

METRIC

TT-P-645C

18 June 2013

SUPERSEDING

TT-P-645B(SH)

w/INT. AMENDMENT 1

August 9, 2006

TT-P-645B

March 12, 1990

FEDERAL SPECIFICATION**PAINT, ALKYD TYPE, FORMULA NUMBER 84**

The General Services Administration has authorized the use of this federal specification, by all federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers an anticorrosive paint for general purpose applications to steel and aluminum. The paint contains a maximum of 250 grams of volatile organic compounds (VOC) per liter (2.08 pounds of VOC per gallon). This paint is to be used as supplied with no thinning.

2. APPLICABLE DOCUMENTS

2.1 Government publications. The following documents, of the issues in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

FEDERAL STANDARDS

- | | | |
|-------------------|---|---|
| FED-STD-141 | - | Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing |
| FED-STD-313 | - | Material Safety Data, Transportation Data, and Disposal Data for Hazardous Materials Furnished to Government Activities |
| FED-STD-595/34230 | - | Green, Flat or Lusterless |

MILITARY SPECIFICATIONS

- | | | |
|---------------|---|--|
| MIL-DTL-24607 | - | Enamel, Interior, Nonflaming (Dry), Chlorinated Alkyd Resin, Semigloss |
| MIL-A-22262 | - | Abrasive Blasting Media Ship Hull Blast Cleaning |
| MIL-DTL-24441 | - | Paint, Epoxy-Polyamide, General Specification for |
| MIL-PRF-24763 | - | Enamel, Emulsion Type, for Shipboard Use |
| MIL-PRF-24635 | - | Coating Systems, Weather-Resistant, Exterior Use |

(Copies of these documents are available online at <http://quicksearch.dla.mil/> or <https://assist.dla.mil/>.)

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data that may improve this document should be sent to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@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 <https://assist.dla.mil>.

TT-P-645C

CODE OF FEDERAL REGULATIONS (CFR)

- 29 CFR 1910, 1915, 1917, 1918, 1926 and 1928 - Occupational Safety and Health Administration, Department of Labor
- 29 CFR 1910.1000 - Air Contaminants
- 29 CFR 1910.1200 - Hazard Communication
- 29 CFR 1915.1001, Appendix K, Method ID-191 - Polarized Light Microscopy of Asbestos
- 40 CFR 60, Appendix A-7, Method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings
- 40 CFR 63, Subpart II - National Emission Standards for Hazardous Air Pollutants for Shipbuilding and Ship Repair (Surface Coating)
- 40 CFR 82 - Protection of Stratospheric Ozone
- 40 CFR 261.24(a), Method 1311 - Toxicity Characteristic Leaching Procedure (TCLP)
- 40 CFR 355, Appendixes A and B - The List of Extremely Hazardous Substances and Their Threshold Planning Quantities
- 40 CFR 372.65 - Chemicals and Chemical Categories to Which this Part Applies

(Copies of these documents are available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20401 or online at www.gpoaccess.gov/index.html.)

FEDERAL ACQUISITION REGULATION (FAR)

- FAR Part 23, Subpart 23.4, paragraph 23.403 - Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, and Drug-Free Workplace, Subpart 23.4, Use of Recovered Materials, paragraph 23.403, Policy

(Copies of this document are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 or online at <http://www.arnet.gov/far>.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

- S9510-AB-ATM-010 - Nuclear Powered Submarine Atmosphere Control Manual

(Copies of the chapter titled "Material Control Program" are available from Commander, Naval Sea Systems Command, ATTN: SEA 05Z4, 1333 Isaac Hull Ave. SE Stop 5122, Washington Navy Yard, DC 20376-5122 or by email request to commandstandards@navy.mil.)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

- EPA 600/4-79-020 - Methods for Chemical Analysis of Water and Wastes
- EPA SW-846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

(Copies of these documents are available from the Environmental Protection Agency, Ariel Rios Building, 1200 Pennsylvania Avenue, N.W., Washington DC 20460 or online at www.epa.gov.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

TT-P-645C

ASTM INTERNATIONAL

ASTM D95	-	Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
ASTM D185	-	Standard Test Methods for Coarse Particles in Pigments
ASTM D476	-	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D522	-	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
ASTM D523	-	Standard Test Method for Specular Gloss
ASTM D562	-	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
ASTM D869	-	Standard Test Method for Evaluating Degree of Settling of Paint
ASTM D1210	-	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
ASTM D1296	-	Standard Test Method for Odor of Volatile Solvents and Diluents
ASTM D1364	-	Standard Test Method for Water in Volatile Solvents (Karl Fischer Reagent Titration Method)
ASTM D1475	-	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D1729	-	Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
ASTM D1849	-	Standard Test Method for Package Stability of Paint
ASTM D2245	-	Standard Test Method for Identification of Oils and Oil Acids in Solvent-Reducible Paints
ASTM D2369	-	Standard Test Method for Volatile Content of Coatings
ASTM D2698	-	Standard Test Method for Determination of the Pigment Content of Solvent-Reducible Paints by High-Speed Centrifuging
ASTM D2805	-	Standard Test Method for Hiding Power of Paints by Reflectometry
ASTM D3278	-	Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D3359	-	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D4400	-	Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
ASTM D5895	-	Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders
ASTM E1252	-	Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Infrared Analysis

TT-P-645C

ASTM F718 - Standard Specification for Shipbuilders and Marine Paints and Coatings
Product/Procedure Data Sheet

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at www.astm.org.)

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-SP 10 - Near-White Blast Cleaning

(Copies of this document are available from SSPC Publication Sales, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656 or online at www.sspc.org.)

