

MIL-L-81352A(AS)

10 February 1972

SUPERSEDING

MIL-L-81352(WP)

4 February 1966

MILITARY SPECIFICATION

LACQUER, ACRYLIC (FOR NAVAL WEAPONS SYSTEMS)

This specification has been approved by the Naval Air Systems Command, Department of the Navy.

1. SCOPE

* 1.1 Scope. This specification covers the requirements for one grade of acrylic lacquer for use as a general-purpose, exterior, protective coating for metal surfaces, and is particularly formulated for resistance to diester lubricating oil and heat. It provides for two compositions, one of which is suitable for use under AIR POLLUTION REGULATIONS (see 6.3).

* 1.2 Classification. Acrylic lacquer covered by this specification shall be of the following compositions as specified (see 6.2):

Composition G - For use where AIR POLLUTION REGULATIONS do not apply.

Composition L - For use where AIR POLLUTION REGULATIONS are in force.

* 1.2.1 Colors. This specification covers one grade of acrylic lacquer in the colors stated in Table I, as specified (see 6.2):

1.2.1.1 Table I is not restrictive; the coating may be procured in any color desired by the activity concerned. When colors other than those listed above are required, the pigmentation and applicable qualitative and quantitative requirements shall conform to those of the nearest matching color contained herein. Where no near matching color exists, the pigments shall be in accordance with the best commercial quality.

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TABLE I
COLOR NUMBERS AND NAMES

FED-STD-595 Color Number	Color Name	FED-STD-595 Color Number	Color Name
Gloss Colors		Camouflage Colors	
-	Clear	26081	Seaplane Gray
10049	Maroon	27875	Semi-gloss Insignia White
11136	Insignia Red	31136	Insignia Red
12197	International Orange	33538	Orange Yellow
13538	Orange Yellow	34087	Olive Drab
13655	Light Yellow	34151	Interior Green
14087	Olive Drab	35042	Non-specular Sea Blue
14187	Light Green	35044	Insignia Blue
15044	Insignia Blue	36231	Dark Gull Gray
15102	Light Blue	36440	Light Gull Gray
16081	Engine Gray	37038	Black
16440	Light Gray	37875	Insignia White
16473	Aircraft Gray	34097	Field Green
17038	Gloss Black		
17875	Insignia White		

2. APPLICABLE DOCUMENTS

2.1 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:

SPECIFICATIONS

Federal

QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet
TT-P-143	Paint, Varnish, Lacquer, and Related Materials, Packaging, Packing, and Marking of
TT-P-320	Pigment, Aluminum, Powder and Paste, for Paint

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SPECIFICATIONS

Federal (Continued)

TT-P-343	Pigment, Carbon-Black, Dry
TT-P-345	Pigment, Chrome-Green, Pure Dry
TT-P-346	Pigment, Chrome-Yellow and Chrome-Orange, Dry
TT-P-347	Pigment, Chromium-Oxide-Green, Dry
TT-P-350	Pigment, Lampblack-Dry
TT-P-355	Pigment, Copper-Phthalocyanine-Blue, Dry
TT-P-375	Pigment, Indian Red and Bright Red (Iron Oxide), Dry (For Use in Protective Coatings)
TT-P-385	Pigment, Iron-Blue, Dry
TT-P-442	Pigment, Titanium Dioxide, For Protective Coatings)
TT-P-458	Pigment, Yellow-Iron Oxide, Hydrated, Synthetic, Dry
TT-T-548	Toluene, Technical
TT-X-916	Xylene (For Use in Organic Coatings)

Military

MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-E-7125	Ethylene Glycol Monoethyl Ether Acetate
MIL-C-8514	Coating Compound, Metal Pretreatment Resin-Acid
MIL-A-8625	Anodic Coatings, For Aluminum and Aluminum Alloys
MIL-A-15197	Antimony-Sulfide, Pigment (Paint Ingredient)
MIL-C-22750	Coating, Epoxy-Polyamide, Chemical and Solvent Resistant for Weapons System

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SPECIFICATIONS

Military (Continued)

MIL-C-22751	Coating System, Epoxy-Polyamide, Chemical and Solvent Resistant, Process for Application of
MIL-P-23377	Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys

STANDARDS

Federal

Fed. Test Method Std. No. 141	Paint, Varnish, Lacquer and Related Materials, Methods of Inspection, Sampling and Testing
FED-STD-595	Color

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
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(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

* 3.1 Material. The ingredients used in the manufacture of this product shall conform to applicable Government specifications except as otherwise specified herein.

