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SSPC: The Society for Protective Coatings

PAINTING SYSTEM GUIDE 19.00

Guide for Selecting Painting Systems for Ship Bottoms*

1. Scope

1.1 This guide covers painting systems for ship bottoms from the keel to the light load line on steel ships. The area from the light load line to the deep load line, more commonly called the boottop area, may also be coated with these systems; however, SSPC-PS Guide 20.00 covers painting systems for this area. It should be noted that boottops are rarely used with today's commercial ships, and bottom systems may extend up to the deep load line.

1.2 These coating systems may also be used for other floating or stationary structures exposed to or submerged in salt or brackish water. This would include barges, buoys, oceanographic installations, etc.

2. Description

2.1 This guide outlines the components of a complete painting system for the protection of the exterior bottoms of steel ships operating primarily in salt or brackish waters. It consists of surface preparation for both new construction and for maintenance and repair of existing ships, prime coats, or intermediate anti-corrosive coats and antifouling finishes.

3. Reference Standards

3.1 The standards referenced in this guide are listed in Section 3.4 through 3.6 and form a part of the specification.

3.2 The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise specified.

3.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

3.4 SSPC STANDARDS AND JOINT STANDARDS:

PA 1	Shop, Field, and Maintenance Painting of Steel
PA 2	Measurement of Dry Coating Thickness With Magnetic Gages
PA Guide 4	Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems
Paint 16	Coal Tar Epoxy Polyamide Black (or Dark Red) Paint
Paint 17	Chlorinated Rubber Primer
Paint 18	Chlorinated Rubber Intermediate Coat Paint
Paint 19	Chlorinated Rubber Topcoat Paint
Paint 27	Basic Zinc Chromate – Vinyl Butyral Wash Primer
PS Guide 20.00	Guide for Selecting Painting Systems for Boottoppings
PS Guide 22.00	Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems
SP 5/NACE No. 1	White Metal Blast Cleaning
SP 7/NACE No. 4	Brush-Off Blast Cleaning
SP 10/NACE No. 2	Near-White Blast Cleaning

3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:

D 3925	Practice for Sampling Liquid Paints and Related Pigmented Coatings

3.6 FEDERAL SPECIFICATIONS AND STANDARDS:

DoD-P-15931	Paint, Antifouling, Vinyl (Formerly MIL-P-15931)
MIL-PRF-23236	Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Formerly MIL-P-23236 or DoD-P-23236)
MIL-DTL-24441	Paint, Epoxy-Polyamide, General Specification for (Formerly MIL-P-24441)

4. Surface Preparation

4.1 NEW CONSTRUCTION: The surface should be abrasive blast cleaned as specified in SSPC-SP 10, "Near-White Blast Cleaning." If specified in the procurement documents, a better degree of blast cleaning shall be substituted (SSPC-SP 5). If preconstruction primers are to be used the surface preparation is to be as specified in SSPC-Guide 22.00, "Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems."

4.2 MAINTENANCE AND REPAIR OF EXISTING SHIPS: Immediately upon docking, the entire bottom should

be washed with fresh water at high pressure to remove marine fouling, loosely adhering paint, salt deposits, and calcareous deposits from cathodic protection. High pressure water cleaning equipment should operate at approximately 14 to 21 Mpa (2,000 to 3,000 psi) for proper removal.

COMMENT: Once the hull has been cleaned and has dried, the entire bottom should be carefully inspected for coating system breakdown. For large areas of breakdown, abrasive blasting to the degree required by the coating system is recommended. For tenaciously adhering fouling, SSPC-SP 7, "Brush-Off Blast Cleaning," may be required. SSPC-SP 7 may also be required for proper adhesion of the new coating to certain aged coatings, e.g., epoxy, etc.

5. Paints

A shipbottom coating system consists of anti-corrosive and/or barrier coatings overcoated with appropriate antifouling paint. The following outlines accepted coating systems, recommended number of coats, appropriate antifouling paint, and maintenance and repair procedures. Special notations and comments follow for each shipbottom coating system. Table 1 summarizes these recommendations.

5.1 BITUMINOUS ALUMINUM PIGMENTED SYSTEM: Aluminum flake-filled solution of various melting point bituminous resins.

COMMENT: The greatest attribute of this system is its ease of scheduling maintenance. Surface preparation is not as demanding as for epoxy, vinyl, or chlorinated rubber systems. These are single-package and can be supplied as high-build paints. As these products dry by solvent evaporation, restrictions of temperature during application are equal to both vinyl and chlorinated rubber systems. Abrasion resistance is fair.

Due to the solvent sensitivity of these systems, application of the conventional rosin-based antifoulings can be achieved at any time. The surface must be clean, dry, and free of all contaminants. In addition, conventional antifouling based on rosin modified with esterified rosins or oils may be used. These coatings are generally filled with inert extenders and cuprous oxide and are not considered scrubbable.

