

INCH-POUND

MIL-PRF-24647D

16 February 2005

SUPERSEDING

MIL-PRF-24647C

24 September 2001

PERFORMANCE SPECIFICATION

PAINT SYSTEM, ANTICORROSIVE AND ANTIFOULING, SHIP HULL

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers ship hull anticorrosive and antifouling paint systems.

1.2 Classification. Paints covered by this specification are of the following types, classes, grades, and applications, as specified (see Table I and 6.2):

1.2.1 Types. The types of ship hull anticorrosive and antifouling paint systems are as follows:

- | | | |
|----------|---|--|
| Type I | - | Paint systems having topcoats that contain biocide(s) other than copper which ablate or self-polish. |
| Type II | - | Paint systems having topcoats that contain biocide(s) (copper or other biocide not cited in Type I) which ablate or self-polish. |
| Type III | - | Paint systems having topcoats that are foul-release and contain no biocide. |
| Type IV | - | Paint systems having topcoats that contain biocide(s) (copper or other) which do not ablate or self-polish. |

1.2.2 Classes. The classes of ship hull anticorrosive and antifouling paint systems are as follows:

- | | | |
|---------|---|--|
| Class 1 | - | Paint systems for use on rigid, fiberglass, wood, or metallic substrates, other than aluminum. |
| Class 2 | - | Paint systems for use on aluminum substrates. |
| Class 3 | - | Paint systems for use on elastomeric substrates. |

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navsea.navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

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1.2.3 Grades. The grades of ship hull anticorrosive and antifouling paint systems are as follows:

- Grade A - Volatile organic content (VOC) of the antifouling topcoats shall not exceed 400 grams per liter (g/L) (3.4 pounds per gallon (lb/gal)). VOC of any other individual paint in the system shall not exceed 340 g/L (2.8 lb/gal).
- Grade B - VOC of the antifouling topcoats shall not exceed 400 g/L (3.4 lb/gal). VOC of any other individual paint in the system shall not exceed 250 g/L (2.1 lb/gal).
- Grade C - VOC of the antifouling topcoats shall not exceed 400 g/L (3.4 lb/gal). VOC of any other individual paint in the system shall not exceed 100 g/L (0.8 lb/gal).

1.2.4 Applications. The applications of ship hull anticorrosive and antifouling paint systems are as follows:

- Application 1 - Paint systems for use on the underwater hull, with a service life of three years.
- Application 2 - Paint systems for use on the underwater hull, with a service life of seven years.
- Application 3 - Paint systems for use on the underwater hull, with a service life of twelve years.
- Application 4 - Paint systems for use on high-speed vessels with a service life of a minimum of two years.

TABLE I. Coating system type, class, application matrix^{1/}.

Type	Class	App 1	App 2	App 3	App 4
I	1	YES	YES	YES	YES
	2	YES	YES	YES	YES
	3	YES	YES	YES	NO
II	1	YES	YES	YES	YES
	2	NO	NO	NO	NO
	3	YES	YES	YES	NO
III	1	YES	YES	NO	YES
	2	YES	YES	NO	YES
	3	YES	YES	NO	NO
IV	1	YES	NO	NO	NO
	2	YES ^{2/}	NO	NO	NO
	3	YES	NO	NO	NO

Notes:

^{1/} Any Grade is acceptable for the allowable systems above.

^{2/} If the antifoulant contains metallic copper compounds, then it may not be used on aluminum substrates.

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1.3 Part or identifying number (PIN). PINs to be used for ship hull anticorrosive and antifouling paint systems acquired to this specification are created as follows:

M 24647 = X X X X
 Prefix for Specification Type (see Class (see Grade Application
 Military Number code code (see code (see code
 Specification below) below) below) below)

Type Code		Class Code		Grade Code		Application Code	
Type	Code	Class	Code	Grade	Code	Application	Code
I	A	1	1	A	A	1	1
II	B	2	2	B	B	2	2
III	C	3	3	C	C	3	3
IV	D					4	4

Examples: M24647-A2C1
M24647-D1B1

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

- FED-STD-313 - Material Safety Data, Transportation Data, and Disposal Data for Hazardous Materials Furnished to Government Activities
- FED-STD-595 - Colors Used in Government Procurement

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-PRF-23236 - Coating Systems for Ship Structures
- MIL-DTL-24441 - Paint, Epoxy-Polyamide, General Specification for

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-129 - Military Marking for Shipment and Storage

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or <http://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

- 40 CFR60, Appendix A, Method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings
- 40 CFR150-180 - Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Regulations
- 40 CFR63, Subpart II - U.S. EPA National Emissions Standards for Hazardous Air Pollutants, Shipbuilding and Ship Repair (Surface Coatings)
- 40 CFR261, Appendix II, Method 1311 - Toxic Characteristics Leaching Procedure (TCLP)

(The Code of Federal Regulations (CFR) may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 or online at www.gpoaccess.gov/index.html.)

DEPARTMENT OF LABOR, OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION (OSHA)

- 29 CFR1910, 1915, 1917, 1918, 1926, and 1928 - Occupational Safety and Health Standards
- 29 CFR1990 - Identification, Classification, and Regulation of Potential Occupational Carcinogens

(The Code of Federal Regulations (CFR) may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 or online at www.gpoaccess.gov/index.html.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

Threshold Limit Values (TLV) for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices

(Copies of this document are available from the American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240 or www.acgih.org.)

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ASTM INTERNATIONAL

A1011/ A1011M	-	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
B209	-	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (DoD adopted)
D283	-	Standard Test Method for Chemical Analysis of Cuprous Oxide and Copper Pigments
D562	-	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer (DoD adopted)
D660	-	Standard Test Method for Evaluating Degree of Checking of Exterior Paints (DoD adopted)
D661	-	Standard Test Method for Evaluating Degree of Cracking of Exterior Paints (DoD adopted)
D714	-	Standard Test Method for Evaluating Degree of Blistering of Paints (DoD adopted)
D1475	-	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products (DoD adopted)
D2000	-	Standard Classification System for Rubber Products in Automotive Applications (DoD adopted)
D2244	-	Standard Method for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates (DoD adopted)
D2369	-	Standard Test Method for Volatile Content of Coatings (DoD adopted)
D2621	-	Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
D3278	-	Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus (DoD adopted)
D3335	-	Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
D3623	-	Standard Test Method for Testing Antifouling Panels in Shallow Submergence
D3960	-	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D4400	-	Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
D4938	-	Standard Test Method for Erosion Testing of Antifouling Paints Using High Velocity Water
D5479	-	Standard Practice for Testing Biofouling Resistance of Marine Coatings Partially Immersed
D6442	-	Standard Test Method for Determination of Copper Release Rate From Antifouling Coating Systems in Artificial Seawater
D6990	-	Standard Practice for Evaluating Biofouling Resistance and Physical Performance of Marine Coating Systems
E1347	-	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry
F718	-	Standard for Shipbuilders and Marine Paints and Coatings Product/Procedure Data Sheet (DoD adopted)
F1130	-	Standard Practice for Inspecting the Coating System of a Ship
G80	-	Standard Test Method for Specific Cathodic Disbonding of Pipeline Coatings