3. REQUIREMENTS

3.1 Formula. The paint shall consist of the alkyd resin, pigments, extender pigments, and solvents conforming to the [table I](#) requirements which, when combined in the proportions shown in [table I](#), shall result in a paint conforming to the requirements of the applicable paragraphs of this specification.

3.1.1 Formula no. 84. The formula in [table I](#) is designated Navy Standard Formula No. 84. When Formula No. 84 is specified, or when this specification is referenced without reference to formula number, the paint shall conform to the requirements of this section. Manufacturers may use alternate ingredients as long as the alternate ingredients are specifically approved by NAVSEA and the paint is shown to meet all the requirements by first article testing (see 4.2) and conformance testing (see 4.2 and 4.3). Conformance testing may be conducted by the Government at any time to verify that the product being acquired meets the requirements of the specification.

3.1.1.1 First article inspection. When first article testing is required, the paint shall be required to meet all the requirements of this specification (see 4.2 and 6.4).

3.1.2 Composition. The paint shall consist of the ingredients listed in [table I](#) and its footnotes in the proportions shown in [table I](#) and [table II](#). In addition, to assist in meeting drying times, brushing, condition in container, and storage stability requirements, the amounts of driers, antissettling, antisagging, and antiskinning agents may be varied as necessary to meet the other requirements of this specification.

TT-P-645C

TABLE I. Formula no. 84.

Ingredients	Kilograms (kg)	Pounds (lb)	%WT
Alkyd resin solution ^{1/}	242.45	534.37	48.6
Parachlorobenzotrifluoride ^{2/}	94.15	207.51	18.9
Magnesium silicate ^{3/}	60.1	132.38	12.0
Paint thinner ^{4/}	34.1	75.13	6.8
Paint thinner ^{5/}	3.82	8.43	0.77
Calcium borosilicate ^{6/}	23.76	52.37	4.8
Titanium dioxide ^{7/}	12.34	27.19	2.48
Yellow pigment ^{8/}	13.75	30.3	2.8
Blue pigment ^{9/}	1.10	2.44	0.22
Suspending agent ^{10/}	4.28	9.43	0.86
Calcium drier ^{11/}	4.07	8.97	0.81
Dispersant ^{12/}	1.67	3.69	0.33
Zirconium drier ^{13/}	2.05	4.53	0.41
Antiskinning agent ^{14/}	0.96	2.11	0.19
Cobalt drier ^{15/}	0.62	1.36	0.12
Totals ^{16/}	499.22	1100.21	100.0

FOOTNOTES:

^{1/} The alkyd resin complies with [table II](#) requirements.

^{2/} Parachlorobenzotrifluoride, Emco Company, Chicago, IL.
(There are chemically identical alternatives available from other manufacturers.)

^{3/} Talcron MP-1250, Specialty Minerals, Inc., Bethlehem, PA.

^{4/} Mineral Spirits.

^{5/} Methyl amyl ketone, EMCO, North Chicago, IL.

^{6/} CW-2230, Halox Pigments, Hammond, IN.

^{7/} ASTM D476, Type II or Ti-Pure R-960, DuPont, 1007 Market Street, Wilmington, DE 19898.

^{8/} RX-1205 Monoazo yellow, BASF Catalysts LLC, Iselin, NJ, Novaperm Yellow F2G-EDS, Clariant Corp., 400 Monroe Road, Charlotte, NC 28205. Pigment amount is maximum required to meet specification color requirement.

^{9/} Milori Blue 910B, Daicolor-Pope, Patterson, NJ, Hostaperm Blue, B2G-ED, LV 3491, Clariant Corp., 400 Monroe Road, Charlotte, NC 28205. Pigment amount is maximum required to meet specification color requirement.

^{10/} Bentone 38 (10%) Gel, NCP Coatings, Niles, MI.

^{11/} Calcium neodecanoate (6%), OMG Americas, Cleveland, OH.

^{12/} Disperbyk 111, Byk-Chemie USA, Wallingford, CT.

^{13/} Zirconium neodecanoate (18%), OMG Americas, Cleveland, OH.

^{14/} Skino #2, OMG Mooney Americas, Cleveland, OH.

^{15/} Cobalt neodecanoate (12%), OMG Americas, Cleveland, OH.

^{16/} This formula makes approximately 100 gallons of paint.

NOTE: See 3.1.1 for alternate ingredients listed in this table.

TT-P-645C

TABLE II. Alkyd resin requirements.

Characteristics	Requirements	
	Minimum	Maximum
Nonvolatile resin, % WT of solution	49	71
Phthalic anhydride, % WT of non-volatile vehicle	30	-----
Drying oil acids, % WT of non-volatile vehicle	45	55
Acid number	5	12
Dihydric alcohol, % WT of non-volatile resin	-----	7
Viscosity in krebs units at 25 °C	71	125
Color, gardener	-----	10
Weight per gallon, kilograms/liter (pounds/gallon)	0.96 (8.0)	1.27 (10.5)
Soya oil	Positive	
Rosin	Negative	
Phenolic resin	Negative	

3.2 Manufacturing. The component raw materials shall be mixed, ground, and blended as required to produce a product that is uniform and free from grit, lumps, skins, and floating pigment. The paint shall be entirely suitable for the purpose intended and shall be in full conformance to the requirements of this specification.

3.2.1 Toxicity. When evaluated in accordance with 4.7 [the Health Hazard Assessment (HHA)], the paint shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.7 and 6.7). The paint shall not contain more than 0.005 percent cobalt compounds by weight in its formulation, unless a cobalt drier is used (see [table V](#)).

3.3 Quantitative requirements. The paint shall conform to the quantitative requirements shown in [table III](#) and as herein specified.

