

MIL-C-23675(Wep)
14 February 1963

MILITARY SPECIFICATION

COATING, ANTI-FOULING, HULL BOTTOM, FOR WEAPONS SYSTEMS

This specification has been approved by
the Bureau of Naval Weapons, Department
of the Navy.

1. SCOPE

1.1 Scope - This specification covers the requirements for a pigmented acrylic base anti-fouling paint for the protection of seaplane hull bottoms. (see 6.1)

1.2 Classification - This specification covers one grade of acrylic anti-fouling paint.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-A-362	Aluminum Alloy (Class 2024) Plates and Sheets
TT-M-261	Methyl Ethyl Ketone (for use in organic Coatings)
TT-P-143	Paint, varnish, lacquer, and related materials; general specification for packaging, packing and marking of
TT-T-548	Toluol (for use in organic Coatings)
UU-T-106	Tape, pressure-sensitive adhesive, masking paper

FSC 8010

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Military

MIL-A-8625	Anodic coatings, for aluminum and aluminum alloys
MIL-H-3136	Standard test fluids hydrocarbon and iso-octane
MIL-E-7125	Ethylene glycol monoethyl ether acetate
MIL-L-7808	Lubricating oil, aircraft turbine engine, synthetic base
MIL-P-7962	Primer coating, cellulose-nitrate modified alkyd type, corrosion-inhibiting, fast drying (for spray application over pretreatment coating)
MIL-C-8514	Coating compound, metal pretreatment, resin-acid
MIL-Z-15486	Zinc Oxide, Technical, Acicular, Paint Use

STANDARDS

Federal

Federal Test Method Standard No. 141	Paint, Varnish, Lacquer, and Related Materials; Method of Inspection, Sampling and Testing
Federal Standard No. 595	Colors

Military

MIL-STD-105	Sampling procedures and tables for inspection by attributes
MIL-STD-129	Marking for Shipment and Storage

(When requesting specifications, standards, and other publications refer to both title and number. Copies of this specification and applicable specifications, standards and other publications may be obtained upon application to the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pa., Attention: Code CDS.)

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3. REQUIREMENTS

3.1 Materials - The ingredients used in the manufacture of this product shall conform to the applicable Government Specification. Ingredient materials conforming to contractor's specifications may be used provided that prior approval is obtained from the Government. The use of contractor's specifications will not constitute waiver of Government inspection.

3.2 Composition - The anti-fouling coating shall be formulated in accordance with Table I.

3.2.1 Ingredients - All ingredients used in the manufacture of this product shall comply with the following:

3.2.1.1 Pigment - The mercurous chloride (HgCl₂) shall consist of N.F. quality or better, and shall not have deteriorated in storage prior to use. Zinc oxide shall conform to Specification MIL-Z-15486.

3.2.1.2 Vehicle - The vehicle shall consist of a mixture of two (2) acrylic resins in solution; a 100% methyl methacrylate, 30% in ethylene glycol monoethyl ether acetate, 710-850 centipoises at 30° C (of the 30% solution); and a 100% methyl methacrylate polymer, 40% in methyl ethyl ketone MEK, 480-1350 centipoises at 30° C (determined at 35% solids).

TABLE I
COMPOSITION
PERCENT BY WEIGHT 3/ 4/

MATERIAL	MINIMUM	MAXIMUM
Zinc Oxide, Acicular (MIL-Z-15486)	15	16
Mercurous Chloride <u>1/</u>	47	48
Acrylic Resin (30% solids)	14	15
Acrylic Resin (40% solids)	14	15
Butyl Benzyl Phthalate <u>2/</u>	5.5	6.0
Toluene (TT-T-548)	2.0	2.5

1/ The presence of mercurous chloride shall be established quantitatively and qualitatively (see 4.5.2).

2/ Plasticizer shall contain a minimum of 95% butyl benzyl phthalate with a refractive index of 1.535 to 1.540 $\frac{(25^\circ \text{C})}{(25^\circ \text{C})}$.