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(Copies of these documents are available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SP 10 - Near-White Blast Cleaning

(Copies of these documents are available from SSPC Publication Sales, 40 24th Street, 6th floor, Pittsburgh, PA 15222-4656 or www.sspc.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The paints furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products before contract award (see 4.2 and 6.3).

3.2 Description of paints. Each paint system being qualified to a Type, Class, Grade and Application of this document shall consist of the following individual paints.

3.2.1 Anticorrosive paint (first coat). When required, the first coat of anti corrosive paint is intended for direct application to the substrate being painted. Paint systems submitted for qualification to Classes 1 or 2 of this specification shall be qualified with anticorrosive paints that conform to MIL-DTL-24441, MIL-PRF-23236, or a commercial anticorrosive paint from the same manufacturer. Paint systems submitted for qualification to Class 3 (elastomeric substrates) do not require qualification with anticorrosive coatings, but shall be qualified with any required adhesion-promoting tie coat. The paint shall be a light, pastel color.

3.2.2 Anticorrosive paint (second coat). The second coat of the anticorrosive layer shall approximate FED-STD-595 color number 36270, except as noted in 3.4.1 for submarine service.

3.2.3 Tie coat. Tie coat(s), if required, is intended for application to the anticorrosive paint and over coated with antifouling paint.

3.2.4 Antifouling topcoat. Antifouling topcoat(s), shall be of the applicable Type.

3.2.5 System identification. Manufacturer shall, at the time of qualification submittal, identify by unique nomenclature, the total system being qualified and each individual product constituting the system by unique alpha/numeric nomenclature {product name, alpha/numeric identification, color and required application thickness in micrometers (μm) [microns (thousandths of an inch)]}. At a minimum, the manufacturer shall identify the following:

- a. All Types, Classes, Grades, and Applications, including any required adhesion promoting tie coats.
- b. The product(s) constituting the antifouling topcoat(s).
- c. For Classes 1 and 2, the commercial product designation for the vendor's approved MIL-DTL-24441, or MIL-PRF-23236 anticorrosive coating being qualified with the antifouling topcoat(s).

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3.2.6 System modifications. Given the long duration of selected tests, it is conceivable that certain commercial products may be modified over the course of the qualification process. The manufacturer shall note any changes. Examples include, but are not limited to, paint VOC reductions or slight (less than 3% by weight) additive modifications/additions. It is not NAVSEA's intent to discourage positive formulation changes, however, the manufacturer shall provide a written certification and technical justification that such changes do not negatively affect the long-term properties of the material. Should the material properties discussed under Tables II, III, or IV be affected, the new material shall be submitted, and the qualification process repeated.

3.2.7 Underwater-hull cleaning. The vendor shall indicate the frequency and process for underwater hull cleaning, if applicable. Unless approved prior to testing, mechanical cleaning shall not be allowed as a supplemental measure to satisfy any of the requirements of 3.4.4.

3.3 Material requirements. The paint systems furnished under this specification, when mixed and applied in accordance with the manufacturer's instructions, shall produce a coating that satisfies all the requirements of this specification. The composition of the paint furnished under this specification shall be the responsibility of the manufacturer, except as limited by this specification.

3.3.1 Types. Four Types of antifouling topcoats, which shall function in accordance with an identifiable toxic release mechanism, are specified below.

3.3.1.1 Types I and II. Paint systems with an ablative antifouling topcoat which shall dissolve, polish, erode, or reduce in thickness as the primary condition for performing its antifouling function. Type I antifouling topcoats will contain less than 3%, by weight, copper bearing compounds while Type II will contain greater than 3%, by weight, copper-bearing compounds. The antifouling topcoats may be rejuvenated by optional mechanical underwater brushing or other cleaning.

3.3.1.2 Type III. Paint system with a foul-release topcoat which inhibits adhesion of biofouling. There are no toxic agents in the coating. A hull with Type III antifouling topcoats must attain a certain speed for the fouling to release or detach from the hull. It may also be cleaned by divers using a soft-bristled, mechanical, underwater brush, or other foul-release cleaning system.

3.3.1.3 Type IV. Paint system with a non-ablating antifouling topcoat which does not diminish in thickness during service. Most products of this Type will function by leaching a toxic agent. Type IV antifouling topcoats may also be rejuvenated by optional mechanical underwater brushing or other cleaning.

3.3.2 Classes.

3.3.2.1 Class 1. Paint systems intended for use on rigid fiberglass, wood, or metallic substrates other than aluminum.

3.3.2.2 Class 2. Paint systems intended for use on aluminum alloys.

3.3.2.3 Class 3. Paint systems intended for use on elastomeric substrates.

3.3.3 Grades.

3.3.3.1 Grade A. The VOC of antifouling topcoat(s) shall not exceed 400 g/L (3.4 lb/gal) when in the ready-to-apply condition. The VOC of any other individual paint in the system shall be a maximum of 340 g/L (2.8 lb/gal). Ready-to-apply condition includes any volatile solvents added to prepare the paint for application (see 3.7).

3.3.3.2 Grade B. The VOC of antifouling topcoat(s) shall not exceed 400 g/L (3.4 lb/gal) when in the ready-to-apply condition (see 3.7). The VOC of any other individual paint in the system shall be a maximum of 250 g/L (2.1 lb/gal).

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3.3.3.3 Grade C. The VOC of antifouling topcoat(s) shall not exceed 400 g/L (3.4 lb/gal) when in the ready-to-apply condition (see 3.7). The VOC of any other individual paint in the system shall be a maximum of 100 g/L (0.8 lb/gal).

3.3.4 Applications.

3.3.4.1 Application 1. Paint systems shall have a minimum service life of 3 years without failure due to loss of adhesion, blistering, flaking, depletion by excessive ablation or loss of anti-fouling capability (excepting minor sliming and biofouling from the boottop to the light load line).