3.2 Toxicity. 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 procuring activity to the appropriate department medical service who will act as an advisor to the procuring activity.

* 3.3 Composition.

3.3.1 Composition G. The composition shall conform to the percentages, by weight, given in Table II. The volatile portion shall be as specified in 3.4.3.1.

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3.3.2 Composition L. The composition shall conform to the percentages, by weight, given in Table II. The volatile portion shall be as specified in 3.4.3.2.

3.4 Ingredients. All ingredients used in the manufacture of these products shall conform to applicable Government specifications and the requirements of 3.4.1 through 3.4.5.

3.4.1 Resin. The resinous portion of the lacquer shall consist of a one-to-one blend, by weight, of acrylic ester resins defined respectively, by the infrared absorption curves of Figures 1 and 2.

3.4.2 Plasticizer. The chemical plasticizer shall consist of butyl benzyl phthalate.

3.4.3 Volatile content.

3.4.3.1 Composition G. The volatile content shall consist of toluene and ethylene glycol monoethyl ether acetate. Butyl alcohol and methyl ethyl ketone shall only occur as the solvent in the resin solution. Not more than 20 percent of the total solvent composition shall be ethylene glycol monoethyl ether acetate. Methyl pyrrolidone, if present, shall be equal to not more than 1 percent of the total pigment content (see 4.6.1).

* 3.4.3.2 Composition L. The volatile content shall consist of a non-photochemically reactive solvent. A non-photochemically reactive solvent is any solvent with an aggregate of less than 20 percent of its total volume composed of the chemical compounds classified below, or which does not exceed any of the following individual percentage composition limitations, referred to the total volume of solvent:

- (a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers, or ketones having an olefinic or cyclo-olefinic type of unsaturation: 5 percent;
- (b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene: 8 percent;
- (c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichloroethylene or toluene: 20 percent.

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TABLE II
COMPOSITION (PERCENT BY WEIGHT)

Color	Non-volatile Packaged Lacquer (Min.)	Pigment (Percent of non-volatile) (Max.)	Extender ^{1/} (Percent of total Pigment) (Max.)
<u>Gloss Colors</u>			
Olive Drab	32	20	-
Black	32	5	-
Red	35	20	-
Engine Gray	39	20	-
Blue	35	20	-
Clear	30	None	-
All other colors	45	50	-
<u>Camouflage Colors</u>			
Black	45	55	85
All other colors	49	55	50

^{1/} The flattening pigment shall not exceed that required to produce the specified gloss values. The flattening pigments shall be siliceous matter. Calcium sulfate and metallic soaps are prohibited except that metallic soaps may be used as an aid to grinding in an amount not to exceed 1 percent of the total pigments. Flattening pigments other than the above will be permitted only upon submission to the procuring activity of evidence of satisfactory weather resistance of materials so formulated.

* 3.4.3.3 Thinner. Thinner for composition G shall be a blend of toluene and xylene, prepared by adding 1 volume of xylene with two volumes of toluene. The thinner to be used with the Composition L lacquer shall be non-photochemically reactive, as defined in 3.4.3.2, and shall be compatible with the lacquer.

3.4.4 Non-volatile vehicle. Formulation for the non-volatile vehicle shall consist of 95 percent resin blend (3.4.1) and 5 percent plasticizer (3.4.2).

* 3.4.5 Pigments. Unless otherwise specified (see 1.2), pigments shall be as shown in Table III. When pigments listed in Table III are not covered by Government specifications listed in 2.1, they shall be of high durability established by past usage in a comparable lacquer.

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3.5 Qualitative requirements. The lacquer furnished herein shall conform to the requirements of Table IV and as specified in 3.5.1 through 3.5.13.