3/ The minimum total nonvolatile content (by weight) shall be 77%.

4/ The min. pigment content (by weight) of the total nonvolatile shall be 79%.

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3.2.1.3 Solvent - The anti-fouling coating shall be capable of being thinned with toluene conforming to Specification TT-T-548 for spraying, or with ethylene glycol monoethyl ether acetate conforming to Specification MIL-E-7125 for brushing.

3.2.1.4 Free mercury and mercuric chloride - Free mercury or mercuric chloride shall not be present in the paint (see 4.5.2.3).

3.3 Qualitative requirements -

3.3.1 Condition in container - The packaged anti-fouling paint shall pour freely without stirring, be uniform and homogenous in appearance without showing any trace of grit, rough particles or separation of pigment. There shall be no settling which cannot be redispersed readily with a paddle to a homogenous state. (See 4.5.1.)

3.3.2 Odor - The odor of the wet anti-fouling coating shall not be obnoxious. An air-dried film shall retain no residual odor 48 hours after application (see 4.5.1).

3.3.3 Viscosity - The viscosity of the anti-fouling coating at a spraying reduction of 3 parts paint to 2 parts toluene shall be 14-16 seconds with #4 Ford Cup (see 4.5.1).

3.3.4 Weight per gallon - The weight per gallon of the packaged coating shall be 17.4 to 17.6 pounds per gallon (see 4.5.1).

3.3.5 Fineness of grind - The fineness of grind shall be not less than 6 (see 4.5.1).

3.3.6 Storage stability - A full closed container of paint stored for one year at 21° C (70° F) shall meet all the tests specified herein. (See 4.5.3.)

3.4 Film properties -

3.4.1 Adhesion (knife test) - The anti-fouling coating shall show good intercoat adhesion when used over the anti-fouling primer system and the entire anti-fouling coating system shall show good adhesion to the aluminum substrate. The anti-fouling film under test shall cut loose in the form of a ribbon on cutting. The cut shall show bevelled edges. (See 4.5.1.)

3.4.2 Surface appearance - The anti-fouling coating shall be free from streaks, blisters, coarse particles, silking, or other irregularities of surface (see 4.5.4).

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3.4.3 Drying time - The anti-fouling paint shall set to touch in 15 minutes and dry hard in one hour. Drying time shall be determined with a 10 mil clearance draw down blade on the packaged paint. (see 4.5.1)

3.4.4 Anchorage (tape test) - The anti-fouling topcoat under test shall show no more removal from the MIL-P-7962 undercoat, nor the entire system from the panel, than that exhibited by a simultaneously tested sample of anti-fouling coating, prepared as shown in table II. (see 4.5.5)

3.4.5 Color - The color of the anti-fouling coating shall approximately match Federal Standard No. 595 color number 37875.

3.4.5.1 Color (for white by photoelectric tristimulus) - The minimum values shall be as follows: (see 4.5.1)

B value	-	78
A value	-	82
G value	-	82

3.5 Resistance properties -

3.5.1 Water resistance - The anti-fouling coating and the entire coating system shall withstand 18 hours immersion in distilled water at room temperature without showing any softening, loss of adhesion, discoloration, wrinkling, blistering or any other defects. (see 4.5.6)

3.5.2 Hydrocarbon resistance - The coating film shall withstand immersion in hydrocarbon test fluid conforming to specification MIL-H-3136, Type III, at room temperature for 4 hours. Immediately after removal, the film shall show no blistering or film failure, except that slight gumming above the liquid level shall not be cause for rejection. Twenty-four hours after removal, the film shall, in all respects, be equal to or better than the film of the anti-fouling coating prepared as shown in table II, immersed under the same conditions. A slight discoloration or dulling shall not be cause for rejection. (see 4.5.7) The test fluid shall not be discolored by extraction of leachable matter from the paint film.