3.3.4.2 Application 2. Paint systems shall have a minimum service life of 7 years without failure due to loss of adhesion, blistering, flaking, depletion due to excessive ablation or loss of antifouling capability (except sliming and biofouling from the boottop to the light load line).

3.3.4.3 Application 3. Paint systems shall have a minimum service life of 12 years without failure due to loss of adhesion, blistering, flaking, depletion due to excessive ablation or loss of antifouling capability (except sliming and biofouling from the boottop to the light load line).

3.3.4.4 Application 4. Paint systems for use on vessels attaining 50 knots or greater, shall have a minimum service life of 2 years without failure due to loss of adhesion, blistering, flaking, depletion by excessive ablation or loss of anti-fouling capability (except minor sliming and biofouling from the boottop to the light load line).

3.3.5 Composition. The manufacturer is given a choice in the formulation of the paints described by this document, provided the end product conforms to all requirements of this specification. Soluble metals content and total metal content of each individual paint of the paint system shall not exceed the values listed in Tables II and III when tested in accordance with 4.4.11. Copper and zinc contents listed in Tables II and III do not apply to antifouling topcoat paints of Types I, II, and IV.

TABLE II. Soluble metals content.

Requirement	Maximum (soluble), mg/L
Antimony and/or its compounds	15
Arsenic and/or its compounds	0.001
Barium and/or its compounds (excluding barite)	100
Beryllium and/or its compounds	0.75
Cadmium and/or its compounds	1
Chromium (VI) compounds	5
Chromium and/or chromium (III) compounds	560
Cobalt and/or its compounds	50
Copper and/or its compounds	25
Fluoride salts	180
Lead and/or its compounds	5
Mercury and/or its compounds	0.2
Molybdenum and/or its compounds	350
Nickel and/or its compounds	20
Selenium and/or its compounds	1
Silver and/or its compounds	5
Tantalum and/or its compounds	100
Thallium and/or its compounds	7
Tungsten and/or its compounds	100
Vanadium and/or its compounds	24
Zinc and/or its compounds	250

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TABLE III. Total metals content.

Requirement	Metals content (total), weight percent maximum
Antimony and/or its compounds	0.015
Arsenic and/or its compounds	0.001
Asbestos	0.0005
Barium and/or its compounds (excluding barite)	0.10
Beryllium and/or its compounds	0.0002
Cadmium and/or its compounds	0.0005
Chromium (VI) compounds	0.0005
Chromium and/or chromium (III) compounds	0.56
Cobalt and/or its compounds	0.005
Copper and/or its compounds	0.01
Fluoride salts	0.18
Lead and/or its compounds	0.005
Mercury and/or its compounds	0.0002
Molybdenum and/or its compounds	0.35
Nickel and/or its compounds	0.02
Selenium and/or its compounds	0.001
Silver and/or its compounds	0.001
Tantalum and/or its compounds	0.10
Thallium and/or its compounds	0.007
Tungsten and/or its compounds	0.10
Vanadium and/or its compounds	0.01
Zinc and/or its compounds	0.25

3.3.5.1 Identification characteristics. Manufacturer shall disclose to the Government the identification characteristics required in Table IV in accordance with the test method listed therein for each individual paint (mixed and individual components, as applicable) in the system. Paint identification characteristics listed in Table IV, when tested in accordance with requirements in 3.4, shall conform to the values disclosed by the manufacturer.

3.3.5.2 Toxicity. Manufacturer shall prepare container label instructions for the paint in accordance with the OSHA requirements of 29 CFR, parts 1910, 1915, 1917, 1918, 1926, and 1928 (see 5.1). The paint shall contain no detectable asbestos, asbestos from pigments, benzene, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, coal tar or coal tar derivatives, tri-butyl tin compounds, or any ACGIH carcinogenic or ACGIH suspected carcinogenic compounds (see 3.5).

3.3.5.3 Toxic products. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency.

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TABLE IV. Identification characteristics.^{1/}

Test	Applicable ASTM test method
Biocide (report – manufacturing range or variation, +/- %, method used to determine) ^{2/}	---
Volatiles (report – manufacturing range or variation, +/- %) ^{3/}	D2369
Nonvolatile vehicle (report – manufacturing range or variation, +/- %)	D2697
Consistency, gram equivalent KU (report – manufacturing range or variation, +/- KU)	D562
Weight per unit volume (report – manufacturing range or variation, +/- g/L)	D1475
Dry to touch time (report – maximum not to exceed 2 hours at 20 degrees Celsius [°C] (68 degrees Fahrenheit [°F]), at ASTM F718 film thickness)	D5895
Dry hard time (report – maximum not to exceed 16 hours at 20 °C [68 °F], at ASTM F718 film thickness)	D5895
Flash point (report – required minimum not less than 21 °C [70 °F])	D3278
Pot life (where applicable) (report – hours, temperatures)	---
Color	
R ₀ 1.8 ^{4/}	---
All other paint system colors	D1729
Infrared spectra of nonvolatile vehicle	D2621
Sag resistance (report – minimum value)	D4400
Toxicity ^{5/}	---
Copper leach rate (Type II, and IV only) ^{2/}	D6442
Ablation/erosion rate (Type I and II only) ^{2/}	D4938, D4939 or similar
Copper content (Type II and IV only) ^{2/}	D283

Notes:

- ^{1/} Manufacturing range percentages having variations of more than +/- 3 percent, without supporting documentation, will be rejected and can cause delay or rejection of qualification. Manufacturers shall provide documentation for any identification characteristics deemed non-applicable, i.e., dry-time for a tie-coat designed to be over-coated before completely drying. Also, should a test method not be applicable for the product, the manufacturer shall report the data and the alternative test method used.
- ^{2/} Antifouling topcoats only.
- ^{3/} VOC shall be determined in accordance with 4.4.3.
- ^{4/} Determine in accordance with 4.4.8.
- ^{5/} Certify in accordance with 3.3.5.2.

3.4 Qualitative requirements.3.4.1 Color. Colors of the individual paints of the paint systems shall:

- a. Be in accordance with the FED-STD-595 color provided as an identification characteristic for that paint, when tested in accordance with 4.4.8.1, for the colors of the individual anticorrosive and tie coat paints, except R₀ color paints.
- b. For submarine service, have an R_w = 0.9 +/- 0.2, when measured in accordance with 4.4.8.2, for the R₀ 1.8 dark gray/black color anticorrosive topcoats of the paint system.

