by associated, localized paint failures. For example, localized peeling paint confined to a wall external to a bathroom may be due to inadequate venting of the bathroom.

2-2.1 Joints, Cracks, Holes, or Other Surface Defects.

Fill joints, cracks, holes, and other surface defects to create a sound substrate with an acceptable texture. Use materials which are compatible with the specified coatings.

Use caulks and sealants to fill joints and cracks in wood, metal and, in some cases, in concrete and masonry. Use putty to fill holes in wood. Use specially formulated Portland cement materials in cracks and over spalled areas in concrete. Some of these contain organic polymers to improve adhesion and flexibility. Use patching plaster to repair large areas of interior plaster, spackle to repair cracks and small holes in wallboard, and joint cement to fill joints between wallboards and repair mortar. Before application of these repair materials, ensure surfaces are clean, dry, free of loose material, and primed according to the written instructions of the material manufacturer.

2-2.2 Cementitious Surfaces.

For concrete repair, use epoxy resin systems that meet ASTM C 881. Select the appropriate material based on application and working temperature.

2-2.3 Steel.

Require removal of accumulated dirt, trash, rust scale, pack rust ,and debris prior to or in conjunction with cleaning and surface preparation operations. Use NACE SP0178 to specify degree of surface imperfection repair for critical applications. This may include removal of slag, flux deposits, weld spatter, and burrs. Use SSPC-Guide 11 to specify edge treatment for critical applications. This may include rounding sharp edges such as those created by flame cutting and shearing by grinding. The rolled edges of angles, channels, and wide flange beams do not normally require further rounding unless specifically required.

2-3 SURFACE PREPARATION.

Select the proper surface preparation method based on the substrate to be coated, condition of the substrate, and the coating to be applied. Appendix A-1 identifies best practices associated with methods of surface preparation. Grease and oil are usually removed by solvent cleaning or steam cleaning, and mildew is killed and removed with a hypochlorite (bleach) solution, as described in Appendix A.

2-3.1 Wood.

Ensure wood surfaces are dry and clean before painting. New treated lumber may require an extended time to dry. Do not expose bare wood to direct sunlight for more than two weeks before priming. Sunlight causes photodegradation of surface wood-cell walls. This results in a cohesively weak layer on the wood surface which may fail when painted. If exposed, remove this layer by sanding prior to painting. Failure of paint caused by a degraded-wood surface is suspected when wood fibers are detected on the backside of peeling paint chips.

2-3.1.1 Existing Intact Paint.

When the existing paint is intact, clean the surface with water, detergent, and bleach as needed to remove surface contaminants, such as soil, chalk, and mildew. Remove loose paint by hand scraping when the existing paint is peeling and does not contain lead. Feather paint edges by sanding. Power sanding may damage the wood if improperly done. Water and abrasive blasting are not recommended for wood, because these techniques can damage the wood. When lead paint is present, use special precautions such as wet scraping.

2-3.1.2 Removal of Existing Paint.

Remove paint from wood when failure is by cross-grain cracking (that is, cracking perpendicular to the wood grain). This failure occurs when the total paint thickness is too thick or the paint is too inflexible. Painting over this condition almost always results in early failure of the maintenance paint layer. Paint removal from wood is difficult and may not always be feasible. Chemical strippers can be used, but the alkaline types may damage (chemically degrade) the surface of the wood and cause a future peeling-paint failure. Failure caused by a stripper-degraded wood surface is more likely for exterior exposures than for interior exposures. This is because the greater expansion and contraction of wood in exterior exposures requires that the surface wood have a greater mechanical strength.

2-3.2 Concrete/Masonry.

Prepare concrete and masonry surfaces to an appropriate class of surface preparation as described in SSPC-SP CAB-1, SSPC-SP CAB-2, SSPC-SP CAB-3, or SSPC-SP 13/NACE No. 6. Bare concrete and masonry surfaces, as well as painted surfaces, are usually best cleaned with water and detergent. Use low-pressure washing (less than 2,000 psi [14MPa]) or steam cleaning (ASTM D4258) to remove loose surface contaminants from surfaces. Use low-pressure water cleaning (2,000 psi to 5,000 psi [14 MPa to 34 MPa]) (ASTM D4259) to remove loose old coatings, other more tightly held contaminants, or chalk. If existing paints contain lead, special worker safety and environmental controls will be needed.

Abrasive blasting (ASTM D4259 and ASTM D4261) or acid etching of bare surfaces (ASTM D4260) may also be used to obtain a surface profile as well as to clean surfaces for coating. Avoid damaging surfaces with high-pressure water or abrasives. Remove grease and oil with detergents or steam before abrasive blasting or acid etching. First, remove any efflorescence present by dry wire brushing or acid washing. Special worker safety and environmental controls may be needed.

2-3.2.1 Testing for Moisture Content.

Concrete surfaces must be free of standing water prior to paint application. Concrete that appears dry can absorb and transfer ground moisture. Moisture vapor emissions can cause failures in non-permeable coatings and flooring systems. For these coatings, perform a moisture vapor emission test at a representative location prior to installing the coating or flooring system.

The plastic sheet method (ASTM D4263) can be used to detect the presence of moisture in concrete. The method involves taping a piece of plastic sheet to the surface and looking for condensed moisture under the sheet after 24 hours. The inside of the sheet should be dry if the moisture content is acceptable. The anhydrous calcium chloride test (ASTM F1869) can be used to determine the Moisture Vapor Emission Rate (MVER) at a point in time and at a specific location.

2-3.3 Steel.

Prepare steel for coating by solvent cleaning as described in SSPC-SP 1. Cleaning methods described in SSPC-SP 1 include organic solvents, vapor degreasing, immersion in appropriate solvent, use of emulsion or alkaline cleaners, and steam cleaning with or without detergents. SSPC-SP 1 is specifically included as the first step in the SSPC surface preparation procedures.

Remove mill scale, rust, and existing coatings by abrasive blasting (SSPC-SP 7, SSPC-SP 6, SSPC-SP 10, SSPC-SP 5) when installing a new coating system on a steel substrate. These methods can both clean the surface and produce a surface profile. The specific abrasive method selected depends upon the conditions of the steel, the desired coating life, the environment, and the coating to be applied. If lead paint is present, take special precautions to protect workers and the environment. Allow high-pressure and ultra-high pressure water jetting, with or without injected abrasives. Prepare the surface using hand tool cleaning (SSPC-SP 2) or power tool cleaning (SSPC-SP 3 or SSPC-SP 11) for localized repair or touch-up of existing coatings.

2-3.3.1 Specific Surface Preparation Requirements for Coatings for Steel.

Different types of coatings require different levels of cleaning. Use the more stringent (highest degree of cleanliness) of manufacturer's written instructions (tech data sheets) or contract specification requirements. Table 2-2 provides typical requirements for use where other guidance is unavailable. In each cell, the surface preparation methods are listed in order of decreasing cleanliness (the highest degree of cleanliness is at the top of the list). For immersion service or ESC C3, C4 and C5 environments, use the higher degree of cleanliness where surface preparation alternatives are provided.

In Table 2-2, “New Coating System,” includes coatings applied to new surfaces and existing uncoated surfaces, and existing coated surfaces made bare by cleaning operations. “Maintenance or Touch-up” refers to work performed on existing coated surfaces or small areas of touch up which is incidental to a new coating system.