TABLE III. Formula no. 84 quantitative requirements.

Characteristics	Requirements	
	Minimum	Maximum
Pigment, % WT of paint	50	54.0
Volatiles, % WT of paint	21.3	25.3
Nonvolatile vehicle, % WT of paint (calculated by difference)	20.7	28.7
Water, % WT of paint	-----	0.5
Coarse particles and skins (as residue on n. 325 sieve) % WT of paint	-----	0.2
Viscosity, krebs units	75	105
Weight per gallon, kilograms/liter (pounds/gallon)	1.20 (10)	1.44 (12)
60° specular gloss	7	25
Contrast ratio	0.92	-----
Time to dry to touch (hours)	-----	2.0
Time to dry through (hours)	-----	6.0
Fineness of grind, hegman units	5	-----
Flashpoint, °C (°F)	38 (100)	-----
Sag resistance, millimeter (mils)	0.15 (6)	-----
VOC, grams/liter (pounds/gallon)	-----	250 (2.08)
Asbestos content, % WT of dry film	-----	0.5
Crystalline silica content, % WT of dry film	-----	0.5

TT-P-645C

3.3.1 Metal content. The content of each soluble metal and total content of each metal of the paint shall be less than the values listed in [table IV](#) and [table V](#) when tested as specified in 4.6.2.

TABLE IV. Soluble metals content.

Soluble metal and its compounds	Maximum, mg/L
Antimony and its compounds	15.0
Arsenic and its compounds	5.0
Barium and its compounds (excluding barite)	100.0
Beryllium and its compounds	0.75
Cadmium and its compounds	1.0
Chromium (VI) compounds	1.0
Chromium and its chromium (III) compounds	560.0
Cobalt and its compounds	50.0
Copper and its compounds	25.0
Fluoride salts	180.0
Lead and its compounds	5.0
Mercury and its compounds	0.20
Molybdenum and its compounds	350.0
Nickel and its compounds	20.0
Selenium and its compounds	1.0
Silver and its compounds	5.0
Tantalum and its compounds	100.0
Thallium and its compounds	7.0
Tungsten and its compounds	100.0
Vanadium and its compounds	24.0
Zinc and its compounds	250.0

TT-P-645C

TABLE V. Total metals content.

Metal and its compounds	Maximum, % WT
Antimony and its compounds	0.015
Arsenic and its compounds	0.005
Barium and its compounds (excluding barite)	0.10
Beryllium and its compounds	0.0002
Cadmium and its compounds	0.0005
Chromium (VI) compounds	0.001
Chromium and its chromium (III) compounds	0.56
Cobalt and its compounds ^{1/}	0.005
Copper and its compounds	0.01
Fluoride salts	0.18
Lead and its compounds	0.005
Mercury and its compounds	0.0002
Molybdenum and its compounds	0.35
Nickel and its compounds	0.02
Selenium and its compounds	0.002
Silver and its compounds	0.001
Tantalum and its compounds	0.100
Thallium and its compounds	0.007
Tungsten and its compounds	0.100
Vanadium and its compounds	0.01
Zinc and its compounds	0.25
NOTE: ^{1/} Total cobalt content may exceed 0.005 % WT (up to 0.2 % WT) only if a cobalt drier is used to effect proper drying. Regardless of whether a cobalt drier is used, soluble cobalt content may not exceed table IV requirements.	

3.3.2 Hazardous air pollutants (HAPs). The contents of HAPs solvents in the total paint shall be less than the percent by weight (%WT) values listed in [table VI](#) when tested as specified in 4.6.3.

TT-P-645C

TABLE VI. Hazardous solvent content.

Hazardous solvent in total paint	Maximum, %WT
Benzene	0.05
Chlorinated solvent(s), total Carbon tetrachloride Chloroform (trichloromethane) Methylene chloride (dichloromethane) Tetrachloroethylene (perchloroethylene) 1,1,1-Trichloroethylene (methyl chloroform) Trichloroethylene	0.05
Ethyl benzene	0.05
Methyl, ethyl, and butyl mono-ethers of ethylene glycol or the acetates, total (methyl, ethyl, and butyl cellosolves and acetates)	0.05
Methyl ethyl ketone (MEK)	0.05
Methyl isobutyl ketone (MIBK)	0.05
Toluene	0.05
Xylene (all forms), total	0.1

3.4 Qualitative requirements. The paint shall conform to the qualitative requirements specified in 3.4.1 through 3.4.10.

3.4.1 Odor. The odor shall be characteristic of the volatiles permitted when tested as specified (see [table VII](#)).

3.4.2 Color. The color of the paint shall approximately match color chip no. 34230 of FED-STD-595 when tested as specified (see 4.6.10).

3.4.3 Flexibility. The paint shall show no evidence of cracking when tested as specified (see 4.6.5).

3.4.4 VOC regulations. This paint complies with 40 CFR 63, Subpart II and shall be used as supplied without thinning (see 4.6.4).

3.4.5 Condition in container. When tested as specified in 4.6.6, a freshly opened, full container of paint shall be free from lumps, abnormal thickening, or livering and shall show no more pigment settling or caking than can be readily reincorporated to a smooth, uniform state.

3.4.5.1 Storage stability.

3.4.5.1.1 Full container. When tested as specified in 4.6.7.1, the product shall be capable of being readily broken up with a paddle to a smooth uniform consistency. It shall be free from livering, curdling, gelling, pigment float, hard caking, gummy sediment, or other objectionable properties for at least 1 year after date of manufacture. The paint shall conform in all respects to this specification.