3.4.2 Condition in container. The coatings shall be readily mixed with a mechanical mixer to a smooth, uniform consistency after stirring for five minutes. Coatings shall not liver, hard settle, skin, seed or otherwise become unfit for use. Water based products shall not show phase separation, evidence of biological growth, putrefaction, corrosion of the container, or persistent foam which lasts more than 5 minutes.

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TABLE V. Tests.

Property	Requirements	Tests	Quality conformance
Pigment (pesticide), %	3.3.5 & Table IV	D2371	X
Volatiles, %	3.3.5 & Table IV	D2369	X
Nonvolatile vehicle, %	3.3.5 & Table IV	D2697	X
Consistency, gram equivalent KU	3.3.5 & Table IV	D562	X
Weight per unit volume, g/L	3.3.5 & Table IV	D1475	X
Copper content of pigment, %	3.3.5 & Table IV	D283	
Dry time, min	3.3.5 & Table IV	D5895	X
Flash point, °C	3.3.5 & Table IV	D3278	X
Infrared spectra of nonvolatile vehicle	3.3.5 & Table IV	D2621	X
Sag resistance	3.3.5 & Table IV	D4400 (Method A)	X
Lead content	3.3.5 & Table IV	D3335	
Toxicity	3.3.5.2	3.3.5 and 3.5	
Color	3.4.1, Table IV, 3.8	4.4.8	
Condition in container	3.4.2		X
Shelf life	3.4.3.1	4.4.4.1	
Partially full container	3.4.3.2	4.4.4.2	
Accelerated storage stability	3.4.3.3	4.4.4.3	
Resistance to tropical biofouling			
- Panel tests	3.4.4.1	4.4.1.1	
- Ship tests	3.4.4.2	4.4.1.2	
Spraying properties	3.4.5	4.4.5	X
Brushing properties	3.4.6	4.4.6	
Rolling properties	3.4.7	4.4.7	
Recoatibility	3.4.8	4.4.2	
Cathodic protection compatibility	3.4.9	4.4.9	
Pressure cycling	3.4.10	4.4.10	

3.4.3 Storage stability. A previously unopened, original container of paint when stored and tested as required in 3.4.3.1 through 3.4.3.3 shall:

- a. Readily mix with a mechanical mixer within five minutes to a smooth uniform condition.
- b. Be free of grit(s), seed, tough or gummy sediment, skins, hard pigment settling, and persistent foam.
- c. Not vary from the characteristics established by Table IV by more than the following:
 - (1) Consistency - ten Kreb units (KU).
 - (2) Dry-to-touch and dry-hard times – 60 minutes.
 - (3) Color - see 3.4.1.
 - (4) Each individual paint of the system shall be readily applied to the manufacturer's ASTM F718 wet film thickness with no sagging, running, or streaking.

3.4.3.1 Shelf life. An original, unopened can of each individual paint or component of the system shall meet the requirements of 3.4.3 when conditioned as specified in 4.4.4.1.

3.4.3.2 Partially full container. Each individual paint or component of the system shall meet the requirements of 3.4.3 when conditioned as specified in 4.4.4.2.

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3.4.3.3 Accelerated storage stability. An original, unopened can of each individual paint or component of the system shall meet the requirements of 3.4.3 when conditioned as specified in 4.4.4.3.

3.4.4 Resistance to tropical biofouling organism attachment. Physical damage to the antifouling topcoat related to the toughness of the film to withstand immersion and fouling growth/release shall be considered as part of the percent of the total surface susceptible to marine fouling. Panel testing (3.4.4.1) and ship testing (3.4.4.2) may be done concurrently at the discretion of NAVSEA.

3.4.4.1 Panel tests.

3.4.4.1.1. Type I, type II, and type IV, all grades and classes, application 1 and 2 paints. Type I, Type II, and Type IV, all Grades and Classes, Application 1 and 2 paints shall meet the following requirements when tested in accordance with 4.4.1.1:

- a. The anticorrosive paint layer shall:
 1. Not be exposed at any point due to erosion of the antifouling paint.
 2. Be free of peeling or flaking and shall not be rated lower than 8 few for blistering.
- b. The antifouling topcoat shall not be rated:
 1. Lower than 9 (any pattern Type) for checking.
 2. Lower than 9 (any pattern Type) for cracking to the anticorrosive coating.
 3. Lower than 8 few for blistering.
- c. The fouling resistance (FR) rating of the antifouling topcoat shall not be less than 90 (slime excluded) at any time during the test.

3.4.4.1.2. Type I and type II, all grades and classes, application 3 paints. Type I and Type II, all Grades and Classes, Application 3 paints shall meet the requirements of 3.4.4.1.1, when tested in accordance with 4.4.1.1(h).

3.4.4.1.3. Type III, all grades, classes, and applications paints. Type III, all Grades, Classes, and Applications paints shall meet the following requirements when tested in accordance with 4.4.1.1(i):

- a. For those panels with more than 25% hard fouling (i.e., barnacles, encrusting bryozoa, and tubeworms) after the static immersion period, 60% of this fouling shall release by a 20 knot velocity in channel flow testing.
- b. 80% of the total panel surface shall be free of hard-fouling (i.e., barnacles, encrusting bryozoa, tunicates, and tubeworms) after each test run at 20 knots and 85% of the surface shall be free of hard fouling after testing at 30 knots.
- c. Areas shall not accumulate fouling over a 1-year cycle. Any hard fouling not removed at the end of a test cycle shall be noted. This fouling in this area would be expected to grow over the next static immersion period. Under the next flow channel cycle, this fouling shall be exposed to more significant hydrodynamic forces and be removed. This is to say, the 2nd flow channel run shall remove any fouling left from the 1st run, and the 3rd run shall remove any fouling left after the 2nd run, etc.
- d. There shall be less than 1% of the antifouling coating affected by damage after the test period.

3.4.4.2 Ship tests. Ship tests shall meet the requirements of 3.4.4.2.1 and 3.4.4.2.2 when tested in accordance with 4.4.1.2. Ratings will exclude areas (e.g., docking blocks) not coated with the antifouling materials.

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3.4.4.2.1. Performance criteria. The test coating shall perform equal to or better than a qualified coating which is applied to the entire underwater hull for patch testing, or as a patch for full ship testing. Performance criteria include but are not limited to; fouling control, ablation/erosion rate (if applicable), physical performance, and cleaning requirements.

3.4.4.2.2. Length of testing. Testing (patch or full ship) performed on any Government vessel shall be for 12 months minimum; commercial vessels shall be for 24 months minimum.