Table 2-2 Typical Steel Surface Preparation Requirements for Coatings

Coating	Minimum Surface Preparation	
	New Coating System	Maintenance or Touch-up
Drying Oil	SSPC-SP 3 SSPC-SP 2	SSPC-SP 3 SSPC-SP 2
Alkyd	SSPC-SP 6/NACE No. 3 SSPC-SP 6 (WAB)/NACE WAB-3 SSPC-SP WJ-3 / NACE WJ-3 SSPC-SP 11 SSPC-SP 15	SSPC-SP 3 SSPC-SP 2 SSPC-SP WJ-4 / NACE WJ-4
Asphaltic	SSPC-SP 6/NACE No. 3 SSPC-SP 6 (WAB)/NACE WAB-3 SSPC-SP WJ-3 / NACE WJ-3 SSPC-SP 11 SSPC-SP 15	SSPC-SP 11 SSPC-SP 15 SSPC-SP 3 SSPC-SP WJ-4 / NACE WJ-4
Latex	SSPC-SP 6/NACE No. 3 SSPC-SP 6 (WAB)/NACE WAB-3 SSPC-SP WJ-3 / NACE WJ-3 SSPC-SP 11 SSPC-SP 15	SSPC-SP 11 SSPC-SP 15 SSPC-SP 3 SSPC-SP WJ-4 / NACE WJ-4
Epoxy	SSPC-SP 10/NACE No. 2 SSPC-SP 10 (WAB)/NACE WAB-2 SSPC-SP WJ-2 / NACE WJ-2 SSPC-SP 6/NACE No. 3 SSPC-SP 6 (WAB)/NACE WAB-3 SSPC-SP WJ-3 / NACE WJ-3	SSPC-SP 11 SSPC-SP 15 SSPC-SP 3 SSPC-SP WJ-4 / NACE WJ-4
Polyurethane	SSPC-SP 10/NACE No. 2 SSPC-SP 10 (WAB)/NACE WAB-2 SSPC-SP WJ-2 / NACE WJ-2	SSPC-SP 11 SSPC-SP 15 SSPC-SP WJ-4 / NACE WJ-4
Organic Zinc	SSPC-SP 10/NACE No. 2 SSPC-SP 10 (WAB)/NACE WAB-2 SSPC-SP WJ-2 / NACE WJ-2 SSPC-SP 6/NACE No. 3 SSPC-SP 6 (WAB)/NACE WAB-3 SSPC-SP WJ-3 / NACE WJ-3	SSPC-SP 11 SSPC-SP 15 SSPC-SP WJ-4 / NACE WJ-4
Inorganic Zinc	SSPC-SP 5/NACE No. 1 SSPC-SP 5 (WAB)/NACE WAB-1 SSPC-SP 10/NACE No. 2 SSPC-SP 10 (WAB)/NACE WAB-2	SSPC-SP 11
Metalizing	SSPC-SP 5/NACE No. 1 SSPC-SP 5 (WAB)/NACE WAB-1	SSPC-SP 11

2-3.4 Galvanized Steel or Inorganic Zinc Rich Coated Surfaces.

Clean these surfaces in accordance with SSPC-SP 16.

2-3.5 Aluminum and Other Soft Metals.

Clean aluminum and other soft metals by solvent cleaning (SSPC-SP 1). Use detergents, if necessary, for removal of dirt or loose corrosion products. Abrasive blasting with plastic beads or other soft abrasives may be necessary to remove old coatings. Use SSPC-SP 16 for brush-off blast cleaning of coated and uncoated aluminum and other soft metals. Use SSPC-SP 17 for thorough abrasive blasting of aluminum and other soft metals.

2-3.6 Mildew Removal.

Remove mildew from surfaces prior to painting. Additional requirements can be found in EPA 402-K-01-001.

2-3.7 Job Specific Demonstration.

If a project includes a complex coating system or procedure, require a job-specific mock-up or test patch representative of the completed coating system. The demonstration must represent the quality of work required, use the specified products for the project, and be approved prior to initiating production-scale effort.

2-3.8 Existing Coated Surfaces.

When the surface to be painted is an old weathered coating film (that is, surface preparation will not include removal of the old coating), use ASTM visual standards to evaluate chalk, mildew, and dirt removal. A minimum chalk rating (ASTM D 4214) of 8 is required for chalk removal, a minimum mildew removal rating (ASTM D 3274) of 8 (preferably 10) is required for mildew removal, and an ASTM D 3274 rating of 10 is required for dirt removal. Consider requiring preparation of a job-specific demonstration (as described in 2-3.7) for large jobs. This demonstration will cover removal of loose material, chalk, and mildew, as well as feathering of edges, and other requirements of the contract specification.

2-4 PROCEDURES FOR PAINT REMOVAL.

It is often necessary to remove old coatings that are peeling, checking, cracking, or the like. General recommendations for removal of paint from a variety of substrates are provided in Table 2-3. More detailed Best Practices are provided in Appendix A.

Table 2-3 Procedures for Coating Removal

(IMPORTANT NOTE – Use environmental and worker safety controls when existing paint or coating contains lead, cadmium, chromium, or other hazardous materials. For Navy projects, refer to UFC 3-810-01N Navy and Marine Corps Environmental Engineering for Facility Construction.)

Substrate	Methods
Wood	Chemical paint strippers, low- or high-pressure water cleaning, heat guns or hot plates along with scraping, or power sanding (perform with caution to avoid damaging wood).
Masonry	Acid cleaners, low- and high-pressure water cleaning, waterjetting, shot blasting, brush-off abrasive blast cleaning and power tool cleaning. Exercise caution to avoid undesirable damage to the masonry.
Steel	Abrasive blast cleaning (see Table 2-1), low- and high-pressure water cleaning, water jetting, power tool cleaning, or chemical paint strippers.
Miscellaneous metals	Chemical paint strippers, brush-off abrasive blast cleaning, low- and high-pressure water cleaning, water jetting, and power tool cleaning. Exercise caution to avoid substrate damage.

2-5 PERSONNEL AND CONTRACTOR CERTIFICATION.

Require minimum personnel and company certification requirements for DoD projects. Select more stringent requirements for high performance or complex coating systems, coatings subjected to exceptional service conditions, or installations with an exceptional consequence of failure. In these instances, require personnel meeting the requirements of SSPC-ACS 1/NACE No. 13, and performing contractors with an appropriate Corporate Certification, such as SSPC Painting Contractor Certification Programs (PCCP) or NACE International Institute Contractor Accreditation Program (NIICAP).

CHAPTER 3 SELECTION OF COATINGS

3-1 GENERAL.

Provide paints and coatings that are durable and minimize the need for preventative and corrective maintenance over the expected service life of the component or system. Identify the appropriate coating to be used based on UFC, UFGS, and Master Painters Institute (MPI) requirements. Where conflicts exist, the UFC and UFGS requirements take precedence over MPI. Select appropriate durability and coating system based on the ESC and service environment. Appendix A-2 identifies best practices for selection of coating systems for common substrates. Include surface preparation as a part of the coating system because of its importance in system performance.

3-1.1 Environmental Requirements.