3.4.5.1.2 Partially full container. When tested as specified in 4.6.7.2, paint shall show no skinning at the end of 48 hours. In addition, the paint shall show no livering, curdling, hard caking, or gummy sediment after being in a partially filled container at an elevated temperature. The paint shall mix readily to a smooth uniform state. Any skin formed shall be easily removed.

TT-P-645C

3.4.6 Application properties.

3.4.6.1 Brushing properties. The product, when tested as specified in [table VII](#), shall be capable of being brushed out and laid off without excess drag on the brush. When dry, the brush-coated surface shall be free from sags, runs, wrinkles, excess brush marks, or other film defects. The film shall exhibit good adhesion and a smooth, uniform appearance.

3.4.6.2 Spraying properties. The paint, when tested as specified in [table VII](#), shall show no running, sagging, streaking, dusting, mottling, color separation, or other film defects. The film shall exhibit good adhesion and a smooth, uniform appearance.

3.4.7 Cross-cut adhesion test. When tested as specified in 4.6.9.1 and 4.6.9.2, a 0.025-millimeter (nominal) [0.001-inch (nominal)] dry film of paint shall achieve a minimum classification of 4B.

3.4.8 Water resistance. When tested as specified in 4.6.8, a film of paint shall show no wrinkling or blistering immediately after removal of the panel from water. The paint shall be only slightly affected with regard to adhesion when observed 2 hours after removal from the water. After 24 hours air drying, the portion of the panel which was immersed shall be almost indistinguishable, with regard to adhesion and general appearance from the portion of the panel that was not immersed.

3.4.9 Compatibility.

3.4.9.1 Compatibility with topcoats. When tested as specified in 4.6.9.1, the paint shall show no signs of incompatibility such as blistering, wrinkling, or peeling when topcoated with coatings manufactured in accordance with MIL-PRF-24635, MIL-DTL-24607, and MIL-PRF-24763. The coating shall be examined for incompatibility immediately after topcoat application and after 48 hours.

3.4.9.2 Compatibility with primers and undercoats. When tested as specified in 4.6.9.2, the paint shall show no signs of incompatibility such as blistering, wrinkling, or peeling when applied over fully cured or dried films of coatings manufactured in accordance with this specification, and qualified MIL-PRF-23236 system or MIL-DTL-24441, Type III and Type IV Formula 150 primer. The coating shall be examined for incompatibility immediately after topcoat application and after 48 hours.

3.4.10 Surface appearance. Films of the paint, prepared as specified in 4.6.11, shall have a smooth and uniform appearance and shall show no evidence of wrinkling, seeding, or other nonuniformity.

3.5 Directions for use. As specified (see 6.2), the manufacturer shall provide directions for the mixing and application of the paint. The directions shall comply with 29 CFR 1910, 1915, 1917, 1918, 1926, and 1928.

3.6 Label. The manufacturer shall prepare label instructions in accordance with 29 CFR 1910.1000. Each container shall be affixed with a hazardous chemical warning label in accordance with 29 CFR 1910.1200. To comply with 40 CFR 63, Subpart II, the following two statements must appear on each paint can label:

- a. A certification that the paint in the container satisfies the NESHAP requirements for shipbuilding and ship repair.
- b. A statement of the ratio of volatile content to solids expressed as grams of volatile organic hazardous air pollutants (VOHAP) per liter of solids.

3.7 Material safety data sheet (MSDS). The contracting activity shall be provided an MSDS at the same time of contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.6).

3.8 Ozone-depleting chemicals. The materials used in the paint shall not contain Class I or Class II ozone-depleting chemicals as defined in 40 CFR 82.

3.9 Recovered materials. The offeror/contractor is encouraged to use recovered materials to the maximum extent practicable, in accordance with paragraph 23.403 of the Federal Acquisition Regulation (FAR).

TT-P-645C

3.10 Off-gassing. The paint shall be tested for off-gassing in accordance with the requirements of 4.8. The Navy will review the results and assign a usage category. The required usage category is “Permitted” or “Limited” (see 4.8 and 6.8).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 First article inspection. First article inspection shall be performed on a random sample drawn from the first production batch of paint. First article inspection shall include all tests specified in [table VII](#) and 4.4 including those designated in [table VII](#) as a “quality conformance inspection test” (see 6.3).

4.3 Quality conformance inspection. Quality conformance inspection shall be provided in accordance with Test Methods 1011, 1021, and 1031 of FED-STD-141, and shall consist of all tests designated as “quality conformance inspection test” in [table VII](#).

4.4 Inspection conditions. Unless otherwise specified in the applicable test paragraph of this specification, all inspections shall be performed in accordance with the test conditions specified in [table VII](#) and 4.6.

4.5 Lot. A lot shall consist of all material manufactured at one time (batch) or all material produced by mixing multiple batches into one uniform unit of material. Failure of a sample to pass any test should be cause for rejection of the lot.

TABLE VII. Test procedures.

Property	Requirement	Test
Toxicity	3.2.1	4.7
Pigment content	Table III	ASTM D2698
Volatile vehicle content	Table III	ASTM D2369
Nonvolatile vehicle content	Table III	FED-STD-141, Test Method 4053.2
Water content ^{2/}	Table III	ASTM D95, ASTM D1364
VOC g/L	Table III	4.6.4
Metal and asbestos content	3.3.1 Table III	4.6.2
Hazardous air pollutants ^{2/}	3.3.2	4.6.3, ASTM E1252
Phthalic anhydride ^{2/}	Table II	----
Rosin/rosin derivatives ^{2/}	Table II	----
Phenolic resin ^{2/}	Table II	FED-STD-141, Test Method 5141.1
Soya oil ^{2/}	Table II	ASTM D2800, ASTM D2245
Drying oil acids ^{2/}	Table II	----
Silica content ^{2/}	Table III	----
Coarse particles/skins	Table III	ASTM D185
Viscosity ^{1/}	Table III	ASTM D562
Weight per liter (gallon) ^{1/}	Table III	ASTM D1475

TT-P-645C

TABLE VII. Test procedures – Continued.