3.4.4.2.3. Service life determination. The Government will monitor the performance of qualified products on operational ships to establish compliance with the service life requirement for the appropriate application of the paint system, as specified in 0.

3.4.5 Spraying properties. Each individual paint of the paint system, when mixed in accordance with manufacturer's instructions as listed on its corresponding ASTM F718 Product Data, shall spray satisfactorily when tested as specified in 4.4.5. The dry film shall show no running, sagging, or streaking, blooming, blushing, bubbling, cratering, dusting, floating, fogging, hazing, mottling, orange peel appearance, pinholing, seeding, or streaking.

3.4.6 Brushing properties. Each individual paint of the paint system, mixed in accordance with ASTM F718, shall brush easily and have good flowing and spreading qualities when tested as specified in 4.4.6. The dried film shall show no running, sagging, blooming, blushing, bubbling, cratering, dusting, floating, fogging, hazing, mottling, orange peel appearance, pinholing, seeding, or streaking.

3.4.7 Rolling properties. Each individual paint of the paint system, mixed in accordance with ASTM F718, shall roll easily and have good flowing and spreading qualities when tested as specified in 4.4.7. The dried film shall show no running, sagging, blooming, blushing, bubbling, cratering, dusting, floating, fogging, hazing, mottling, orange peel appearance, pinholing, seeding, or streaking.

3.4.8 Recoatability. When tested as specified in 4.4.2, a recoat layer of antifouling paint shall show no peeling, flaking, or delamination from the overcoated antifouling paint layer. The recoat layer shall also meet all the requirements of 3.4.4.1.1 for Type I, II and IV paints and 3.4.4.1.3 for Type III paint.

3.4.9 Cathodic protection (CP) compatibility. When tested as specified in 4.4.9, the test paint shall not peel, flake, blister, dissolve or otherwise fail. Lifting of the antifouling from the primer around the drilled hole shall not exceed 12.7 millimeters (mm) [0.5 inches (in)]. This test shall not apply for coatings being qualified for Class 3 (elastomeric) substrates.

3.4.10 Pressure cycling. Pressure cycling shall be performed to determine compatibility of the qualifying paint system to Class 3 substrates for submarine service. When tested in accordance with 4.4.10, the coating shall be inspected for cracking and delamination. The coating shall show no delamination and show minimal cracking to the substrate. Any cracking that does appear should be limited to within 5 centimeters (cm) [2 in] of any edge.

3.5 Directions for use. The manufacturer shall provide written directions on each container for the mixing and applying of the paint supplied and this direction shall include all information necessary to comply with the OSHA Hazard Communication Act and FED-STD-313. Requirements for ASTM F718 data sheets shall be as specified (see 6.2).

3.6 EPA registration number. A U.S. EPA FIFRA antifouling paint registration number is required for all Type I, II, and IV antifouling topcoat paints submitted for qualification to, or supplied to this specification. The container label shall be EPA approved (see 5.1). The manufacturer qualifying a Class 1C and 3C antifouling topcoat paint may substitute a legal determination or EPA finding that the product does not require registration under the provisions of FIFRA.

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3.7 Volatile organic content (VOC). The VOC of each individual paint in the paint system, when in the ready-to-apply condition, shall not exceed that allowed for the specific Grade (see 3.3.3) for which qualification is being sought when tested in accordance with 4.4.3. Ready-to-apply condition includes any volatile solvents (thinners) required by the manufacturer's ASTM F718 data sheets to prepare the paint for application.

3.8 Workmanship. The material shall be produced in accordance with the best commercial practices and shall be of a quality necessary to ensure a uniform, packaged product in conformance with the requirements of section 3 when tested as specified in section 4. The paint described shall be suitable for the purpose intended (application to ship in dry-dock, under ambient condition, with conventional tools, and equipment).

3.9 NESHAP requirements. In accordance with U.S. EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP), shipbuilding coating regulation (40 CFR63, subpart II), certificates of compliance shall be provided, as described in the U.S. EPA "Guidebook on How to Comply with the Shipbuilding and Ship Repair (Surface Coating) Operations NESHAP"(EPA-453/B-97-001, January 1997, pages E-18, E-32, E-33). This certificate need only be provided once to each procuring activity for each coating formulation sold.

3.10 Marking requirements. Marking shall include hazardous warnings in accordance with MIL-STD-129 (see 4.6 and 6.2), FED-STD-313, and 29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928, as applicable.

3.10.1 Special marking. Each unit container shall have the following information:

- a. Specification number.
- b. Type, Class, Grade and Application.
- c. Color.
- d. Manufacturer's name, address, product commercial nomenclature designation, and QPL number.
- e. Hazardous materials information required by MIL-STD-129 (see 4.6 and 6.2), FED-STD-313, and 29 CFR Parts 1910, 1915, 1917, 1918, 1926, and 1928, as applicable.
- f. Required storage information including temperatures.
- g. Antifouling paints shall have the EPA approved label on each container. Containers of antifouling topcoat paints may have the marking information required in a. and f. above in printed materials affixed to the container in a weatherproof pouch to comply with EPA requirements.

3.10.2 Additional marking. Containers shall also be marked as follows:

- a. "Contains a maximum of INSERT PROPER NUMBER HERE grams per liter (INSERT PROPER NUMBER HERE pounds per gallon) of volatile organic content (VOC) per 40 CFR CH. 1, Part 60, Appendix A, (U.S. EPA) method 24."
- b. "This product may be thinned (INSERT QUANTITY and CONTAINER SIZE HERE) per five gallon container with IDENTIFY GENERIC AND TRADEMARK THINNER IDENTIFICATIONS HERE and will contain less than (INSERT VOC REGULATORY NUMBERS LEVEL HERE) volatile organic content (VOC) per 40 CFR CH. 1, Part 60, Appendix A, (U.S. EPA) method 24."

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

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4.2 Qualification inspection. Qualification inspection shall consist of all tests specified in Table IV and paragraph 4.6. The products tested shall be materials drawn from regular production stocks. A test report shall be provided to the contracting officer or agent. Testing of products on Government ships shall be conducted at the convenience of the Government.

4.3 Conformance inspection. Conformance inspection shall consist of the Table V tests marked as such. Tests shall be performed on each lot offered for delivery in accordance to the requirements of this specification.

4.3.1 Lot. A lot shall consist of an individual paint of the paint system of the same Type, Class, Grade and application from a single uniform batch or a uniform blend of batches offered for delivery at one time.