Comply with all applicable Federal, State and local laws and regulations that may pertain to surface preparation and coatings projects. Use MPI products meeting environmental limits for lead, chromate, asbestos, crystalline free silica, and other hazardous materials. Select products with VOC levels that meet Federal, State and local requirements ,as well as UFC 1-200-02. When there is a conflict between Federal, State and local requirements, the more stringent applies; however, at a minimum all coatings must meet the requirements of UFC 1-200-02.

3-1.2 New Surfaces.

Use coating systems that are compatible with the surfaces to which they are applied. Coating incompatibility eventually leads to premature coating failures. Select a coating system based on life-cycle costs. Life-cycle costs include surface preparation, materials, application, necessary maintenance throughout the life of the coating system, disposal costs (waste streams), and environmental impacts. Include costs associated with containment during the removal of old paints and the subsequent disposal of debris that is often considered to be hazardous waste.

3-1.3 Existing Surfaces.

This section applies to existing coated surfaces, existing uncoated surfaces and existing coated surfaces made bare by cleaning operations. Use coating systems that are compatible with the surfaces (substrate and existing coating) to which they are applied. Coating incompatibility eventually leads to premature coating failures. A coating condition survey (CCS) must be accomplished for maintenance coating designs, or to determine if maintenance overcoating is appropriate. At a minimum, the CCS must identify existing coating conditions, analysis of remaining coating life, suitability of overcoating, technical requirements for overcoating, and any other information of interest to the coating system maintenance. Appendix A-3 contains additional information on coating condition surveys.

Select a maintenance approach based on life-cycle costs. Complete replacement of a coating system is typically more expensive than maintenance painting but may provide a substantially longer service life. Life-cycle costs include surface preparation,

materials, application, necessary maintenance throughout the life of the coating system, disposal costs (waste streams), and environmental impacts. Include costs associated with containment during the removal of old paints and the subsequent disposal of debris that is often considered to be hazardous waste.

3-2 ARCHITECTURAL FINISHES.

Select durable materials for painting of new and existing, interior and exterior substrates, including masonry, concrete, metal, wood, and other miscellaneous materials from those listed in UFGS 09 90 00.

A Decision Tree that can be used as a guide in selecting Architectural Finishes is available on the MPI website (http://www.specifypaint.com/demo/demo_wbdg.html). Appendix A provides general guidance on coating system selection. Consult with an Army, Navy, or Air Force coatings specialist for applications where the coating will be subjected to exceptional service conditions or there is an exceptional consequence of failure. Note that not all coatings and systems available in MPI are included in the guide specifications. In the event of conflicts between MPI resources and DoD guide specifications, use the paint materials included in the DoD guide specifications.

3-2.1 Coating Selection for Corrosive and Humid Locations

Where available, select more durable coatings for projects located in corrosive environments and humid locations. Some of the coating systems listed in the guide specifications are explicitly for aggressive environments. Corrosive locations are defined in UFC 1-200-01, section titled "Corrosion Prone Locations". For exterior painting of metallic surfaces, corrosive locations include project locations with Environmental Severity Classifications (ESC) of C3 thru C5, or humid locations. For exterior painting of nonmetallic surfaces, corrosive locations are project locations with ESC of C4 and C5, or humid locations. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). Interior high humidity areas such as bathrooms, locker rooms, laundry rooms, pools, and trainers are also considered as corrosive locations and require more durable coatings.

When using the MPI resources, such as the MPI Decision Tree, MPI designates systems for “Normal” or Aggressive” service and identifies the coating performance level which the specifier may find helpful when selecting from coating system options. When using the MPI resources, select “Normal” for locations defined as noncorrosive and select “Aggressive” for corrosive locations.

3-2.2 Wooden Floors.

Use the UFGS for paints and coatings for surface preparation (scraping and sanding) and coating of general use wooden floors. Use the appropriate UFGS for gymnasium flooring and other special purpose athletic hardwood floors.

3-3 COATING SYSTEMS FOR SPECIFIC USES.

Use coating systems specifically designed for metal storage tanks, pipelines, towers, waterfront structures, siding, fences, hot surfaces, concrete storage tanks, swimming pools, catchment basins, pavements, concrete floors, and surfaces particularly susceptible to mold and mildew.

3-3.1 Steel Storage Tanks

3-3.1.1 Fuel Storage Tanks.

Use coatings on steel fuel tanks to keep the fuel clean and help prevent leaks resulting from corrosion. Specify internal lining of welded steel petroleum tanks and exterior coating of steel structures as required by UFC 3-460-01. Specify interior cleaning prior to condition assessment of in-service tanks in accordance with applicable UFGS. Specify cathodic protection of fuel storage tanks as required by UFC 3-570-01.

3-3.1.2 Steel Water Tanks.

Specify internal and external coating of welded steel water tanks as required by UFC 3-230-01. Specify cathodic protection of water storage tanks as required by UFC 3-570-01 to supplement the protection afforded by the coatings.

3-3.1.3 Other Steel Tanks.

Use a suitable corrosion-resistant lining (such as fiberglass-reinforced polyester) to protect the interiors of steel tanks containing wastewater, chemicals, or other corrosive liquids from corrosion. Since there are no Federal specifications for such products, consult with protective coating specialists and specialty coating suppliers. Specify exterior coating of steel structures using applicable UFGS. Cathodic protection should be considered for these tanks, but the tanks must be evaluated by a certified Cathodic Protection expert.

3-3.2 Steel Distribution Lines.

Use protective coatings on steel distribution lines containing water, fuel, or other liquids to prevent loss of product from corrosion and contamination of soils and groundwater.

3-3.2.1 Steel Fuel Lines

Protect buried and immersed steel fuel lines using coatings and cathodic protection as required by UFC 3-460-01. Use UFGS 33 52 80 for interior and exterior coating of aboveground and buried, carbon steel, liquid fuel pipelines. Specify cathodic protection as required by UFC 3-570-01 to supplement the protection afforded by the coatings.

3-3.2.2 Steel Water Distribution Lines.

Protect aboveground and buried, carbon steel, steel water distribution lines as required by UFC 3-230-01.

3-3.3 Communication Towers and Other Tall Structures.

Use the UFGS for maintenance, repair, and coating of tall antenna towers. Use marking requirements in Federal Aviation Administration (FAA) Advisory Circular 70/7460-1L.

3-3.4 Waterfront Structures.

Use the UFGS for coating of steel waterfront structures for new construction and maintenance of steel waterfront structures such as “H” piles and sheet piles.

3-3.5 Hydraulic Structures and Appurtenant Works.

Use the UFGS for hydraulic structures for coating items such as locks, gates,and associated pipelines and equipment. Specify cathodic protection when appropriate.

3-3.6 Factory Finished Metal Siding.

Factory-finishing of steel, galvanized steel, or aluminum siding is accomplished by specialized procedures (such as coil coating) using commercial products. Follow the manufacturer recommended coating repair methods.

3-3.7 Hot Steel Surfaces.

Conventional coatings cannot protect mufflers, stacks, and other hot steel. Use specialty coatings selected by the equipment manufacturer for new construction and maintenance.

3-3.8 Concrete Fuel Tanks.

Consult a DoD coatings specialist for maintaining coatings on existing concrete fuel tanks.

3-3.9 Concrete Swimming Pools.

Consult swimming pool operations and maintenance manuals for maintenance painting of interior and exterior swimming pools.

3-3.10 Chemically Resistant Finishes for Concrete Floors.