Property	Requirement	Test
Drying time Dry to touch ^{1/} Dry through	Table III	ASTM D5895
Fineness of grind ^{1/}	Table III	ASTM D1210
Flash point ^{1/}	Table III	ASTM D3278
Gloss ^{1/}	Table III	ASTM D523
Sag resistance ^{1/}	Table III	ASTM D4400
Odor	3.4.1	ASTM D1296
Color ^{1/} and Surface appearance ^{1/}	3.4.2 3.4.10	4.6.10, ASTM D1729 4.6.11, FED-STD-141 Test Method 3011.1
Flexibility	3.4.3	4.6.5, ASTM D522
Condition in container	3.4.5	4.6.6, FED-STD-141 Test Method 3011.3, ASTM D869
Storage stability Full container Partially full container	3.4.5.1.1 3.4.5.1.2	ASTM D869 4.6.7.1, FED-STD-141 Test Method 3011.3, ASTM D1849 4.6.7.2, FED-STD-141 Test Method 3021.1
Brushing properties	3.4.6.1	FED-STD-141 Test Method 4321.3
Spraying properties	3.4.6.2	FED-STD-141 Test Method 2131.2/4331.2
Water resistance	3.4.8	4.6.8
Compatibility with topcoats with primer and undercoats	3.4.9.1 3.4.9.2	4.6.9.1, ASTM D3359 4.6.9.2
Contrast ratio	Table III	ASTM D2805
Off-gassing	3.10	4.8
NOTES:		
^{1/} Quality conformance inspection test (see 4.3).		
^{2/} By data certification. Test methods (if applicable) are provided for information only.		

4.6 Test methods and test panel preparation. Test methods shall be in accordance with [table VII](#).

4.6.1 Panel preparation. Steel panels [minimum size 75 millimeter by 150 millimeter by 3 millimeter (3 inches by 6 inches by 0.12 inch) thick (nominal)] shall be prepared for testing by abrasive blasting to a near-white metal surface in accordance with SSPC-SP 10 to achieve a minimum 0.051 millimeter (0.002 inch; 2.0 mil) surface profile. The blasted panels shall be solvent wiped to remove any traces of oil or residue, blown dry with dry air, wrapped in plastic and stored in a desiccator, oven, or air-tight storage bag, or use other means to prevent rusting prior to coating. The abrasive used for blasting shall be in accordance with MIL-A-22262 and be listed on the current qualified products list. Unless otherwise specified in the applicable test paragraph of this specification, the test panels shall be coated with TT-P-645 paint applied in one coat at a wet film thickness that will yield a dry film thickness 50 percent greater than the blast profile. Unless otherwise specified in the applicable test paragraph of this specification, dry time shall be 48 hours at 21 °C (70 °F).

4.6.2 Soluble and total metal content. Asbestos, soluble and total metal content, except tantalum and tungsten, shall be determined on a dry film of the paint in accordance with the 40 CFR 261.24(a), Method 1311 and the appropriate test listed below. Asbestos shall be analyzed in accordance with 29 CFR 1915.1001, Appendix K, and the results shall be recorded as percent by weight of the dry paint film. Soluble metal content shall be analyzed as milligrams per liter (mg/L). Total metal content shall be analyzed as percent by weight of the dry paint film. The test results for asbestos, each individual soluble metal, and total metal shall be as specified in 3.3.1, [table III](#), [table IV](#), and [table V](#). Tantalum and tungsten soluble metal content and total metal content shall be analyzed as specified in 4.6.2.1.

TABLE VIII. Test methods for evaluating solid waste physical/chemical methods, EPA SW-846.

Metal/material	Digestion test method
All metals, except chromium (VI)	3050
Chromium (VI)	3060
Metal/material	SW-846 analysis test method
Antimony	7040 or 7041
Arsenic	7060 or 7061
Barium	7080 or 7081
Cadmium	7131
Total chromium	7190
Chromium (VI)	7195, 7196, or 7197
Lead	7421
Mercury	7470 or 7471
Nickel	7520 or 7521
Selenium	7740 or 7741
Silver	7760 or 7761

TABLE IX. Methods for chemical analysis of water and waste, EPA 600/4-79-020.

Metal/material	Test method
Beryllium	210.1 or 210.2
Cobalt	219.1 or 219.2
Copper	220.1 or 220.2
Fluoride	340.1, 340.2, or 340.3
Molybdenum	246.1 or 246.2
Thallium	279.1 or 279.2
Vanadium	286.1 or 286.2
Zinc	289.1 or 289.2

4.6.2.1 Tantalum and tungsten content. Tantalum and tungsten content of the paint shall be determined using any appropriate spectroscopy test method. The tests shall be conducted in accordance with the equipment manufacturer's directions for the use of the instrument. The paint manufacturer shall justify the test method choice and analytical accuracy. Test results for tantalum and tungsten shall be as specified in [table IV](#) and [table V](#).

4.6.3 Hazardous solvent content. Hazardous solvent content shall be determined in accordance with Test Methods 7356 and 7360 of FED-STD-141. Solvent fractions shall be identified in accordance with ASTM E1252. Test results shall be recorded as percent by weight of the total paint. The test results for each solvent shall be as specified in 3.3.2 and [table VI](#).

4.6.3.1 Alternate analysis methods. Manufacturer may use other analysis methods if such methods are shown to identify and quantify the hazardous air pollutants with the accuracy required (see 6.3).