4.3.1.1 Batch. A batch shall consist of a quantity of an individual paint of the paint system from a single finished product manufactured at the same time from the same units (sacks, cans, barrels, and so forth) or same supplier lot labeled ingredients.

4.3.2 Sampling. Two representative random samples from each lot shall be tested. The samples shall be packaged in separate containers. Minimum size for each sample shall be two containers of the size specified in the contract (see 6.2). If one or more defects are found in any sample, the entire lot shall be rejected. The contractor has the option of screening 100 percent of the rejected lot for the rejected characteristic(s), or providing a new lot which shall be inspected as specified in 4.3.

4.4 Test methods (all types). Test methods shall be as listed in Table IV or as otherwise specified herein. The requirements listed in Table IV shall be tested in accordance with the applicable tests and test paragraphs listed therein. Results of tests shall be in accordance with the requirements paragraph listed in Table IV or in the test paragraph.

4.4.1 Resistance to tropical biofouling organism attachment.

4.4.1.1 Panel test.

- a. Tests shall be conducted in Biscayne Bay, Florida; Daytona Beach, Florida; or Pearl Harbor, Hawaii.
- b. Tests shall have twelve test panels prepared for each paint system.
- c. Test panels shall be as follows:
 - (1) Class 1 panels shall be made of the steel specified in ASTM A1011 / A1011M and a minimum of 3.175 mm (1/8 in) thick.
 - (2) Aluminum test panels for Class 2 testing shall be ASTM B209 (alloy 5086 H112). The use of these panels shall be at the discretion of NAVSEA.
 - (3) Test panels for Class 3 testing shall be of the material to which the coating is to be applied.
 - (4) Surface preparation of all steel test panels shall be in accordance with SSPC-SP 10 procedures; aluminum test panels shall be free of all contamination including dirt, grease, oil, and corrosion product; and elastomeric substrates shall be in accordance with the manufacturer's instructions.
- d. Paint thicknesses of each individual coating and the total system shall be in accordance with the manufacturer's ASTM F718 data sheet.
- e. Waterline immersion testing shall be conducted in accordance with ASTM D5479, and shallow submergence testing shall be conducted in accordance with ASTM D3623 for Type I, II, and IV paints. All panels in these tests shall be under cathodic protection from a zinc anode. This shall be done with either an individual anode per panel or with a single anode of sufficient capacity to polarize the entire set of test samples. Rate as follows:
 - (1) Fouling shall be rated in accordance ASTM D6990, (for the purposes of fouling rating, the rating shall be calculated by subtracting from 100 the percent of the surface area covered with fouling, not the sum of individual species present).

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- (2) Checking shall be rated in accordance with ASTM D660.
 - (3) Cracking shall be rated in accordance with ASTM D661.
 - (4) Blistering shall be rated in accordance with ASTM D714.
 - (5) Inspect for exposed anticorrosive paint, as appropriate. Fouling at the panel edges shall be neglected. Of the six panels in each test (waterline and shallow immersion), three shall be left undisturbed, under immersion for the test duration. They shall not be rinsed in any fashion. The remainder may be removed on a regular schedule and rinsed with low pressure water (<350 kPa (50 psi)) for inspection. At the end of the requisite exposure period, all panels shall be low pressure rinsed, inspected, and rated. Individual data shall be reported for all panels.
- f. Types I, II, and IV, all Classes, all Grades, Application 1 paints shall be tested for 12 months. Paint systems shall meet the requirements of 3.4.4.1.1.
 - g. Types I and II, all Classes, all Grades, Application 2 paints shall be tested for 24 months, with an evaluation made after 12 months. Paint systems shall meet the requirements of 3.4.4.1.1.
 - h. Types I and II, all Classes, all Grades, Application 3 paints shall be tested as in 4.4.1.1(g), and then show sufficient ablation/erosion rates (see Table IV) to meet the service life requirement.
 - i. Testing of systems belonging to Type III, all Classes, Grades and Applications shall be conducted as follows:
 - (1) The testing shall consist of test panels subjected to a static exposure for a 2-4 month period (in Biscayne Bay, Florida or Pearl Harbor, Hawaii followed by flow channel testing (ASTM D4938). This process is one cycle. The total test shall include a minimum of 4 and a maximum of 8 cycles or extend nominally one to two years in duration. Testing shall be completed until at least one observation of 25% hard fouling and one observation of 40% hard fouling (i.e., barnacles, encrusting bryozoa, and tubeworms) occurs following the static period or the maximum of 8 tests cycles are completed.
 - (2) Each test panel shall be 6 inches by 12 inches by 0.125 inches thick. Four panels shall be subjected to testing. Test panels shall be exposed nominally 1 meter below the waterline. The test surface shall face horizontal down. (Only one side of the panel shall serve as the test surface). The backside of the panel shall be coated with a nontoxic material and secured in such a fashion to a backing plate to discourage fouling on this surface.
 - (3) For testing, the panel shall be removed from the static test site and immersed into a flow channel apparatus for testing in general accordance with ASTM D4938. Single-sided exposure of the test surface is acceptable. Should the flow channel not be co-located with the exposure site, transportation of the panels is acceptable provided that: (1) they are maintained in a wet condition immersed in a sample of the local seawater and (2) the transportation and flow channel testing can be initiated within 36 hours.
 - (4) Within the flow channel, two panels shall be installed in the test section with a maximum velocity of 20 knots. Two shall be installed in the section with a maximum velocity of 30 knots.
 - (5) The flow channel shall allow for incremental velocity testing up to the test speeds. The initial velocity (in the 20-knot section) shall be in the range of 3-6 knots. Increments in the test velocity shall be about 8%. The flow channel shall be run with fresh, natural seawater. A maximum temperature rise of 5 °C is allowed between the background temperature and the test temperature. The complete test run shall extend for 36 hours (nominally).
 - (6) At the conclusion of the flow channel run, the panels shall be removed from the test, photographed, and returned to the static exposure site. Panel shall remain wet in seawater during all phases of testing and transportation.