5.2 VINYL SYSTEM: After cleaning, the steel shall be pretreated with a wash primer to improve adhesion. Apply the first coat of vinyl primer as soon as practical and preferably within 24 hours after the application of the wash primer.

Application of the vinyl antifouling can be at any time provided the anti-corrosive system is clean, dry, and free of surface contaminants.

COMMENT: The greatest attribute of a vinyl anticorrosive system is the rate of cure achieved at low temperatures. They are also single-package for ease of application. As these are thermoplastic in nature, intercoat adhesion after long service times is excellent when overcoating clean, dry, aged vinyls with new vinyl systems. This property makes these systems very good for maintenance and repair.

These systems have low volume solids and require multiple coats to achieve the proper dry film thicknesses. High-build products are possible, but care must be taken to ensure that all the solvents are released prior to putting into service. Abrasion resistance is inferior to pure epoxy or flake glass epoxy or polyester systems.

5.2.1 Wash Primer Pretreatment: Use SSPC-Paint 27*, "Basic Zinc Chromate Vinyl Butyral Wash Primer":

COMMENT: This paint is an alcohol solution of polyvinyl butyral resin pigmented with basic zinc chromate reacted with an alcohol solution of phosphoric acid just prior to use.

5.2.2 Vinyl Antifouling Coating: DOD-P-15931, "Paint Antifouling, Vinyl," Formulas 121 or 129:

COMMENT: These are based on vinyl resin and rosin, filled with inert extenders and cuprous oxide. Formula 129 (Black) is less effective than Formula 121 (Red), and is normally used only on boottop areas where black color is required.

5.3 Catalyzed Epoxy: MIL-DTL-24441, "Paint, Epoxy Polyamide, General Specification for,":

COMMENT: These are polyamide epoxies unmodified with hydrocarbon resins, tars, or other vehicle extenders. They can be chemically cured with amine or polyamide resins. (MIL-DTL-24441 has replaced MIL-P-24441.)

For maximum performance on fast ships that are expected to see long service, unmodified epoxy will also offer excellent abrasion resistance. Generally, these are high-build products which minimize the number of coats necessary to meet thickness requirements.

Generally, epoxy systems have poor curing characteristics at temperatures below 10°C (50°F). Below this temperature, intercoat adhesion is only poor to fair with most epoxy coatings. After long-term exposure, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

The first coat of vinyl antifouling should be applied while the last coat of the epoxy anticorrosive is still in the "tacky" stage of cure. To determine suitability of the epoxy coat, simply press the thumb to the epoxy coated surface. If the epoxy is firm to the touch, yet leaves a thumb print in the coating, the epoxy is ready to receive the first coat of antifouling.

5.4 CHLORINATED RUBBER: SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer," SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint," and SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint," and chlorinated rubber antifouling paint:

TABLE 1
RECOMMENDED SHIPBOTTOM COATING SYSTEMS

GENERIC CLASS OF ANTI-CORROSIVE	NO. OF COATS	DRY FILM THICKNESS	RECOMMENDED ANTIFOULING	NO. OF COATS	DRY FILM THICKNESS	MAINTENANCE AND REPAIR PROCEDURES
5.1 Bituminous Aluminum Pigmented	2	7.0-8.0 Mils 175-200 Micrometers	Conventional rosin-based antifouling	2	3.0-4.0 Mils 75-100 Micrometers	Fresh water wash, spot blast or power tool clean bad areas.
5.2 Vinyl						
(A) Wash primer	1	(A) 0.5 Mils 13 Micrometers	Vinyl antifouling	2	4 Mils 100 Micrometers	Fresh water wash, spot blast bad areas.
(B) Anticorrosive	3 or 4	(B) 4.5-6.0 Mils 114-150 Micrometers				
5.3 Catalyzed Epoxy	2 or 3	8.0-12.0 Mils 200-300 Micrometers	Vinyl antifouling	2	4 Mils 100 Micrometers	Fresh water wash, spot blast bad areas.
5.4 Chlorinated Rubber	3	9.0 Mils 230 Micrometers	Chlorinated rubber antifouling	2	4 Mils 100 Micrometers	Fresh water wash, spot blast bad areas.
5.5 Pitch Epoxy	2	16.0 Mils 400 Micrometers	Vinyl antifouling	2	4 Mils 100 Micrometers	Fresh water wash, spot blast bad areas, step back antifouling in areas of repair.
5.6 Flakeglass Epoxy or Polyester	1 or 2	25.0 Mils 635 Micrometers	Vinyl antifouling	2	4 Mils 100 Micrometers	Fresh water wash, spot blast bad areas, step back antifouling in areas of repair.