4.6.4 Volatile organic compounds (VOC). VOC tests shall be conducted on paint prepared for application in accordance with the manufacturer's ASTM F718 data sheet. The VOC test shall be conducted in accordance with 40 CFR 60, Appendix A-7, (EPA) Method 24, and shall be in accordance with the requirements of [table III](#).

TT-P-645C

4.6.5 Flexibility. Flexibility shall be determined in accordance with ASTM D522. The paint shall be applied to a flat metal plate of approximately 31 gauge coated with a dry film thickness of 0.025 ± 0.008 millimeter (0.001 ± 0.0003 inch) of paint manufactured to this specification by means of a doctor blade capable of yielding a dry film thickness of 0.025 ± 0.008 millimeter (0.001 ± 0.0003 inch). The panel shall be allowed to air-dry for 2 hours then baked for 24 hours at 100 to 105 °C (212 to 221 °F). The panel shall then be removed from the oven and allowed to stand for 30 minutes at laboratory temperature [nominal 23 °C (73 °F)]. The panel shall then be bent over a 3.2- millimeter ($\frac{1}{8}$ -inch) mandrel or a tapered mandrel where the minimum diameter is 3.2 millimeters ($\frac{1}{8}$ inch) and the film examined at the bend under a magnification of five diameters. Flexibility shall be as specified in 3.4.3.

4.6.6 Condition in container. A container of the product in the size ordered shall be inspected. The product shall be equilibrated to test laboratory conditions [nominal 23 °C (73 °F)]. Evidence of pressure or vacuum in the unopened container shall be noted. The container shall then be opened and examined in accordance with Test Method 3011.3 of FED-STD-141 for evidence of skinning, corrosion of container interior, odor of putrefaction, rancidity or souring, gel bodies, and hard settling. If the sample is in a 1 liter (1 quart) or smaller container, the character of the lower (or settled) layer shall be determined with a spatula as specified in ASTM D869. If the sample is larger than 1 liter (1 quart), this step shall be omitted. The paint shall be hand-stirred 300 stirs in 2 minutes with a spatula appropriate to the container, stirring so as to ensure uniform distribution of any settled material. Immediately after stirring, the consistency of the paint shall be measured using the Krebs-Stormer viscometer. The paint shall be applied to a test panel and after it has dried, the paint film shall be examined for grains 0.8 millimeter ($\frac{1}{32}$ inch) in diameter, even larger gelatinous lumps, and streaks caused by such grains or lumps. The condition of the product shall be as specified in 3.4.5.

4.6.7 Storage stability.

4.6.7.1 Full container. Storage stability shall be tested in accordance with ASTM D1849. A container of the product of the size ordered shall be stored at the temperature recommended in the manufacturer's data sheet or ASTM F718 for a period of 1 year. After completion of 1 year, the stored sample shall be equilibrated to test laboratory conditions [nominal 23 °C (73 °F)]. Evidence of pressure or vacuum in the unopened container shall be noted. The container shall then be opened and examined in accordance with Test Method 3011.1 of FED-STD-141 for evidence of skinning, corrosion of container interior, odor of putrefaction, rancidity, or souring. If the sample is in a 1 liter (1 quart) or smaller container, the character of the lower (or settled) layer shall be determined with a spatula as specified in ASTM D869. If the sample is larger than 1 liter (1 quart), this step shall be omitted. The paint shall be hand-stirred 300 stirs in 2 minutes with a spatula appropriate to the container, stirring so as to ensure uniform distribution of any settled material. Immediately after stirring, the consistency of the paint shall be measured using the Krebs-Stormer viscometer. The paint shall be applied to a test panel and after it has dried, the paint film shall be examined for grains 0.8 millimeter ($\frac{1}{32}$ inch) in diameter, even larger gelatinous lumps, and streaks caused by such grains or lumps. The condition of the product shall be as specified in 3.4.5.1.1.

4.6.7.2 Partially filled container. A sample of paint shall be prepared and tested in accordance with Test Method 3021.1 of FED-STD-141. After 48 hours, the sample shall be inspected for skinning, livering, curdling, hard caking, or gummy sediment. The sample shall be examined for ease of mixing. The paint shall be as specified in 3.4.5.1.2.

4.6.8 Water resistance. A 0.076 ± 0.025 -millimeter (0.003 ± 0.001 -inch) film of the paint shall be spray applied on a panel prepared as specified in 4.6.1. The paint shall be cured at room temperature [approximately 22 °C (72 °F)] for 48 hours. Fifty percent of the panel shall be immersed in room temperature distilled water for 24 hours. The condition shall be as specified in 3.4.8.

TT-P-645C

4.6.9 Compatibility.

4.6.9.1 Compatibility with topcoats. Three panels shall be prepared and coated as specified in 4.6.1. A 0.051- to 0.076-millimeter (0.002- to 0.003-inch; 2- to 3-mil) topcoat manufactured to MIL-PRF-24635 shall be applied to the first panel; a 0.051- to 0.076-millimeter (0.002- to 0.003-inch; 2- to 3-mil) topcoat of enamel qualified to MIL-PRF-24763 shall be applied to the second panel; and a 0.051- to 0.076-millimeter (0.002- to 0.003-inch; 2- to 3-mil) topcoat of MIL-DTL-24607 enamel shall be applied to the third panel. After drying [curing the three panels for 48 hours at 50 °C (122 °F)], the panels shall be cooled to ambient laboratory conditions, and a 0.051- to 0.076-millimeter (0.002- to 0.003-inch; 2- to 3-mil) topcoat of the test paint manufactured to this specification shall be applied. The panels shall be examined for blistering, wrinkling, or peeling of the test paint immediately after application and after 48 hours. Adhesion shall be checked 48 hours after test paint application by Test Method B of ASTM D3359. Test paint condition shall be as specified in 3.4.7 and 3.4.9.1.