3.5.1 Condition in container. The lacquer, in a freshly opened full container, shall show no grit, skinning, curdling, livering or excessive pigment flotation, shall show no more settling or caking than may be easily redispersed with a paddle to a uniform homogeneous condition (see 4.6.1).

3.5.2 Storage stability. The lacquer, stored in a full, closed container for 1 year at 21° to 32°C (70° to 90°F) shall pass all tests specified in this specification except weathering (see 4.6.2).

3.5.3 Odor. The odor of the lacquer, wet or dry, shall not be obnoxious. An air-dried film shall retain no residual odor 48 hours after application (see 4.6.1).

3.5.4 Color. The color of the lacquer film after drying 24 hours shall match the applicable color specified in Table III. A slight variation in color for Insignia Red will be permitted (see 4.6.1). For Insignia White only: the minimum tristimulus values in Table IV shall be considered as defining the minimum values for Insignia White colors: brighter or whiter shades than color chip numbers 17875, 27875 and 37875 shall be considered acceptable. The Insignia White color shall contain no tinting pigment whatsoever. For Field Green only, the color shall be a good visual match. The minimum percent infrared reflectance, relative to magnesium carbonate, shall conform to the following spectrophotometric limits when tested as specified in 4.6.1.1:

<u>Wave length in millimicrons</u>	<u>Minimum percent Total reflectance (Field Green only)</u>
750	20
800	45
850	55

3.5.4.1 When colors other than those in Table III are specified, they shall conform to the color(s) shown in FED-STD-595, as specified by the procuring activity.

3.5.5 Working properties. Two coats of the lacquer reduced to spray consistency and applied to a smooth, vertical metal surface, shall show good working properties and no tendency to cobweb, orange peel, or haze. It shall be equal to or better than that exhibited by a simultaneously tested control lacquer of the corresponding color (see 4.6.3).

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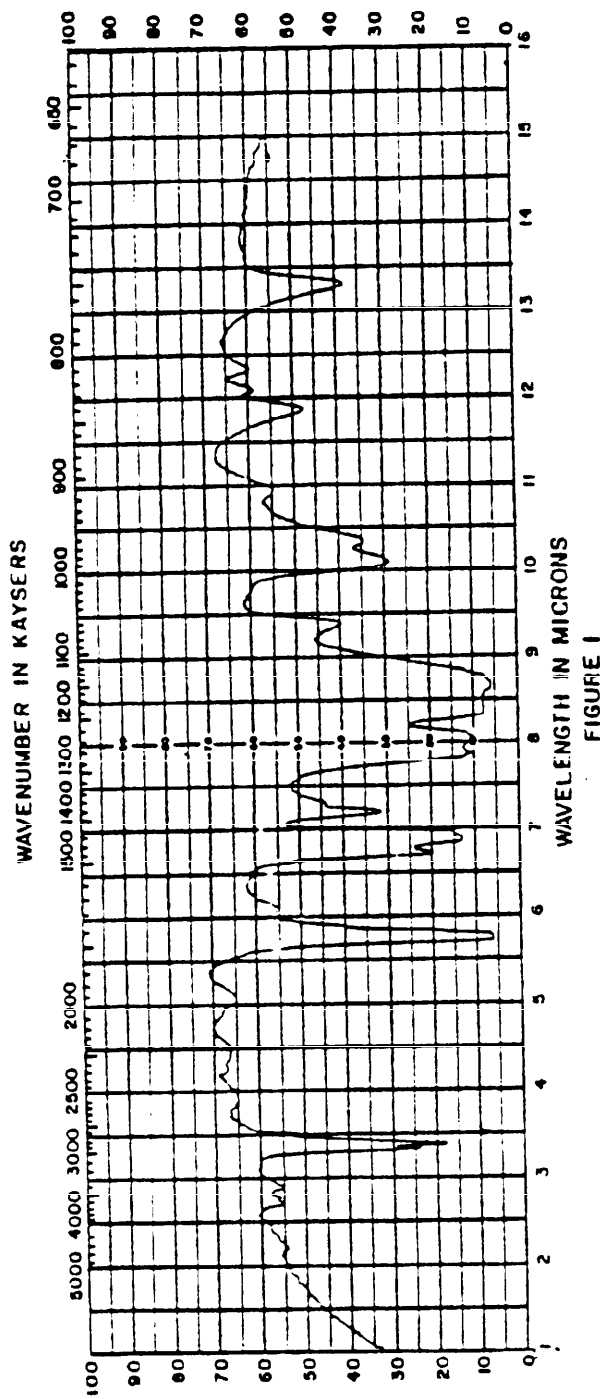