3.5.3 Lubricating oil resistance - The anti-fouling coating system shall withstand immersion in lubricating oil conforming to Specification MIL-L-7808 for a period of 2 hours at a temperature of $121^{\circ} \pm 2^{\circ} \text{C}$ ($250 \pm 4^{\circ} \text{F}$) without showing any blistering, film softening or any film failure, except that slight gumming above the liquid level shall not be cause for rejection. Slight discoloration will be permitted. Twenty-four hours after removal, the film shall,

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in all respects, be equal to or better than the film of the anti-fouling coating prepared as show in table II, which has been similarly immersed in the lubricating oil. The oil shall not be discolored by extraction of leachable matter from the paint film. (see 4.5.8)

3.6 Working properties - The anti-fouling coating reduced for spraying with 3 parts paint and 2 parts toluene (by volume), or for brushing with 4 parts paint to 1 part ethylene glycol monoethyl ether acetate, and applied over the primer system shall show good working properties, and shall dry to a uniform smooth surface free of runs, sags, lifting, bubbling, wrinkling, streaking or other defects. (see 4.5.9)

3.7 Workmanship - The component ingredients shall be intimately assembled and processed as required in accordance with the best practice for the manufacture of high quality coating.

4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and service acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specifications where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests - All tests required for the testing of anti-fouling coating are classified as acceptance tests.

4.3 Test conditions - The laboratory testing conditions shall be in accordance with Federal Test Method Standard No. 141 and as described herein.

4.3.1 Test panels. - Except as otherwise specified, herein, all panels used for test purposes shall be aluminum-clad aluminum alloy conforming to Specification QQ-A-362, anodized in accordance with MIL-A-8625. The panels shall be 0.020 by 3 by 6 inches in size, and shall be finished as follows: Spray one coat of wash primer, conforming to Specification MIL-C-8514, to a dry film thickness of 0.0002 to 0.0003 inch (0.2-0.3 mil), and air dry for 30 minutes. Spray on two coats of MIL-P-7962 lacquer primer allowing 1/2 hour air dry between coats and one hour air dry after the second coat (0.0006 to 0.0008 inch dry film thickness). Two light spray coats (1 pass

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per coat) of anti-fouling coating under test shall then be applied over the primer with a 1 hour drying interval between coats. The total dry film thickness of the 2 coats of anti-fouling coating shall be 0.002 ± 0.0002 inch. Prior to testing, the panels shall be air-dried for 72 hours.

4.3.2 Methods for preparing paint samples - Samples shall be prepared for testing in accordance with Federal Test Method Standard No. 141 and as specified herein. All tests shall be conducted with the package coating unless application by spray or brush is required. When spray is required, the coating shall be reduced with 3 parts paint to 2 parts toluene (TT-T-548) and where brushing is required the coating shall be reduced to 4 parts of package paint to 1 part ethylene glycol monoethyl ether acetate (MIL-E-7125).

4.3.3 Test anti-fouling coating - A satisfactory anti-fouling coating has been prepared using the ingredients and the exact proportions shown in table II.

TABLE II 1/
ANTI-FOULING COATING

INGREDIENTS	WEIGHT IN GRAMS
Zinc Oxide, acicular <u>2/</u>	725
Mercurous Chloride <u>3/</u>	2215
Acrylic Resin <u>4/</u> (30% solids)	690
Acrylic Resin <u>5/</u> (40% solids)	690
Butyl Benzyl Phthalate <u>6/</u>	270
Toluene (TT-T-548)	100

1/ Grind the ingredients for 48 hours in a 1 gallon capacity crock containing 3000 grams of white porcelain pebbles. Pour off charge. Wash out crock with 50 grams of toluene (grind 1 hour) and add to original charge. The volume of coating is about 3 quarts.

2/ Zinc Oxide should conform to Specification MIL-Z-15486.