Use the UFGS for fuel resistive coatings to install chemically resistant coating systems (resistant to fuels and hydraulic fluids). Consult the activity industrial hygienist for coatings on floors where chemicals or hazardous waste is stored.

3-3.11 Fouling-Resistant Coatings.

Antifouling coatings may be used on immersed portions of marker buoys and water cooling pipelines. For marker buoys, follow NAVSEA practices for ship hull antifoulant in NAVSEA Standard Item 009-32, Table One. For water cooling exchange pipelines, follow current industrial practices.

3-3.12 Mildew Resistant Coatings.

Mildewcides in paints are used to control mildew growth in the can and on the paint after application. Abate mildew growth on painted or unpainted surfaces of buildings, repair damaged areas, and clean substrates prior to applying a new or maintenance coating.

3-3.13 Pavement Markings.

Use the UFGS for pavement markings to install markings and applicable products on airfield and road pavements.

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CHAPTER 4 APPLICATION

4-1 GENERAL.

Review coating suppliers Technical Data Sheets (TDS) or Product Data Sheets (PDS) and Safety Data Sheets (SDS) for each product to be used. Unless otherwise specified, comply with the storage requirements, application instructions, environmental parameters, mixing, curing time, thinning, and film thickness shown on the TDS/PDS.

If thinning is necessary, require a thinner product recommended by the coating manufacturer. Do not exceed the thinner volume recommended by the coating manufacturer or allowed by VOC regulations. Job site tinting is not allowed. The coating manufacturer or certified agent must tint all coatings.

4-1.1 Safety and Environmental Restrictions.

Comply with all applicable Federal, State, and local laws and regulations that may pertain to surface preparation and coatings projects. For Navy projects, refer to UFC 3-810-01N. Air Force components must comply with Air Force Manual (AFMAN) 91-203; in addition, always check with the local Bioenvironmental Department for local requirements. For Army projects, utilize EM 385-1-1 in addition to installation environmental requirements.

4-2 WEATHER CONDITIONS AFFECTING APPLICATION OF PAINTS.

Review the coating manufacturer's technical data sheets to determine if the environmental limits as well as other constraints on application of the paint are readily achieved. Include any extraordinary requirements in the project specifications.

4-3 METHODS OF APPLICATION.

Review the coating manufacturer's technical data sheets to determine if the methods of application are readily achieved. Include any extraordinary requirements in the project specifications.

4-4 PERSONNEL AND CONTRACTOR CERTIFICATION.

UFGS have minimum Contractor certification levels and may have more stringent requirements based on project specifics. Select more stringent requirements for high performance coating systems, complex coating systems, coatings subjected to exceptional service conditions, or installations with an exceptional consequence of failure. In these instances, require personnel meeting the requirements of SSPC-ACS 1/NACE No. 13, and performing contractors with an appropriate Corporate Certification: SSPC Painting Contractor Certification Programs (PCCP) or NACE International Institute Contractor Accreditation Program (NIICAP).

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CHAPTER 5 INSPECTION OF PAINTING OPERATIONS

5-1 GENERAL.

Inspect painting operations to ensure conformance with the specification requirements. Depending upon the job and the contract requirements, quality-control inspectors may be contractor-supplied (that is, contractor quality control - CQC) or Government personnel. Include clear quality-control technical requirements, reporting requirements, and adjudication processes.

5-2 CONTRACTOR QUALITY CONTROL INSPECTION.

UFGS documents contain minimum quality-control requirements for DOD projects, which may be monitored by the contractor. Require a qualified third-party inspector for high performance or complex coating systems, coatings subjected to exceptional service conditions, or installations with an exceptional consequence of failure.

5-2.1 Duties of an Inspector.

The duties of an inspector include understanding the contract specification requirements, documenting performance of the contract in accordance with the specification, reporting rework requirements, and documenting rework. Keep records during all phases of the job. Records form an important part of the permanent record on each building and provide key information in the case of warranty claims and contract disputes.

5-3 WARRANTY INSPECTION.

Include a warranty inspection requirement for coatings that will be subjected to exceptional service conditions or with an exceptional consequence of failure. The warranty inspection includes a visual inspection of the film, and may involve chalk, film thickness, and adhesion measurements. Any defects found during the warranty inspection must be corrected by the Contractor.

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APPENDIX A BEST PRACTICES

The Best Practices Appendix is considered guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

A-1 METHODS OF SURFACE PREPARATION.

Information on surface preparation methods and procedures is presented to help select appropriate general procedures and to inspect surface preparation jobs. It is not intended to be a complete source of information for those doing the work.

A-1.1 Abrasive Blasting.

Abrasive blast cleaning is most often associated with cleaning painted and unpainted steel. It may also be used with care to prepare concrete and masonry surfaces and to clean and roughen existing coatings for painting. Abrasive blasting is an impact cleaning method. High-velocity abrasive particles—driven by air, water, or centrifugal force—impact the surface to remove rust, mill scale, and old paint from the surfaces. Abrasive cleaning does not remove oil or grease. If the surface to be abrasive blasted is painted with lead paint, employ additional controls to minimize hazards to workers and the surrounding environment.

There are five degrees of cleanliness of blast cleaning designated by the SSPC/NACE standards for steel substrates. These designations are white metal, near-white metal, commercial, brush-off, and industrial. Note: Industrial is NOT an acceptable method for DoD components. Acceptable methods are summarized in Chapter 2. The degree of cleanliness obtained in abrasive blasting depends on the type of abrasive, the force with which the abrasive particles hits the surface, and the dwell time.

A-1.1.1 Air (Conventional).

In conventional abrasive blasting, dry abrasive is propelled against the surface to be cleaned so that rust, contaminants, and old paint are removed by the impact of the abrasive particles. Clean the surface of blasting residue before painting. This is usually done by vacuuming the surface. In the past, blowing clean air across the surface was used and termed “blow down”. However, this approach has the side effect of pushing the abrasive media into the substrate. This is especially noticeable in high profile requirements, where a tape test is used to verify the substrate is free of embedded grit and dust. Uncontrolled abrasive blasting is restricted in most locations because of environmental regulations. Consult the local industrial hygiene or environmental office for regulations governing local actions. Procedures for containment of blasting debris are being used for paint removal from industrial and other structures. SSPC has developed a guide (SSPC-Guide 6) for selecting containment procedures depending upon the degree of containment desired. Recycling the abrasive can reduce the amount of debris generated. Recycling systems separate the paint waste from the abrasive.

A-1.1.2 Wet Abrasive Blasting.

Wet-abrasive blasting is used to control the amount of airborne dust. It may be considered when dry abrasive blasting cannot be used due to environmental or worker safety restrictions. There are two general types of wet abrasive blasting. In one, water is injected near the nozzle exit into the stream of abrasive. In the other, water is added to the abrasive at the control unit upstream of the nozzle and the mixture of air, water, and sand is propelled through the hose to the nozzle. For both types of wet blasting, the blasting and rinsing water may contain a corrosion inhibitor if approved by the coating manufacturer. After wet blasting, rinse the surface free of spent abrasive. The surface must be completely dry before coating. When lead paint is present, the water and other debris must be contained and disposed of properly. This waste may be classified as a hazardous waste under Federal and local regulations and must be handled accordingly.