FIGURE 1

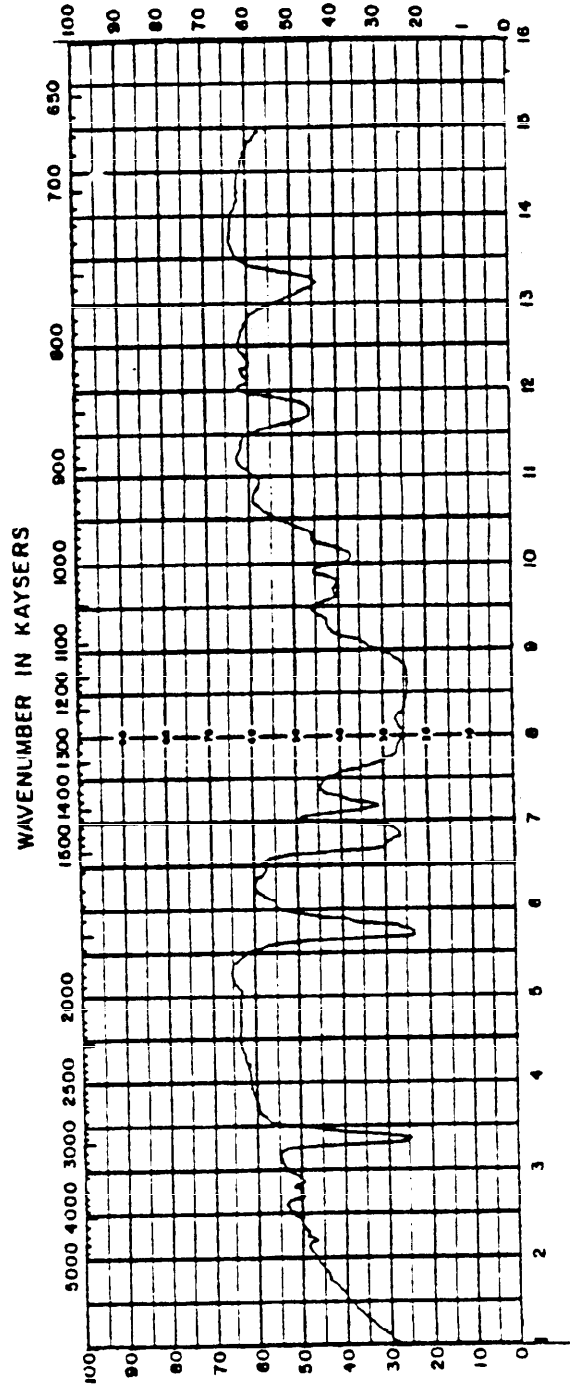


FIGURE 2

Figures 1 and 2. Infrared Absorption Curves

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TABLE III. PIGMENTATION 1/ 2/

FED-STD-595 Color No.	Color	Pigmentation (except flattening pigments)
17875 27875 37875	Insignia White <u>4/</u> Insignia White <u>4/</u> Insignia White <u>4/</u>	Titanium Dioxide TT-P-442
17038 37038	Gloss Black Black	Carbon Black TT-P-343
16473 36231 36440	Aircraft Gray Dark Gull Gray Light Gull Gray	Titanium Dioxide, Carbon Black <u>3/</u>
16081 26081 16440	Engine Gray Seaplane Gray Light Gray	Titanium Dioxide, Yellow Iron Oxide, TT-P-458, Carbon Black <u>3/</u>
15044 15102 35044 35042	Insignia Blue Light Blue Insignia Blue Nonspecular Sea Blue	Titanium Dioxide, Carbon Black <u>3/</u> Iron Blue TT-P-385
11136 31136	Insignia Red Insignia Red	BON Red <u>6/</u> , Molybdate Orange <u>7/</u>
10049	Maroon	Iron Oxide, Titanium Dioxide, Carbon Black
13538	Orange Yellow	Medium Chrome Yellow <u>5/</u>
13655	Light Yellow	Light Chrome Yellow <u>5/</u>
33538	Orange Yellow	Chrome Yellow <u>5/</u> , Chrome Orange <u>5/</u> or Molybdate Orange TT-P-375
12197	International Orange	Molybdate Orange <u>7/</u> TT-P-375
14087	Olive Drab	Medium Chrome Yellow or Orange <u>5/</u> , Shading Yellow, Pure Iron Oxide (Yellow or Red), Titanium Dioxide, Carbon Black <u>3/</u> Iron Blue.