3/ Mercurous Chloride shall conform to National Formulary quality or better.

4/ Rohm and Haas, Acryloid A-10 (30% in ethylene glycol monoethyl ether acetate conforming to Specification MIL-E-7125).

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5/ Rohm and Haas, Acryloid A-101 (40% in methyl ethyl ketone conforming to Specification TT-M-261).

6/ Monsanto Chemical Company, Santicizer "160".

4.4 Batch data - Batch production data shall be furnished in accordance with Federal Test Method No. 141, Method 1031.1.

4.4.1 Report of tests - The manufacturer shall submit test reports to the Government inspector, in accordance with the requirements of Federal Test Methods Standard No. 141, Method 1031.1, for each batch, showing the results of all tests specified herein except Storage Stability. Each ingredient material shall be identified as to the name of its manufacturer and that manufacturer's trade-name and formula number.

4.4.1.1 Alternate method of reports - In lieu of reporting analytical results on the breakdown of the nonvolatile composition of the paint, the manufacturer may report such results as "calculated" under the condition that he has carefully described by separate reports, the character and detail of his production methods which in his opinion guarantee that any suitable analysis made by the Government will yield acceptable results.

4.4.2 Examination of product - The anti-fouling coating shall be examined for conformance with the requirements of this specification with respect to material and workmanship.

4.4.3 Sampling -

4.4.3.1 Sampling and visual inspection of filled containers - Sampling and inspection of filled containers shall be performed as required by Federal Test Method Standard No. 141, Method 1031.1.

4.5 Test methods - The tests of this specification shall be conducted in accordance with the specified methods of Federal Test Method Standard No. 141 and as described herein.

4.5.1 The following tests shall be conducted in accordance with the specified methods of Federal Test Method Standard No. 141 and as described herein.

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TESTS	METHOD NO. FEDERAL TEST METHOD STANDARD 141
Pigment Content	4022
Volatile and Nonvolatile Content	4041
Vehicle Solids	4052
Condition in Container	3011
Odor	4401
Coarse Particles	4092
Viscosity (Ford Cup)	4282
Weight per gallon	4184
Fineness of Grind (determined with use of gage leaving a minimum path length of 4 inches)	4411
Adhesion (Knife test) (See paragraph 4.3.1 for panel preparation)	6304
Drying Time (Doctor blade clearance 10 mil)	4061
Color	4250
Color from photoelectric tristimulus data	4252

4.5.2 Pigment Content - About 4 grams of the coating under test shall be weighed into each of 2 centrifuge tubes (40 ml capacity). Twenty-five ml of a mixture (equal parts of benzene and acetone) shall be added to each tube and thoroughly stirred with a piece of stiff wire. The tubes shall be placed in centrifuge and revolved at 2500 rpm for about 30 minutes or until the supernatant liquid is clear. The clear liquid shall be poured off without removing the pigment. Twenty-five mls of solvent mixture shall again be added and the above procedure repeated. This procedure shall be repeated as outlined above so that a total of 5 centrifuging operations will have been performed. After removal of clear supernatant liquid of the fifth centrifuging procedure, the tubes shall be placed in an oven in a vertical position and maintained at 105° C until all the

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liquid is evaporated. The tubes shall then be placed in a horizontal position and kept in the oven for an additional 1/2 hour. The tubes shall then be cooled to room temperature in a desiccator, weighed, and the pigment content calculated.

$$\frac{\text{Wt Pigment}}{\text{Wt Sample}} \times 100 = \% \text{ Pigment}$$

4.5.2.1 Mercurous chloride content - The caked pigment in the tubes of paragraph 4.5.2 shall be crushed with a spatula or stirring rod and the pigment thoroughly mixed until homogenous. About 1/2 gram of the pigment shall be weighed into a preheated clean 30 or 50 ml beaker (heated to about 450° C in a muffle for about 15 minutes). The pigment shall be spread over the bottom surface by gently tapping the beaker, and the beaker then placed in a cold muffle furnace. The temperature of the furnace shall be raised slowly to 450° C and maintained at this temperature for 30 minutes. This procedure shall take place in a draft hood. The beaker shall be cooled in a desiccator and the pigment weighed and the percent mercurous chloride calculated.