4.6.9.2 Compatibility with primers. Three panels shall be prepared and coated as specified in 4.6.1. A 0.051- to 0.076-millimeter (2- to 3-mil) paint manufactured to this specification shall be applied to the first panel; a 0.051- to 0.076-millimeter (2- to 3-mil) coating of MIL-DTL-24441, F.150, Type III polyamide epoxy shall be applied to the second panel; and a 0.051- to 0.076-millimeter (2- to 3-mil) coating of MIL-DTL-24441, F.150, Type IV polyamide epoxy shall be applied to the third panel. After drying [curing the three panels for 48 hours at 50 °C (122 °F)], one coat, at 0.051- to 0.076-millimeter (2- to 3-mil) of the test paint produced to this specification, shall be applied. The panels shall be examined for blistering, wrinkling, or peeling of the test paint immediately after application and 48 hours after application. Adhesion shall be checked 48 hours after topcoat application by Test Method B of ASTM D3359. Test paint condition shall be as specified in 3.4.7 and 3.4.9.2.

4.6.10 Color match. The paint color shall approximately match the FED-STD-595 color chip number 34230 when evaluated as specified in [table VII](#) (see 3.4.2).

4.6.11 Surface appearance. On a clean, smooth glass plate (a standard black and white Leneta chart is also acceptable) the paint shall be drawn down obtaining a wet film thickness using a 0.005-inch drawdown bar. The paint shall be dried for 24 hours in a horizontal position at 23±1 °C (74±2 °F) and 50±5 percent relative humidity. The paint shall be examined for conformance to 3.4.10.

4.7 Toxicity. An HHA shall be conducted to ensure conformance to 3.2.1, as specified (see 6.2). The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the paint using the administrative HHA data provided by the manufacturer/distributor to the NMCPHC.

4.8 Off-gassing. The paint shall be tested for off-gassing at a Government approved testing facility in accordance with S9510-AB-ATM-010 chapter titled “Material Control Program” (see 3.10 and 6.8).

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisitions.)

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activity within the Military Department or Defense Agency, or within the Military Department’s System Command. 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

INFORMATION FOR GUIDANCE ONLY. (This section contains information of a general or explanatory nature that is helpful, but is not mandatory.)

TT-P-645C

6.1 Intended use. This paint is intended for use on interior bulkhead and shipboard surfaces. This product may be applied where air pollution regulations apply. This paint is a non-lead, non-chromate, non-asbestos material. The dried paint film has been tested to U. S. EPA standards and the paint debris is, as of the time of this specification, a non-hazardous waste. It may be applied by brush, spray, or roller and is suitable for any metal or wood structure. During development, this paint was easily sprayed with a Binks #7 HTES (high transfer efficiency special) gun. Spraying with a high volume, low pressure (HVLP) gun was successful using an AIRVERTER® HVLP Sprayer available from Smith Eastern Corporation. The basic formulation provides a paint of a green color. This paint has been formulated to comply with air pollution regulations which allow a maximum VOC of 250 grams of solvent minus water per liter of paint (2.08 pounds/gallon) as delivered, and does not require thinning for brush or spray application.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Requirements for an HHA (see 3.2.1 and 4.7).
- c. Request for directions for use (see 3.4).
- d. Packaging requirements (see 5.1 and 6.9).
- e. Whether MSDS and ASTM F718 data sheets are required with each shipment (see 6.6).

6.3 NAVSEA approval and direction. Deviations from specified materials, procedures, and requirements and selection of specific alternative materials and procedures will be submitted to NAVSEA for evaluation and direction. Requests should include supporting documentation.

6.4 Inspection for first article. First article inspection is required for all manufacturing sources. The contracting officer should specify to offerors that the item shall be a first article sample from the first production batch (see 3.1) to be tested as specified in 4.2. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspections to those bidders offering a product which has been previously tested by the Government, and that bidders offering such product, who wish to rely on such tests, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Volatile content. Although the container marking specifically refers to the Federal Regulations, the paints may be used anywhere else a product complying with 3.2 is allowed. This includes other air pollution control districts or similar areas controlling the emission of solvents into the atmosphere.

6.6 Materials safety data sheets (MSDS). The contracting activity should be provided an MSDS at the time of contract award. The MSDS should be provided in accordance with OSHA section 29 CFR 1910.1200, Chapter XVII and found as part of FED-STD-313. OSHA section 1910.1200 requires reporting threshold criteria for known or suspected human carcinogens on MSDS 0.1 percent or greater, and 1 percent or greater for other health hazards. The MSDS should be included with each unit of issue of material covered by the specification, when specified (see 6.2).

6.6.1 Material safety data sheets and ASTM F718. Contracting officers will identify those activities requiring copies of completed MSDSs prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313. When specified, an ASTM F718 data sheet should be included with each shipment of the material covered by this specification (see 6.2).

6.7 Toxicity evaluation. The NMCPHC requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation.

6.7.1 Toxicological product formulations. The contractor should have the toxicological product formulations and associated information available for review by the NMCPHC to evaluate the safety of the material for the proposed use.