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TABLE III. PIGMENTATION 1/ 2/ (CONTINUED)

FED-STD-595 Color No.	Color.	Pigmentation (except flattening pigments)
34087	Olive Drab	Phthalocyanine Blue TT-P-355, Iron Blue, Chrome Yellow or Orange <u>5/</u> , Chrome Oxide Green TT-P-347, Titanium Dioxide, Pure Iron Oxide, Molybdate Orange, Shading Yellow, Antimony Sulfide
14187	Light Green	Chrome Green TT-P-345, Yellow Iron Oxide, TT-P-458 Light or Medium Chrome Yellow <u>5/</u> TT-P-346, Iron Blue, Titanium Dioxide, Shading Yellow
34151	Interior Green	Chrome Yellow or Orange <u>5/</u> TT-P-346, Titanium Dioxide, Shading Yellow, Yellow Iron Oxide and Chrome Oxide Green
34097	Field Green	Medium Chrome Yellow, Phthalocyanine Blue and Antimony Sulfide MIL-A-15197

- 1/ The pigments specified in Table III, or any combination thereof, shall be the principal ingredients used in the lacquer to obtain the colors specified. To exactly match the required color, other tinting pigments (except for Insignia White) of proven good outdoor durability may be used. The pigments shall be sufficiently insoluble to prevent leaching during immersion.
- 2/ Titanium dioxide shall conform to Type III of TT-P-442.
- 3/ Lampblack, TT-P-350, may be used if desired in these colors.
- 4/ This color shall contain no tinting pigment.
- 5/ Pigments conforming to TT-P-346 may be unsatisfactory. The proprietary light-fast Chrome Yellows and Oranges are satisfactory.
- 6/ Manganese precipitate of Color Index No. 48 Permanent Red; otherwise known as Permanent Red-2B Manganese.
- 7/ Red Shade may not be used.

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TABLE IV. QUANTITATIVE REQUIREMENTS

Requirement	Minimum	Maximum
Coarse particles (retained on a No. 325 sieve) percent by weight of total lacquer (see 4.6.1)	---	0.1
Fineness of grind		
All gloss colors	7.0	---
All camouflage colors	6.0	---
Viscosity, all colors except clear (reduced as specified in 4.5.1) (determined with a No. 3 Ford cup) (see 4.6.1)		
Clear	16	22
	14	22
Specular gloss (60 degrees geometry) (see 4.6.1)		
All gloss colors (except the following)	65	---
Insignia White	70	---
Camouflage colors		
Insignia White	---	10
Black	---	10
Insignia Blue	---	10
Non-specular Sea Blue	---	10
Interior Green	12	19
Olive Drab	---	10
Orange Yellow	---	10
Bright Red	---	10
Light Gull Gray	7	12
Dark Gull Gray	---	10
Seaplane Gray	7	15
Semigloss Insignia White	40	55
Field Green	---	5
Color (by photoelectric tristimulus) (see 4.6.1) ^{1/}		
Insignia White only (gloss)		
A value	90.0	---
B value	90.0	---
G value	90.0	---
Insignia White (camouflage) and semigloss		
Insignia White only		
B value	82.0	---
A value	84.0	---
G value	84.0	---

^{1/} Tristimulus values may be obtained using Hunter reflectometer with three filters, in the same manner described in the National Bureau of Standards Research Paper RP1345 (November 1940) or using the Photovolt Lumetron reflectometer.