4.4.1.2 Ship test. Ship tests (patch and full) shall:

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- a. Have individual paints of the total system applied and cured in accordance with the requirements of the manufacturer's ASTM F718 data sheet for those products (see 3.3).
- b. Have the test ship(s) operate in high biofouling tropical or sub-tropical areas such as the Caribbean, Mediterranean or Western Pacific. Ship antifouling coatings shall not be underwater scrubbed or otherwise maintained. Data from ships subject to underwater maintenance shall not be accepted.
- c. Have ship inspections conducted in accordance with ASTM F1130. Rating of waterborne ships shall be in accordance with standard industry practices. Report:
 - (1) Checking in accordance with ASTM D660.
 - (2) Cracking in accordance with ASTM D661.
 - (3) Blistering in accordance with ASTM D714.
- d. Biofouling or physical failure due to verifiable physical damage that has removed the anticorrosive paint to the steel hull or removed the antifouling paint to the anticorrosive layers may be subtracted from the percentage area biofouled or anticorrosive paint failure.
- e. Have patch tests of 3 meters (m) [10 feet(ft)] in width (minimum) located amidships with underwater hull systems running from the keel to the heavy load line and boottop systems running from the heavy load line to the light load line. Patch tests shall include:
 - (1) A 3 meter (10 ft) wide (minimum) section of the antifouling component of the paint system being qualified, applied over a standard NAVSEA approved antifouling system.
 - (2) A 3 m (10 ft) wide (minimum) section of a NAVSEA approved antifouling system, for comparison, if a NAVSEA approved antifouling system is not applied to the test ship. This shall be of the same Class and Type as the system being qualified, (i.e., one shall use a Type I, Class 1 coating as a control for a Type I, Class 1 qualification process.)
 - (3) Manufacturer commercial ship patch tests shall be on commercial, Military Sealift Command (MSC), Maritime Administration (MARAD), or other Government agency ships. The application and inspections shall be certified and verified by a disinterested third party mutually agreed on by NAVSEA and the paint vendor and shall be at the vendor's cost. The ship operations (travel routes, ports, times in port and lay-up times) shall be reported.
 - (4) Tests of paint systems intended for elastomeric substrates shall be conducted only on Government ships having extensive elastomeric surfaces.
- f. Full ship applications shall consist of a full hull application of the manufacturer's total commercial system, except that the following shall be included:
 - (1) Unless waived by NAVSEA, there shall be a control paint system applied consisting of a system chosen from the QPL of this specification, or as otherwise approved NAVSEA. This control paint system shall be applied to provide a comparator for the test system.
 - (2) Commercial, MSC, MARAD, or other Government agency ships applications and inspections must be certified and verified by a disinterested third party mutually agreed on by NAVSEA and the paint vendor at the vendor's cost. The ship operations shall be certified and verifiable with travel, port time and lay-up times documented.
 - (3) The application and inspections of full ship applications to Government ships shall be at a Naval shipyard or under Navy contract at a commercial shipyard. The application shall be inspected by a Navy representative at Navy cost.
- g. Paints in service on Navy ships will be monitored by the Government for two, five years, seven, or twelve years, as appropriate. Paints shall meet the requirements of 3.4.4.2.3.

4.4.2 Recoatability.

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4.4.2.1 Type I, II, and IV. Two panels from each set of test systems shall be retrieved from those tested in 4.4.1.1, after completion of the required test. These panels shall be removed from test and shall be cleaned for a period not to exceed 2 minutes with fresh water at a nominal pressure of 15,000 to 20,000 kPa (2175-2900 psi). Test panels shall not be allowed to dry between being removed from test and the pressure cleaning. Dry for 24 hours at ambient conditions. Recoat one-half of each test panel with one coat of the same topcoat as originally used. Recoating shall be in accordance with the manufacturer's ASTM F718 instructions. Application and curing of this recoat paint film shall be in accordance with the manufacturer's ASTM F718. The recoated panels shall be immersed for 3 months as specified in 4.4.1.1(e). Rate as specified in 4.4.1.1(e). Test paints shall meet the requirements of 3.4.8.

4.4.2.2 Type III. Two panels of each set of test systems shall be retrieved from those tested in 4.4.1.1, after completion of the required test. These panels shall be removed from test and shall be cleaned for a period not to exceed 2 minutes with fresh water at a nominal pressure of 15,000 to 20,000 kPa (2175-2900 psi). Test panels shall not be allowed to dry between being removed from test and the pressure cleaning. Dry for 24 hours at ambient conditions. Recoat one-half of each test panel with one coat of the same topcoat as originally used. Recoating shall be in accordance with the manufacturer's ASTM F718 instructions. Application and curing of this recoat paint film shall be in accordance with the manufacturer's ASTM F718. The recoated panels shall be tested for 3 months as specified in 4.4.1.1(i). Rate as specified in 4.4.1.1(i). Test paints shall meet the requirements of 3.4.8

4.4.3 Volatile organic content (VOC). VOC shall be determined in accordance with EPA Method 24 (40 CFR, Part 60). The VOC of each paint shall comply with the requirements of Table IV and 3.7.

4.4.4 Storage stability.

4.4.4.1 Shelf life. Store an original, unopened container of each individual paint or component of the system for two years under warehouse conditions, at or below 27 °C (80 °F), and at or below 50% relative humidity. Paints shall conform to the requirements in 3.4.3.1.

4.4.4.2 Partially full container. Expose a sealed, two-thirds full container (4 liters (1 gallon) or less) of each individual paint or component of the system for seven days at 60 °C (140 °F). Paints shall conform to the requirements in 3.4.3.2.

4.4.4.3 Accelerated storage stability. Expose an original, unopened container of each individual paint or component of the system to a temperature of 60 °C (140 °F) (nominal) continually for 30 days. Paints shall conform to the requirements in 3.4.3.3.

4.4.5 Spraying properties. Each individual paint of the paint system shall be mixed in accordance with the manufacturer's ASTM F718 data sheet. Using the manufacturer's ASTM F718 designated spray equipment, spray each paint onto individual ground-glass panels to the manufacturer's ASTM F718 recommended wet film thickness. The panel shall be observed for spraying properties. The dry film shall be inspected for running, sagging, or streaking, blooming, blushing, bubbling, cratering, dusting, floating, fogging, hazing, mottling, orange peel appearance, pinholing, seeding, or streaking. The test results for each individual paint shall meet the requirements of 3.4.5.

4.4.6 Brushing properties. Each individual paint of the paint system shall be mixed in accordance with the manufacturer's ASTM F718 data sheet. Using the manufacturer's ASTM F718 designated equipment, brush each paint onto individual ground-glass panels to the manufacturer's ASTM F718 recommended wet film thickness. The brushing properties of the paint shall be determined. The dry film shall be inspected for running, sagging, or streaking, blooming, blushing, bubbling, cratering, dusting, floating, fogging, hazing, mottling, orange peel appearance, pinholing, seeding, or streaking. The test results for each individual paint shall meet the requirements of 3.4.6.