TT-P-645C

6.8 Material certification. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the submarine's atmosphere and can result in health hazards to personnel or deleterious effects on machinery. These controls are administered through the Submarine Material Control Program, which is described in the Nuclear Powered Submarine Atmosphere Control Manual, S9510-AB-ATM-010 chapter titled "Material Control Program." Under the Submarine Material Control Program, all materials considered for use on submarines require certification and assignment of a usage category. Under the certification process, candidate materials are selected by Navy activities or contractors, and a request for certification is submitted to the Naval Sea Systems Command, SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy.mil. The certification request is accompanied by detailed information, including descriptions of the material, method of application, usage, and storage. A chemical analysis is conducted, which is normally accomplished through off gas testing. The off gas test is required to be conducted in a Government approved laboratory designated by the preparing activity. Information pertaining to this test requirement may be obtained from the Naval Sea Systems Command, SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy.mil. Based on the chemical analysis results, a usage category is assigned to the material defining whether, and to what extent, the material may be used on submarines.

6.9 Suggested packaging requirements. Suggested packaging is contained in [table X](#) and [table XI](#).

TT-P-645C

TABLE X. Suggested packing and packaging.

Packaging	Recommended requirements for direct Government acquisitions
Unit of procurement	The paints covered by this specification should be purchased by volume. The unit of procurement should be in multiples of 1 U.S. liquid gallon or 1 L at 60 °F (15.5 °C).
Containers	<ul style="list-style-type: none"> (a) The paint should be furnished in cans of appropriate volume such as 3.78-L (1-gallon) or multiples thereof. (b) Friction plug containers should be in accordance with PPP-C-96, Type V, Class 2. Interior coatings should be as specified therein. Exterior coatings, including side seam stripping, should be as specified therein for Plan B. Wire handles, as specified therein, should be provided for the 1-gallon container. Closure of the properly filled and sealed cans should be as specified in the appendix thereto. (c) Pails should be to PPP-P-704. (d) All containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of the Code of Federal Regulations 49 CFR, Department of Transportation (DOT).
Intermediate containers	<ul style="list-style-type: none"> (a) Paints should be packaged in intermediate containers. (b) Intermediate containers should be close-fitting corrugated fiberboard boxes in accordance with UFC, NMFC, and 49 CFR requirements. Fiberboard used in the construction of interior (unit and intermediate) and exterior containers, including interior packaging forms, should conform to ASTM D4727. ASTM D4727 classes should be domestic fire-retardant or weather resistant fire-retardant as specified.
Commercial packaging	<ul style="list-style-type: none"> (a) Commercial packaging should be to ASTM D3951. (b) All containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of the Code of Federal Regulations 49 CFR, Department of Transportation (DOT).
Packing	<p>Packing should be specified as follows:</p> <ul style="list-style-type: none"> (a) Overseas delivery (Level A) packing. Intermediate containers of paint should be packed in close-fitting wood boxes conforming to ASTM D6251, overseas type, or PPP-B-621, Class 2. Box closure and strapping should be as specified in the applicable box specification or the appendix thereto except that strapping should be flat and the finish B. (b) Domestic delivery (Level B) packing. Level B packing should be as for level A, except that boxes should be domestic type or class and the strapping should be finish A or B. (c) Commercial packing. The paint, in the specified unit and intermediate containers should, as applicable, be packed in multiples of like sizes in accordance with UFC, NMFC, and 49 CFR requirements.
Palletization	Intermediate containers should be palletized in accordance with MIL-STD-147. Only one size unit or intermediate container should be placed on a pallet.
Packing for Navy acquisitions	<p>Treated lumber and plywood. All lumber and plywood, including laminated veneer materials, used in shipping container and pallet construction, member, blocking, bracing, and reinforcing should be fire-retardant treated material in accordance with MIL-L-19140 as follows:</p> <ul style="list-style-type: none"> (a) General use, weather resistant: MIL-L-19140, Type II, Category I. (b) General use, non-weather resistant: MIL-L-19140, Type I, Category I.
Material safety data sheets (MSDS) and ASTM F718	A copy of the MSDS and ASTM F718 should be attached to the shipping document for each destination (see 6.6).

TT-P-645C

TABLE XI. Suggested marking.

Marking type	Recommended marking
Bar codes	Marking should include bar codes.
Hazardous warnings	(a) Labels should be in accordance with 29 CFR Parts 1910, 1915, 1917, 1918, 1926, and 1928. (b) All individual containers should have the following marking: “CAUTION: This paint contains volatile solvents, with probable hazardous vapors. Use with adequate ventilation. Avoid prolonged breathing of vapors or spray mists. The solvents are highly flammable, avoid open flame and smoking.” (c) Each paint container, shipping container, and palletized load should be marked with the appropriate hazardous symbol in accordance with FED-STD-313.
Volatile organic content (VOC)	“Contains a maximum of 250 grams of solvent of volatile organic content (VOC) per liter of paint per 40 CFR CH.1, part 60, Appendix A-7 (EPA) Method 24.”
OSHA Hazard Communication Act and FED-STD-313.	Markings should include all information necessary to comply with OSHA Hazard Communication Act and FED-STD-313.
Mixing and use instructions	Directions should include mixing, application equipment directions, limitations on thinning, temperature, range for use, and surface preparation recommendations. Directions should refer user to data sheets, MSDS, and ASTM F718 for information.
VOC certification sheets	VOC certification sheets will be provided by the manufacturer for each batch of the coating system when requested by the procuring activity.

6.10 Subject term (key word) listing.

Cobalt compounds

Paint

Magnesium compounds

Pigment

Shipboard surfaces

Volatile organic content (VOC)

6.11 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensive changes.

MILITARY INTERESTS

Custodians:

Army – CR4

Navy – SH

Review Activities:

Navy – EC, MS, OS, SA, YD

CIVIL AGENCY COORDINATING ACTIVITY:

GSA – FAS

Preparing Activity:

Navy – SH

(Project 8010-2009-045)

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 <https://assist.dla.mil>.