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3.5.6 Self-lifting properties. After application of the second coat of lacquer, there shall be no evidence of lifting, excessive embrittlement bleeding, blistering or other irregularities in the system when tested as specified in 4.6.4. It shall be equal to or better than that exhibited by a simultaneously tested control lacquer of the corresponding color.

3.5.7 Drying time. The lacquer, applied to a total film thickness of 1.0 \pm 0.2 mil, shall dry hard in not more than 40 minutes under laboratory conditions of temperature and relative humidity specified herein.

3.5.8 Surface appearance. The lacquer film shall dry to a uniform, smooth surface free of runs, sags, bubbling, wrinkling, streaking, blushing, haze, blisters, coarse particles, silking or other irregularities of surface (see 4.6.5). It shall be equal to or better than the film produced by the control formula of corresponding color.

3.5.9 Primer lifting. The lacquer shall not exhibit excessive embrittlement, bleeding, blistering, wrinkling, lifting or other surface irregularities when tested in accordance with 4.6.6. It shall be equal in all respects to the control formula when similarly tested.

3.5.10 Coating anchorage. The lacquer film shall show good dry-knife adhesion. The coating anchorage of the lacquer under test shall be equal to or better than that exhibited by a simultaneously tested control lacquer of the corresponding color (see 4.6.7).

3.5.11 Infrared reflectance (applicable only to Olive Drab). Olive Drab shall show a minimum infrared reflectance of 28 percent; a maximum infrared reflectance of 55 percent (see 4.6.1).

3.5.12 Anchorage (tape test). The lacquer film under test shall show no more removal from the undercoat, nor the entire system from the panel, than that exhibited by a simultaneously tested sample of the control lacquer of the corresponding color (see 4.6.8).

3.5.13 Resistance properties.

3.5.13.1 Lubricating oil resistance. The lacquer film shall withstand immersion in oil for a period of 24 hours at a temperature of 175° \pm 2°C (350° \pm 4°F). Slight discoloration will be permitted. Four hours after removal, the film shall show no blistering, film softening or other film defects and the film shall in all respects, be equal to or better than the film of a similarly prepared control formula lacquer of corresponding color which has been similarly immersed in the lubricating oil (see 4.6.9).

3.5.13.2 Weather resistance. Panels which have been weather-exposed for 1 year in Florida shall show no greater film deterioration, loss

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of gloss or color change at any time during the exposure period than that exhibited by a simultaneously exposed panel of the control lacquer of the corresponding color. The panels shall be examined after washing with detergent and water. When recoated, as specified in 4.6.10, the exposed lacquer film shall show good intercoat adhesion. At the end of 3 months, and at any time thereafter, the test shall be terminated upon evidence of failure of the lacquer under test to conform to this specification.

3.5.13.3 Resistance to heat. The lacquer film shall withstand exposure for 24 hours at $176^{\circ} +2^{\circ}\text{C}$ ($350^{\circ} +4^{\circ}\text{F}$) with no loss in gloss or excessive color change; the reflectance of Insignia White shall be at least 83 when observed with the blue filter. The exposed lacquer film shall show good film adhesion and no film irregularities and shall be equal to or better than simultaneously tested control lacquer of corresponding color (see 4.6.11).

3.5.13.4 Water resistance. The lacquer film shall withstand immersion in water at room temperature for 24 hours without showing any cracking, blistering, or whitening. A slight whitening or dulling which may be removed by light wiping with a soft cloth shall not be cause for rejection. The immersed film shall, in all respects, be equal to or better than the control lacquer of the corresponding color after immersion under the same conditions (see 4.6.12).

3.5.13.5 Hydrocarbon resistance. The lacquer film shall withstand immersion in hydrocarbon test fluid at room temperature for 4 hours. Immediately after removal, the film shall show no blistering or film failure. The film shall, in all respects, be equal to or better than the film of the control lacquer of corresponding color immersed under the same conditions (see 4.6.13).

3.6 Quantitative requirements. The lacquer shall conform to the quantitative requirements specified herein and in Table IV.

3.6.1 Hiding power. The minimum contrast ratio of the lacquer coating, cast on a black and white Carrara glass at the specified dry-film thickness shall conform to Table V (see 4.6.14).