A-1.2 Ultra High Pressure Waterjetting

Waterjetting is an alternative method of removing coating systems or other materials from surfaces prior to the application of a protective coating or lining system. Waterjetting can be effective in removing water-soluble surface contaminants that may not be removed by dry abrasive blasting alone, specifically, those contaminants found at the bottom of pits of severely corroded metallic substrates. Waterjetting also helps to remove surface grease and oil, rust, shotcreting spatter, and existing coatings and linings. Waterjetting is also used in areas where abrasive blasting is not a feasible method of surface preparation.

Waterjetting does not provide the primary anchor pattern on steel known to the coatings industry as “profile.” The coatings industry uses waterjetting primarily for recoating or relining projects in which there is an adequate preexisting profile. Waterjetting has application in a broad spectrum of industries. It is used when high-performance coatings require extensive surface preparation or surface decontamination.

A-1.3 Acid Cleaning.

Acid cleaning is used for cleaning efflorescence and laitance from concrete. Remove heavy efflorescence and laitance from concrete surfaces by dry brushing or cleaning prior to acid cleaning. This is to prevent dissolution of the efflorescence and subsequent movement of the salts into the concrete. Prior to application of an acid solution, remove heavy oil, grease, and soil deposits. Oily dirty deposits can be removed by solvent or detergent washing.

A-1.4 Chemical Removal of Paint.

SSPC-TU 6 (Chemical Stripping of Organic Coatings from Steel Structures) outlines the selection and use of chemical strippers to remove paint. Paint strippers can be used when complete paint removal is necessary; other removal methods cannot be used due to environmental restraints, operational restraints or potential damage to the substrate or surrounding equipment. Removers are selected according to the type and condition of the old coating as well as the nature of the substrate. They are available as

flammable or nonflammable types and in liquid or semi-paste types. If paint being removed contains lead, additional environmental and worker safety precautions will be needed. Removers are usually toxic and may be fire hazards. Management of the waste associated with the procedure will also be necessary. Consult the local environmental and safety offices for further information.

A-1.5 Solvent Cleaning.

SSPC-SP 1, Solvent Cleaning, defines solvent cleaning in surface preparation. This standard is included as a first step to other surface preparation standards. This standard defines the end-condition of a metal surface from which visible deposits of oil, grease, and other visible contaminants have been removed in preparation for subsequent application of protective coatings or for the use of additional methods to prepare the surface for the application of coatings. The standard also includes requirements for materials and procedures necessary to achieve and verify the end condition. A “solvent” is defined as any liquid or vapor that will dissolve or emulsify visible deposits of soluble contaminants on the surface. Examples of solvents include water, emulsion, or alkaline cleaners, and hydrocarbons.

A-1.6 Hand Tool Cleaning.

SSPC-SP 2, Hand Tool Cleaning, defines hand cleaning. It is primarily used to remove loose mill scale, loose rust, loose paint, and other loose detrimental material. This approach is more applicable to spot repairs in areas where deterioration is not a serious factor or in areas inaccessible to power tools. Remove grease or oil (SSPC-SP 1) prior to hand tool cleaning. Since hand cleaning removes only the loosest contaminants, select primers that are capable of thoroughly wetting the surface. Paint applied to hand-cleaned, steel surfaces has been shown to reduce longevity when compared to application on better-prepared substrates.

A-1.7 Power Tool Cleaning.

SSPC-SP 3, Power Tool Cleaning, defines power tool cleaning. It is primarily used to remove loose mill scale, loose rust, loose paint, and other loose detrimental material. This approach is more applicable to spot repairs in areas where deterioration is not a serious factor. This approach can be used to remove more tightly adhering contaminants and existing paint than hand tool cleaning. SSPC-SP 11 defines a cleanliness level comparable to SSPC-SP 10/NACE No. 2. Some power tools can be used to achieve an anchor profile comparable to abrasive blasting but not as deep. As with other surface preparation methods, remove grease, oil and other contaminants prior to power tool cleaning.

A-1.8 Non-Standard / Non-Traditional Surface Preparation Methods.

Surface preparation methods may be used on substrates not intended by a standard or design of the method. A SSPC Protective Coatings Specialist must be involved in the selection and use for industrial type substrates. For commercial / architectural

applications consult MPI Level Two A for new construction or MPI Level Two B for repainting / maintenance.

A-1.9 Mildew Removal.

When a surface is to be cleaned for repainting, scrub with a solution of 2/3 cup (0.16 L) of trisodium phosphate (TSP), 1 liquid ounce of household detergent, 1 quart (0.95L) of 5-1/4 percent sodium hypochlorite (available as household bleach), and 3 quarts (2.8L) of warm water. Use rubber gloves with this caustic solution and rinse it from the surface with water after scrubbing. It will degrade alkyd and other oil-based coatings, but this will be no problem if the surface is to be repainted. An alternate procedure is to remove all the visible mildew by water cleaning at about 700 psi (5 MPa) at the nozzle and kill the rest by rinsing with a solution of 1 quart (0.95L) of 5-1/4 percent sodium hypochlorite and 3 quarts (2.8L) of warm water. If a painted surface is to be merely cleaned without repainting, apply the scrubbing solution without the TSP to avoid damage to the paint. Apply it first to a small test area to see if the hypochlorite bleaches the paint. If the TSP solution causes any damage, clean with detergent and water only.

Mildew on field structures can be distinguished from dirt with bleach. Common household hypochlorite bleach will cause mildew, but not dirt, to whiten.

A-1.10 Methods for Repairing Surface Defects.

A-1.10.1 Caulking and Sealant Compounds.

Caulking and sealant compounds are resin-based ,viscous materials. These compounds tend to dry on the surface but stay soft and tacky underneath. Sealants have application properties similar to caulking materials but tend to be more flexible and have greater extendibility than caulks. Sealants are often considered more durable than caulks and may be more expensive. Commonly available generic types of caulks and sealants include oil-based, butyl rubber, acrylic latex, silicone, polysulfide, and polyurethane. The oil-based and butyl-rubber type are continually oxidized by exposure to sunlight and become brittle on aging. Thus, their service life is limited. Acrylic-latex and silicone caulks tend to be more stable and have longer service lives. NOTE: Unless formulated for painting, silicone caulks will not hold paint. Applications are usually made with a caulking gun. However, some of these materials may also be available as putties or in preformed extruded beads that can be pressed in place.

A-1.10.2 Putty and Glazing Compounds.

Putty and glazing compounds are supplied in bulk and applied with a putty knife. Do not use putties for joints and crevices that require flexible fillers. Glazing compounds set firmly, but not hard, and thus retain some flexibility. Use acrylic-latex paints, such as MPI’s “Exterior Latex” series (MPI 10 – flat, MPI 11 – semigloss or MPI 119 – gloss) over flexible caulking, sealing, and glazing compounds.

A-2 COATING SYSTEMS FOR COMMON SUBSTRATES.

This section provides general recommendations for wood, concrete and masonry, steel, galvanized steel, and aluminum surfaces. A decision tree that can be used as a guide in selecting architectural finishes is available on the Whole Building Design Guide (WBDG) website (http://www.specifypaint.com/demo/demo_wbdg.html).

A-2.1 Recommendations for Wood.

Oil-based coatings (alkyds), waterborne coatings (acrylic emulsions and latex), and stains perform well on wood. A two-coat system consisting of either a paint or stain is typically sufficient. However, as overcoats are applied to resurface or repair weathered paint, the system's film thickness may become too thick, resulting in the disbonding of the total paint system. Generally, no more than three or four overcoats of new paint will be applied to an existing system. Once this build-up occurs, remove some or all of the existing system prior to application of a new coating system.