COMMENT: These single-package, generally high-build paints are applicable at very low temperatures. Chlorinated rubber systems are thermoplastic, and intercoat adhesion is excellent after long periods of service without major surface preparation.

Although volume solids are somewhat greater than those of pure vinyl systems, they are still considered low as compared to pure or modified epoxy systems. Abrasion resistance is fair.

The antifouling paints generally contain chlorinated rubber resin modified with chlorinated paraffin and rosin. They may also be filled with inert extenders and cuprous oxide or may contain an organotin antifouling agent for improvement in weed and grass control.

Application of the chlorinated rubber antifouling can be achieved at any time to the chlorinated rubber anti-corrosive system provided the surface is clean, dry, and free of surface contamination.

5.5 COAL TAR EPOXY: SSPC-Paint 16, "Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint," or MIL-PRF-23236, "Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast," Type 1, Class 2:

COMMENT: An epoxy resin with coal tar or other hydrocarbon modification, this paint can be chemically cured with amine or polyamide resins.

The advantages of this system are very similar to the advantages of the unmodified epoxy systems, but at a somewhat lower cost. Do not expect equal abrasion resistance with these systems.

Generally, coal tar epoxy systems have poor curing characteristics at temperatures below 10°C (50°F). In that intercoat adhesion after exposure to weather and sunlight is only poor to fair with most coal tar epoxy anti-corrosive coats, surface preparation in the maintenance and repair of these systems must be handled under close supervision. Health hazards associated with coal tar limit the use of those products containing this derivative.

The first coat of vinyl antifouling should be applied while the last coat of the pitch epoxy anticorrosive is still in the "tacky" stage of cure. To determine suitability of the pitch epoxy coat, simply press the thumb to the coated surface. If the pitch epoxy is firm to the touch, yet leaves a thumb print in the coating, it is ready to receive the first coat of antifouling.

5.6 FLAKE GLASS EPOXY OR POLYESTER:

COMMENT: These pure or hydrocarbon modified ep-

oxy or polyester resins are filled with hammer milled fiberglass flakes. Polyesters may contain a large percentage of styrene monomer and are cured with cobalt and peroxides. Epoxies are cured with polyamine or polyamide resins.

This system is designed for very specialized applications where the maximum abrasion resistance is required. It is generally used on keel plates, rudders, skegs, and areas of high abrasion and turbulence.

Generally, flake glass epoxy or polyester systems have poor curing characteristics at temperatures below 10°C (50°F). Because intercoat adhesion is only poor to fair with most flake glass epoxy or polyester anti-corrosives after long-term exposures, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

The first coat of vinyl antifouling should be applied while the last coat of flake glass epoxy or polyester anticorrosive is still in the "tacky" stage of cure. To determine the suitability of the flake glass epoxy or polyester coat, simply press the thumb to the flake glass epoxy or polyester coated surface. If it is firm to the touch, yet leaves a thumb print in the coating, it is ready to receive the first coat of antifouling.

5.7 PROPRIETARY COATING SYSTEMS:
COMMENT: A proprietary coating system of the above generic types with proven performance capability may be used if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paints. The paint manufacturer should furnish a typical label analysis.

6. Paint Application

6.1 PAINT APPLICATION: Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

6.2 NUMBER OF COATS: See Table 1.

6.3 DRY FILM THICKNESS: Measure in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages." See Table 1.

7. Inspection

7.1 All work and materials supplied under this specification is subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

7.2 Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

7.3 Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

8. Disclaimer

8.1 While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

8.2 This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

9. Note

Notes are not a requirement of this specification.

9.1 The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

9.2 Weed growth is predominant in areas reached by sunlight (from the turn of the bilge to the deep load line). It is recommended that antifouling paints which contain organotin compounds with or without cuprous oxide be used in these areas since these agents better retard weed growth.

9.3 CATHODIC PROTECTION: When cathodic protection is provided, the coating system selected for bottoms should be compatible with the cathodic protection system. Dielectric shields are required about and beneath all anodes used in any impressed current system to assure good current distribution. Although zinc anodes do not require dielectric shields, zinc should not be installed over a bare steel hull. Three coats of a coal tar epoxy applied to a dry film thickness of 610 micrometers (24 mils) or equivalent dielectric material are recommended for the purpose, followed by a vinyl antifouling paint. The recommended minimum length and width of the shield around the periphery of the anodes are 1.2 m (four feet) for anodes operating up to

12 volts and 1.8 m (six feet) for anodes capable of operating above 12 volts.

9.4 FLASH POINT: Some federal specifications require a minimum closed cup flash point of 38°C (100°F) because of possible use in confined spaces such as tanks. Lower flash points are considered acceptable for exterior application.

9.5 EPA REGISTRATION: The Federal Insecticide, Fungicide, and Rodenticide Act requires registration of antifouling paints, and should be so certified by the paint supplier.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.