$$\frac{\text{Loss in weight of Sample} \times 100}{\text{Weight of Sample}} = \% \text{ Mercurous Chloride}$$

4.5.2.2 Qualitative test for mercury compound - About 10 milligrams of pigment in the centrifuge tube of paragraph 4.5.2.1 shall be put into a test tube along with about 1 gram of anhydrous, reagent grade, powdered sodium carbonate and mixed thoroughly. The test tube and content shall be heated to near redness and the appearance of a dark color in the mixture will show the presence of a mercury compound.

4.5.2.3 Free mercury and mercuric chloride -

4.5.2.3.1 Free mercury - A portion of the extracted pigment (see 4.5.2.1) shall be examined under a microscope to determine whether free mercury is absent.

4.5.2.3.2 Mercuric chloride - Shake two grams of the extracted pigment (see 4.5.2.1) with 20 ml ethyl ether for 5 minutes. Filter and evaporate the filtrate. The residue, dissolved in 10 ml distilled water and 2 drops of dilute nitric acid, shall show no chloride (cloudiness) upon addition of 1 ml of 2% silver nitrate solution.

4.5.3 Storage stability - A full, closed container of anti-fouling coating shall be stored under warehouse conditions at a temperature of 21° C (70° F) for 1 year, at the end of which time it shall be opened and inspected and tested for conformance to all the requirements of this specification. (See 3.3.6.)

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4.5.4 Surface appearance - The film of a panel prepared as specified in paragraph 4.3.1 shall be examined under a magnification of from 10 to 15 diameters. (See 3.4.2.)

4.5.5 Anchorage (tape test) - Four aluminum panels shall be cleaned carefully with solvent and prepared as specified in 4.3.1. Two of the panels shall be coated with the anti-fouling paint under test and two remaining panels coated with the anti-fouling paint prepared as shown in table II. The panels shall be air-dried for 72 hours. All four panels shall be partially immersed in distilled water, at a temperature of $23^{\circ} \pm 1.1^{\circ} \text{C}$ ($73.5^{\circ} \pm 2^{\circ} \text{F}$), for 18 hours. The panels shall then be removed from the water and wiped dry with a soft cloth. Immediately thereafter, two parallel scratches, one inch apart, and penetrating to the metal, shall be made with a stylus upon a previously immersed part of each panel. A one-inch wide strip of masking tape conforming to Specification UU-T-106 shall be applied across each set of scratches, adhesive side down. The tape shall be pressed down with two passes of a rubber covered roller approximately 3 1/2 inches in diameter by 1 3/4 inches in width. The surface of the roller shall have a Durometer hardness value within the range of 70 to 80. The tape shall be removed in one abrupt motion and each panel examined for conformance to the requirements of this specification. The interval from the time of removal of the panels from the water to the time of application of the tape shall be 60 ± 5 seconds. Stripping of the tape from the panel shall be done immediately after application thereof and pulled horizontally from the surface. (See 3.4.4.)

4.5.6 Water resistance - Panels shall be prepared in accordance with paragraph 4.3.1 and then immersed in distilled water in accordance with Method 6011 of Federal Test Method Standard No. 141 for 24 hours at room temperature. Five minutes after removal from the water, the coating shall be examined. (See 3.5.1.)

4.5.7 Hydrocarbon resistance - Panels prepared in accordance with paragraph 4.3.1 shall be immersed in test fluid conforming to Type III of Specification MIL-H-3136, at room temperature for 4 hours, in accordance with Method 6011 of Federal Test Method Standard No. 141. The film shall be examined immediately after removal, and 24 hours after removal from the fluid. (See 3.5.2.)