Surface preparation of new wood generally consists of a light sanding with special care taken to not damage the wood. Sanding is also appropriate for preparing weathered surfaces for refinishing and for spot repairing areas of localized damage.

A-2.1.1 Oil-Based Paints.

Wood has been successfully painted with oil-based products that penetrate the surface well. These coatings are very easy to apply.

A-2.1.2 Water-Emulsion Paints.

Latex coatings are very effective in providing attractive, protective finishes. They are also less affected by moisture than are oil-based finishes and are generally more flexible and thus less susceptible to cracking as the wood swells and contracts with moisture changes.

A problem sometimes arises when repairing or top coating existing smooth alkyd coatings with latex paints. To obtain good intercoat adhesion, it may be necessary to lightly abrade the existing paint, wipe down, and apply a suitable primer (sometimes called a "transition" or "universal" primer) before applying the first coat of latex paint.

A-2.1.3 Semi-Transparent Stains.

Because oil-based and waterborne paints form continuous films, they may form blisters or disbond because of moisture in the wood attempting to escape. Semi-transparent stains do not form continuous films on wood and so do not have this problem. Thus, they are a good alternative on new wood. However, additional coats applied over the years or heavy-bodied stains will form continuous films.

A-2.1.4 Clear Floor Finishes.

Varieties of clear floor finishes are available for hardwood floors. UFGS documents contain detailed requirements for hardwood floors used in gymnasiums and other applications.

A-2.2 Recommendations for Concrete and Masonry Surfaces.

Concrete and masonry surfaces, as well as those of stucco, plaster, wallboard, and brick, can be coated with a variety of systems depending upon the desired purpose and appearance.

Surface preparation is usually accomplished by power washing with an aqueous detergent solution to remove dirt and other loose materials. Remove any oil or grease by solvent or steam cleaning; any mildew, by scrubbing with bleach; and any efflorescence or laitance, by brushing followed by acid treatment.

A-2.2.1 Waterborne Coatings.

A two-coat waterborne (latex) system provides an attractive breathing film that is normally less affected by moisture in the concrete than non-breathing systems. The latex material is a self-primer in this service, unless otherwise stated. Do not apply alkyd and other oil-based coatings directly to concrete or masonry surfaces, because the alkalinity in the concrete will hydrolyze (breakdown) the binder and cause the coating to peel. However, they can be applied over concrete or masonry surfaces primed with waterborne coatings to produce a tougher, more washable finish.

A-2.2.2 Elastomeric Coatings.

Elastomeric, waterborne acrylic coating systems perform well to seal and protect concrete/masonry surfaces and are normally very low in VOCs. They can successfully bridge fine or larger caulked cracks.

A-2.2.3 Textured Coatings.

Textured coating systems can bridge fine cracks and waterproof from wind-driven rain. They are normally applied over a primer recommended by the supplier to ensure good adhesion. They are available in a variety of textures and may be waterborne, oil or rubber-based products with a VOC limit of 250 grams per liter.

A-2.2.4 Epoxy Coatings.

A two-coat epoxy system will seal and protect concrete/masonry surfaces well. An aliphatic urethane finish coat should be used rather than the second epoxy coat on exterior surfaces to improve the weatherability.

A-2.2.5 Linseed Oil

Linseed oil is effective for sealing, waterproofing and anti-spall protection of concrete where freezing temperatures may cause damage. It is used on roads, bridge decks, sidewalks, curbs, parking ramps, floors, walkways, and other such concrete construction.

A-2.3 Recommendations for Steel.

High-performance coating systems are recommended to prolong the service life of steel structures before it becomes necessary to remove and replace it. Costs for coating maintenance on existing structures can be very high, especially where there are restrictions on abrasive blasting.

Abrasive blasting is always preferred to alternative methods of preparing steel surfaces for painting. It cleans the steel and provides a textured surface to promote good primer adhesion. A commercial blast (SSPC-SP 6/NACE No. 3) is normally adequate for alkyd and epoxy primers for a moderate environment such as interior exposures. A near-white blast (SSPC-SP 10/NACE No. 2) is required for epoxies, including zinc-rich epoxies, exposed to a severe environment such as exterior, marine atmospheric or water or fuel immersion. Some manufacturers may specify a white metal blast (SSPC-SP 5/NACE No. 1) for particular coatings for special applications. It is important that a contract specification does not conflict with the coating manufacturer's written directions. Inorganic zinc-rich primers require a white metal surface with a sharp angular surface profile. Few power tools provide this type of surface. If abrasive blasting cannot be done, then power tool cleaning to bare metal (SSPC-SP 11) can be specified with the additional requirement for an angular profile having a depth meeting the requirements of the coating manufacturer. Hand tool cleaning (SSPC-SP 2) or power tool cleaning (SSPC-SP 3) should not be specified for inorganic zinc primers.

A-2.3.1 Alkyd Systems.

In the past, most military steel structures with atmospheric exposures were coated with an alkyd or other oil-based system. On new painting, they are being replaced in significant part by epoxy systems that provide longer protection. Alkyd systems, however, might still be used for repairing old deteriorated alkyd systems. Alkyd coatings must never be applied directly to concrete or zinc-rich surfaces such as zinc-rich coatings, galvanizing, or zinc containing alloys (to name a few).

A-2.3.2 Epoxy Coating Systems.

A three-coat epoxy system provides good interior service in harsh and moderate environments. An aliphatic urethane finish system is used in place of the third epoxy coat in exterior service to provide greater resistance to deterioration by ultraviolet light. Newer topcoats include Fluorinated Aliphatic Polyurethanes, which provide much better resistance to UV and promise to at least double the life of previous systems. Several different epoxy mastic systems, some aluminum-filled, have been used successfully on steel structures.

A-2.3.3 Zinc-Rich Coatings.

Organic and inorganic zinc-rich coatings can provide good protection from corrosion and abrasion. Inorganic zinc-rich coatings perform well without topcoats in a variety of environments except acidic or alkaline. Inorganic zinc-rich coatings may be topcoated with an acrylic latex finish coat to provide a variety of color finishes or a color pigmented coating of the inorganic zinc-rich coating without the zinc. Epoxy (for interior) or epoxy and aliphatic urethane (for exterior) topcoats may also be used for both types. Localized repair of inorganic zinc systems is usually accomplished with a zinc-rich organic coating to permit good bonding to any exposed steel, inorganic coating, or organic topcoats.

A-2.4 Recommendations for Galvanized Steel.

Galvanized steel corrodes very slowly in moderate environments but may be painted with organic coating systems to provide color or additional corrosion protection, particularly in severe environments. It should never be coated directly with an alkyd paint because the alkalinity on the surface of the galvanizing will hydrolyze the oil in the binder, degrading the binder, and cause paint peeling.

New galvanized steel should be solvent- or steam-cleaned (SSPC-SP 1, Solvent Cleaning) to remove all grease and oil before coating. Older, untopcoated galvanizing should be power-washed to remove any dirt or loose zinc corrosion products. Remove loose coatings by power-washing or scraping and sanding to produce a clean, sound surface. Remove rust by waterjet cleaning to SSPC-SP WJ-2/NACE WJ-2 or SSPC-SP WJ-1/NACE WJ-1 per coating manufacturer requirements or by careful abrasive blasting in accordance with SSPC-SP 16 to limit the removal of galvanizing.