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4.4.7 Rolling properties. Each individual paint of the paint system shall be mixed in accordance with the manufacturer's ASTM F718 data sheet. Using the manufacturer's ASTM F718 designated equipment, roll each paint onto individual ground-glass panels to the manufacturer's ASTM F718 recommended wet film thickness. The rolling properties of the paint shall be determined. The dry film shall be inspected for running, sagging, or streaking, blooming, blushing, bubbling, cratering, dusting, floating, fogging, hazing, mottling, orange peel appearance, pinholing, seeding, or streaking. The test results for each individual paint shall meet the requirements 3.4.7.

4.4.8 Color.

4.4.8.1 Anticorrosive, tie coat paints. Red antifouling topcoats shall be visually consistent with the pigments used. The color of black and gray antifouling topcoat paints and individual paints (except anticorrosive topcoats in R₀ colors) shall be determined. Use at least three standard illuminants to compare the color. In case of doubt, color differences (delta L, delta a and delta b) shall be determined in accordance with ASTM D2244 using a D-65 light source, a 45-degree illumination angle and a 0-degree viewing angle. Color shall be in accordance with the requirements of 3.4.1.

4.4.8.2 Color of camouflage R₀ anticorrosive paints. Test panels of each R₀ dark gray/black color paint shall be prepared and allowed to cure at least 24 hours before testing. The ASTM D2244 LH value color of the R₀ anticorrosive topcoats shall be determined in accordance with ASTM E1347. Before measuring the color, wet the surface of the painted test panel with water to which a small amount of colorless surfactant has been added (a water solution containing less than 1 percent surfactant). The area to be measured shall be completely coated with the water film when it is inserted into the reflectometer for measurement. Check the test panel for complete water coverage after the measurement is completed. If the water film does not completely cover the area just measured, discard the measurement and repeat the process until a measurement is obtained on a test panel having complete water coverage both at the start and the end of the measurement. This ASTM D2244 LH value obtained is defined as R_w. The R_w measured shall conform to the appropriate requirements of 3.4.1.

4.4.9 Cathodic protection compatibility. Two steel panels shall be retrieved from those tested in 4.4.1.1 after completion of the required test. Each test panel shall be electrically connected by an insulated copper wire to a ASTM G80 magnesium anode and shall have a 3.175 mm (1/8 in) (nominal) hole drilled through the coating to the metal at the center of the test panel. The electrical resistance between a point on the surface of the anode and the metal in the drilled hole of the test panel shall be less than 0.01 ohm, when checked with an ohm meter. Connecting points on the test panel shall be coated with an epoxy compound for insulation. The test panel shall be reinstalled in the ASTM D3623 test in such a manner as to separate the test panel from the magnesium anode by 60 cm (2 ft) (nominal) for a period of 3 months. At the completion of the three-month test, inspect each test panel for lifting or undercutting around the drilled hole, peeling, blistering, dissolving, or other paint film defects. Test results shall be in accordance with the requirements of 3.4.9.

4.4.10 Pressure cycling. Four test samples shall be prepared similar to those tested in 4.4.1.1. The samples shall be placed into a pressure tank with fresh water and cycled from 0 to 4140 kilopascals (kPa) (600 psi) for 2200 cycles. The pressure shall be held for one minute when the pressure reaches less than 340 kPa (50 psi) and when the pressure is at the maximum. At 1100 and at completion of the test, the samples shall be removed and meet the requirements of 3.4.10.

4.4.11 Soluble and total metal content. Soluble and total metal content shall be determined on a dry paint film mode from each individual paint of the paint system in accordance with the 40 CFR Part 261, Appendix II, Toxic Characteristic Leaching Procedure (TCLP). Test results shall be in accordance with the requirements of 3.3.5.

4.5 Paints and coatings product/procedure data. Data sheets shall be in accordance with the requirements of 3.3.5.2, and 3.5. Manufacturer's commercial and ASTM F718 data sheets shall reflect the information required in 3.2 for application purposes. The toxic(s) (pesticides, biocides, and so forth) used in the product being qualified shall be in accordance with the requirements of the Type for which the product is being qualified (see 3.3.1 and 6.3).

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4.6 Toxicological product formulations. The contractor shall have the toxicological product formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use.

4.7 Inspection of packaging. The packaging, packing, marking and data sheets of the paint shall be examined to determine compliance with the requirements of Section 5 of this specification.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Department or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES.

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification covers a variety of high Grade, paint systems. These coatings are intended for application to ship hulls to prevent marine biofouling and corrosion. Types I and II antifouling topcoat paints are intended to polish (erode or ablate) under water flow conditions to provide a biofouling free, smooth hull for fuel efficiency. Type III antifouling topcoat paints are intended to provide a foul-release topcoat while Type IV antifouling topcoat paints provide biofouling control without eroding. The paint systems covered by this specification include paints that can be applied to steel, aluminum, and rubber substrates. Antifouling paint conforming to present air protection regulations (1990) is required as Grade A, but the specification provides Grades at lesser VOC levels to encourage manufacturers to develop more environmentally acceptable materials. Except for the biocide-containing antifouling topcoats of Types I, II, and IV, the individual dried paint residues and dry paint contaminated debris may constitute non-hazardous waste.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of the specification.
- b. Type, Class, Grade, and Application of paint required (see 1.2).
- c. Certifications (if any) required (see 3.3.5.2).
- d. Required marking (see 3.10).
- e. Level of packaging and of packing required (see 5.1).
- f. Size of container required, if other than as specified (see 5.1).
- g. Requirements for ASTM F718 data sheets (see 3.5).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 24647 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160.

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6.4 Material safety data sheets and ASTM F718 data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313 and ASTM F718 data sheets. An MSDS and ASTM F718 data sheet will be included with all packaged or packed paint containers (see 3.5). The pertinent Government mailing addresses for submission of data are in FED-STD-313.

6.5 Shelf-life. This specification covers items where shelf-life is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order. The shelf-life codes are contained in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M; Shelf-Life Management Manual, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points (ICPs), and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: <http://www.shelflife.hq.dla.mil/>.

6.6 Subject term (key word) listing.

Ablative
Antifouling
Copper
Cuprous oxide
Erodible
Foul-release
Underwater hull
VOC

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - CR4
Navy - SH

Preparing activity:
Navy - SH
(Project 8010-0214-000)

Review activities:
Army - MR
Navy - CG
AF - 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.