4.5.8 Lubricating oil resistance - Panels prepared as specified in paragraph 4.3.1 shall be immersed in diester lubricating oil composed of di-2-ethyl-hexyl acetate, (95 percent), and tricresyl phosphate, (5 percent by weight), at a temperature of $121^{\circ} \pm 2^{\circ} \text{C}$ ($250^{\circ} \pm 4^{\circ} \text{F}$) for a period of 2 hours. The film shall be cleaned after cooling with detergent and water, mineral spirits, or aliphatic naphtha. Twenty-four hours after removal the panels shall be compared. (See 3.5.3.)

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4.5.9 Working properties - A panel prepared in accordance with paragraph 4.3.1 shall be placed in a nearly vertical position and allowed to air-dry for 24 hours prior to examination. After air-drying for the specified time, the panel shall be examined for defects. (See 3.6.)

4.6 Workmanship - The coating shall be examined to determine conformance with this specification with respect to material and workmanship.

5. PREPARATION FOR DELIVERY

5.1 Application - For direct purchases by or direct shipment to the Government, the packaging, packing and marking for shipment shall be in accordance with Specification TT-P-143 and as specified in 5.2.

5.2 Marking and labeling - Each shipping container shall be marked in accordance with MIL-STD-129. In addition, each container shall bear a printed label showing the following nomenclature and information as applicable:

Specification MIL-

Color - White

Precautions:

Spray mask - A spray mask shall be used when spraying areas with the anti-fouling coating. When brushing, a mask is not required.

Hand cleaning - The hands of personnel should be thoroughly washed after handling, spraying or brushing the anti-fouling paint.

Discoloration - Certain impurities in sea water may cause the white anti-fouling coating to darken slightly or even turn black in small areas. Note that such darkening does not impair the anti-fouling effectiveness of the coating.

Manufacturer's Name or Trade Mark

Date Manufactured by (month and year)

General Application Instructions: To a thoroughly cleaned anodized aluminum hull, apply one spray coat of MIL-C-8514 wash primer to a dry film thickness of 0.2 to 0.3 mil. Air dry 1/2 hour and apply two coats of MIL-P-7962 lacquer primer allowing 1/2 hour air dry between coats. The total dry film thickness for the MIL-P-7962 shall be 0.6 to 0.8 mil. Air dry one hour after the second coat. Apply two light spray coats (1 pass per coat of anti-fouling coating) one hour apart to a total

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dry film thickness of 2.0 ± 0.2 mil for the anti-fouling coating. Permit paint system to air-dry at least 72 hours prior to immersion in water.

Precautionary Note: Avoid excessive thickness, particularly around rivet heads, since subsequent shrinkage may induce stresses and cracking in these areas.

Thinning for Spray Application - Thin anti-fouling coating for spraying using 3 parts paint to 2 parts toluene by volume.

Thinning for brushing - Thin anti-fouling coating for brushing with 4 parts paint to 1 part MIL-E-7125 thinner.

Brushing restrictions - The anti-fouling paint is neither designed nor intended for brushing except for touch-up on small sections where the spray coating has failed due to scratching or abrasion. Lifting of the primer may take place if large sections are brushed.

6. NOTES

6.1 Intended use - The anti-fouling coating, when used in conjunction with wash primer (MIL-C-8514) and primer coating (MIL-P-7962), is intended for use as a finishing system for aluminum seaplane hulls.

6.2 Anti-fouling performance - The anti-fouling coating system should exhibit satisfactory anti-fouling performance for at least 9 to 12 months.

6.3 Ordering data - The material shall be purchased by volume, the unit a U.S. gallon (231, cubic inches at 15.5° C (60° F). Procurement documents should specify the following:

Title, number and date of this specification
Quantity and size of container required
Level of packaging and packing required
(See Section 5)

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.