A-2.4.1 Epoxy Systems.

Two coats of epoxy will provide long-term protection to galvanizing in interior service, as will one coat of epoxy and one coat of aliphatic urethane in exterior service. NOTE: Avoid abrasive blasting or waterjet cleaning of light gauge metals / substrates such as sheet metal. The high velocity behind these methods can warp the substrate.

A-2.4.2 Waterborne System.

Two coats of latex paint will provide a pleasing appearance and good protection to galvanized steel in moderate environments.

A-2.5 Recommendations for Aluminum.

Aluminum surfaces corrode very slowly in moderate environments. They may be coated to provide color or additional protection, particularly in severe environments. Epoxy and epoxy/urethane systems perform well in interior or exterior service, respectively. Alkyd systems usually require surface pretreatments containing toxic materials.

Because aluminum surfaces are relatively soft, they should not be cleaned by blasting with conventional abrasives or grinding to avoid damage. Remove grease or oil by solvent or steam cleaning (SSPC-SP 1). Remove dirt and other loose contaminants by

power washing. Existing coatings are best removed by careful abrasive blasting in accordance with SSPC-SP 16. Alkaline strippers must never be used; they will attack the aluminum.

A-2.5.1 Epoxy Systems.

Two coats of epoxy will provide long-term protection to aluminum in interior service, as will one coat of epoxy and one coat of aliphatic urethane in exterior service. NOTE: Avoid abrasive blasting or waterjet cleaning of light gauge metals / substrates such as sheet metal. The high velocity behind these methods can warp the substrate.

A-2.5.2 Waterborne System.

Two coats of latex paint will provide a pleasing appearance and good protection to aluminum in moderate environments.

A-3 COATING CONDITION SURVEYS (CCS).

A-3.1 Purpose.

The term "maintenance coating" may include overcoating of existing coated surfaces or coating of existing coated surfaces made bare by cleaning operations. The risks of overcoating can usually be avoided by designing project to remove all existing coatings to bare metal, then providing appropriate surface preparation and coating application. However, the extra costs of the coating removal, especially if containing hazardous material, along with the cost of surface preparation to SSPC-SP 10 Abrasive Blast to Near-White Metal, may be exorbitant compared to the costs of maintenance overcoating where the existing coating system is in fair-to-good condition. For maintenance coating design, or to determine if overcoating is appropriate, a coating condition survey should be accomplished.

Note that the aesthetic features of a coating do not define the coating condition; they only describe how the coating looks. Many coating systems have been replaced when only the topcoat needs "refurbishment." Likewise, many structures such as water tanks and fuel tanks have had complete coating replacement when only the roof coating needed replacement. A CCS can identify the weak components as well as the satisfactory components and propose solutions to make maximum use of existing resources.

A-3.2 Scope of Survey.

The scope of the CCS should be tailored to the specific project, and it should be recognized that while multiple coating failures or deficiencies may look similar, the risks of generalizing to save evaluation costs are potentially very high. The cost of large-scale overcoating failure and subsequent replacement of the coating system is far more than the cost of a CCS for all but the smallest projects.

The CCS should be accomplished by personnel from a business that routinely performs coating evaluations, and the individual investigator should be certified by SSPC as a

Protective Coatings Specialist. The CCS should be sufficiently detailed to provide all technical information about the coatings, and structures to be coated, required to properly design the project. At a minimum, the CCS should provide a detailed report of:

- Existing coating conditions, including condition of coating film, and the existence of potentially hazardous substances that may impact coating management (such as lead, cadmium, chromium);
- Analysis of remaining coating life, suitability of overcoating, and technical requirements for overcoating;
- Technical recommendations for the most cost-effective maintenance of existing coating systems, including any hazardous materials present in paint film; and
- Any other information of interest to the coating system maintenance that should be identifiable by an individual trained and experienced in the field of coating analysis, coating failure analysis, and coating design.

A-3.3 Lead and Other Hazardous Materials.

The requirements for removal and disposal of coatings which contain lead are provided in UFGS 02 83 00 and UFGS 09 97 02. Additional guidance is provided in SSPC-Guide 6 and SSPC-Guide 7.

A-3.4 Other CCS Uses.

Activities should consider an annual CCS to survey all structures to be authorized for design in the coming year. When accomplished for multiple projects, the per-structure cost will decrease. By accomplishing this survey prior to design, the basis for design is fully identified.

The CCS can also be a very useful tool when used to screen structures for maintenance painting requirements. A CCS can be scoped to provide a general inspection of many structures to screen for near-term overcoating or recoating requirements. If necessary, a subsequent investigation can provide appropriate details for project planning and design.

A-3.5 CCS Guidance Document.

SSPC Technology Update SSPC-TU 3 Maintenance Overcoating should be used as a guide for scoping the CCS, for accomplishing the CCS, and for designing the coating work.

A-4 LIFE CYCLE COST CONSIDERATIONS FOR COATINGS.

A-4.1.1 Opportunity When Coating New Structures.

The designer of the first coating system for a new fuel tank, pipeline or other constructed facility has the unique opportunity to specify a system that can provide the best life-cycle performance service. Often the coating system—surface preparation, priming and in some cases application of the complete coating system—can be carried out in a shop environment where the environmental and application parameters can be controlled. Whether shop- or field-applied, by controlling the various coating task application conditions, the surface can be very well prepared and the film properties obtained after curing are optimum. Since the cost difference of the "best" materials may not be much greater than the cost of "poor" materials, the use of these materials must be evaluated on a life-cycle performance basis when selecting the coating system if lower cost coating systems are being considered. Maintenance painting is always more difficult and costlier than shop painting ,and frequent maintenance painting on constructed facilities may interfere unacceptably with the mission of the structure. Thus, high-performance systems provide the optimum life-cycle performance and the appropriate high-performance system must always be specified on new construction or maintenance applications.

APPENDIX B GLOSSARY

B-1 ACRONYMS

AFCEC	Air Force Civil Engineer Center
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	ASTM International
BIA	Bilateral Infrastructure Agreement
CCR	Criteria Change Request
CCS	Coating Condition Survey
CQC	Contractor Quality Control
DoD	Department of Defense
EPA	United States Environmental Protection Agency
ESC	Environmental Severity Classification
FAA	Federal Aviation Administration
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
L	Liter
MPa	Megapascal
MPI	Master Painters Institute
NACE	NACE International – The Corrosion Society
NAVFAC	Naval Facilities Engineering Systems Command
NAVSEA	Naval Sea Systems Command
NICAAP	NACE International Institute Contractor Accreditation Program
OSHA	United States Occupational Safety and Health Administration
PCCP	SSPC Painting Contractor Certification Programs
PDS	Product Data Sheet

psi	Pounds per square inch
SDS	Safety Data Sheet
SOFA	Status of Forces Agreements
SSPC	SSPC – The Society for Protective Coatings
TDS	Technical Data Sheet
TSP	Tri Sodium Phosphate
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
U.S.	United States
UV	Ultraviolet
VOC	Volatile Organic Compounds

B-2 DEFINITION OF TERMS

Coating: (1) A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer [ASTM D 16]; (2) Generic term for paint, lacquer, and enamel (from SSPC Glossary)

Corrosion: The deterioration of a material or its properties due to a reaction of that material with its chemical environment. (from 10 USC §2228(f))

Corrosion prone locations: Locations with one or more of the following characteristics (1) Exterior exposed metallic elements at a location with an ESC of C3, C4, or C5, (2) Exterior exposed nonmetallic elements at a location with an ESC of C4 or C5, (3) Locations where microenvironmental factors (for example, prevailing winds, ventilation, waterfront environments, industrial emissions, deicing salt application, possible chemical splash/spillage, adverse weather events such as flooding or wind-driven rain, and penetrations of the building envelope) may create a locally corrosive environment regardless of ESC, (4) Humid locations identified in ANSI/ASHRAE/IES 90.1 as climate zones 0A, 1A, 2A, 3A, 3C, 4C, and 5C, and (5) High humidity interior areas (for example, bathrooms, locker rooms, laundry rooms, pools, and trainers).

Environmental Severity. Describes the corrosivity of the local environment of a given location or region.

Environmental Severity Classification (ESC): A classification of geographical macro environments developed by DoD based on the International Standards Organization Corrosivity Classification Method. Additional details are available at https://www.wbdg.org/ffc/dod/cpc-source/environmental-severity-classification.

Paint: (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material. (from SSPC Glossary)

APPENDIX C REFERENCES

ASHRAE

https://www.ashrae.org/

ANSI/ASHRAE/IES Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL

https://www.astm.org/

ASTM C881/C881M-20, *Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete*

ASTM D3274-09(2017), *Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation*

ASTM D4214-07(2015), *Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films*

ASTM D4258-05(2017), *Standard Practice for Surface Cleaning Concrete for Coating*

ASTM D4259-18, *Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application*

ASTM D4260-05(2017), *Standard Practice for Liquid and Gelled Acid Etching of Concrete*

ASTM D4261-05(2018), *Standard Practice for Surface Cleaning Concrete Masonry Units for Coating*

ASTM D4263-83(2018), *Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method*

ASTM F1869-16a, *Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride*

ENVIRONMENTAL PROTECTION AGENCY

https://www.epa.gov/

EPA 402-K-01-001, *Mold Remediation in Schools and Commercial Buildings*

FEDERAL AVIATION ADMINISTRATION

https://www.faa.gov/

FAA Advisory Circular 70/7460-1L, *Obstruction Marking and Lighting*

NACE INTERNATIONAL

https://www.nace.org

NACE SP0178, *Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service*

Joint SSPC/NACE standards are listed under the SSPC heading

NAVSEA

https://www.navsea.navy.mil/

NAVSEA Standard Item 009-32, *Cleaning and Painting Requirements; accomplish*

U.S. AIR FORCE

Air Force Manual (AFMAN) 91-203, *Air Force Occupational Safety, Fire, and Health Standards*

U.S. ARMY

EM 385-1-1, *Safety and Health Requirements*

SSPC – THE SOCIETY FOR PROTECTIVE COATINGS

www.sspc.org

SSPC-ACS 1/NACE No. 13, *Industrial Coating and Lining Application Specialist Qualification and Certification*

SSPC-Guide 6, *Guide for Containing Surface Preparation Debris Generated during Paint Removal Operations*

SSPC-Guide 7, *Guide to the Disposal of Lead-Contaminated Surface Preparation Debris*

SSPC-Guide 11, *Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating*

SSPC-SP 1, *Solvent Cleaning*

SSPC-SP 2, *Hand Tool Cleaning*

SSPC-SP 3, *Power Tool Cleaning*

SSPC-SP 5/NACE No. 1, *White Metal Blast Cleaning*

SSPC-SP 6/NACE No. 3, *Commercial Blast Cleaning*

SSPC-SP 7/NACE No. 4, *Brush-Off Blast Cleaning*

SSPC-SP 10/NACE No. 2, *Near White Metal Blast Cleaning*

SSPC-SP 11, *Power Tool Cleaning to Bare Metal*

SSPC-SP 13/NACE No. 6, *Surface Preparation of Concrete*

SSPC-SP 15, *Commercial Grade Power Tool Cleaning*

SSPC-SP 16, *Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals*

SSPC-SP 17, *Thorough Abrasive Blast Cleaning of Non-Ferrous Metals*

SSPC-SP WJ-1/NACE WJ-1, *Waterjet Cleaning of Metals -- Clean to Bare Substrate*

SSPC-SP WJ-2/NACE WJ-2, *Waterjet Cleaning of Metals -- Very Thorough Cleaning*

SSPC-SP WJ-3/NACE WJ-3, *Waterjet Cleaning of Metals -- Thorough Cleaning*

SSPC-SP WJ-4/NACE WJ-4, *Waterjet Cleaning of Metals -- Light Cleaning*

SSPC-SP 5 (WAB)/NACE WAB-1, *White Metal Wet Abrasive Blast Cleaning*

SSPC-SP 6 (WAB)/NACE WAB-3, *Commercial Wet Abrasive Blast Cleaning*

SSPC-SP 7 (WAB)/NACE WAB-4, *Brush-Off Wet Abrasive Blast Cleaning*

SSPC-SP 10 (WAB)/NACE WAB-2, *Near White Metal Wet Abrasive Blast Cleaning*

SSPC-SP CAB-1, *Thorough Blast Cleaning of Concrete*

SSPC-SP CAB-2, *Intermediate Blast Cleaning of Concrete*

SSPC-SP CAB-3, *Brush Blast Cleaning of Concrete*

SSPC-TU 3, *Overcoating: Existing Coatings Systems Applied to Steel Substrates*

SSPC-TU 6, *Chemical Stripping of Organic Coatings from Steel Structures*

UNIFIED FACILITIES CRITERIA

http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code (General Building Requirements)*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-230-01, *Water Storage and Distribution*

UFC 3-460-01, *Design: Petroleum Fuel Facilities*

UFD 5-570-01, *Cathodic Protection*

UNIFIED FACILITIES GUIDE SPECIFICATIONS

https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

UFGS 02 83 00, *Lead Remediation*

UFGS 09 90 00, *Paints and Coatings*

UFGS 09 96 00, *High-Performance Coatings*

UFGS 09 67 23.15, *Fuel Resistive Resinous Flooring, 3-Coat System*

UFGS 09 67 23.16, *Fuel Resistive Resinous Flooring, 5-Coat System*

UFGS 09 96 59, *High-Build Glaze Coatings*

UFGS 09 97 02, *Painting: Hydraulic Structures*

UFGS 09 97 13.00 40, *Steel Coatings*

UFGS 09 97 13.15, *Low VOC Polysulfide Interior Coating of Welded Steel Petroleum Fuel Tanks*

UFGS 09 97 13.16, *Interior Coating of Welded Steel Water Tanks*

UFGS 09 97 13.17, *Three Coat Epoxy Interior Coating of Welded Steel Petroleum Fuel Tanks*

UFGS 09 97 13.25, *Maintenance, Repair, and Coating of Tall Antenna Towers*

UFGS 09 97 13.26, *Coating of Steel Waterfront Structures, Zero VOC, (SZC) Splash Zone Coating*

UFGS 09 97 13.27, *Exterior Coating of Steel Structures*

UFGS 33 52 80, *Liquid Fuels Pipeline Coating Systems*

UFGS 32 17 23, *Pavement Markings*