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

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as

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TABLE V. CONTRAST RATIO

(Dry-film thickness 0.001 inch maximum)

FED-STD-595 Color Number	Color Name	Contrast Ratio (Minimum) (Percent)
GLOSS COLORS		
15102	Light Blue	0.98
15044	Insignia Blue	0.98
14187	Light Green	0.98
14087	Olive Drab	0.93
13655	Light Yellow	0.86
13538	Orange Yellow	0.88
12197	International Orange	0.96
11136	Insignia Red	0.88
10049	Maroon	0.98
17875	Insignia White	0.90
16473	Aircraft Gray	0.98
16081	Engine Gray	0.98
16440	Light Gray	0.96
17038	Gloss Black	0.98
CAMOUFLAGE COLORS		
37875	Insignia White	0.83
27875	Semigloss Insignia White	0.88
33538	Orange Yellow	0.80
31136	Insignia Red	0.88
	All other colors	0.98

otherwise specified in the contract or order, the supplier 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 supplies and services conform to prescribed requirements.

4.2 Classification of inspection. The inspection requirements of the acrylic lacquer shall be classified as quality conformance inspection.

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* 4.3 Quality conformance inspection. Quality conformance inspection shall include all examinations and tests of this specification except for weather resistance and storage stability tests as outlined under the inspection procedures 4.3.3 through 4.3.3.4.2.

4.3.1 Lot formation. A lot shall consist of all acrylic lacquer of the same color, manufactured at one time from one batch, forming a part of one contract or order, and submitted for acceptance at one time.

4.3.2 Sampling.

4.3.2.1 Sampling for tests. Samples shall be selected as required by Method 1021 of Fed. Test Method Std. No. 141.

4.3.2.2 Sampling for visual inspection of filled containers. A random sample of filled containers shall be selected in accordance with MIL-STD-105 and subjected to the examinations specified in 4.3.3.4.2.

4.3.3 Inspection procedure.

4.3.3.1 Quality conformance tests. Test specimens shall be prepared from the samples selected in accordance with 4.3.2.1 and subjected to all the tests of 4.6 except as authorized in 4.3.3.3.1 through 4.3.3.3.3. Non-conformance of test specimens to a single requirement shall be cause for rejection of the lot represented by the sample.

4.3.3.2 Batch data. Batch production data shall be furnished in accordance with Method 1031 of Fed. Test Method Std. No. 141.

4.3.3.3 Report of tests. The manufacturer shall submit notarized test reports to the Government representative, in accordance with Method 1031 of Fed. Test Method Std. No. 141, for each batch showing the results including numerical values when applicable of all tests specified herein except weather resistance (4.6.10) and storage stability (4.6.2). Reports of numerical tests as satisfactory are not acceptable. Each ingredient material shall be identified with the name of its manufacturer and that manufacturer's trade name and formula number.

4.3.3.3.1 Nonvolatile and volatile composition. In lieu of reporting analytical results on the breakdown of the nonvolatile and volatile composition of the lacquer, the manufacturer may report such results as "calculated" under the condition that he has carefully described by separate report, attached to manufacturer's test reports, the character and details of his production methods which in his opinion, guarantee that any samples analyzed made by the Government will yield acceptable results.

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4.3.3.3.2 Resin combination. The manufacturer shall submit a notarized certification signed by a responsible official of its management, attesting that the resin combination of the lacquer being furnished, regardless of the gloss or camouflage color, has met the Florida exposure weather-resistance test (4.6.10) when formulated in a gloss color. Panel preparation need not conform to 4.5.1. The specific test data on the resin combination may be obtained from the prime resin manufacturer for inclusion in the certification.

4.3.3.3.3 Storage stability. The manufacturer shall submit a notarized certification signed by a responsible official of its management, attesting that the acrylic lacquer will meet all the requirements of this specification after storage as specified in 3.5.2 for a period of one year.

4.3.3.4 Examinations.

4.3.3.4.1 Examination of product. The lacquer shall be examined for conformance with the requirements of this specification with respect to material and workmanship.

4.3.3.4.2 Examination of preparation for delivery. The samples selected in accordance with 4.3.2.2 shall be examined for proper filling or weight, markings, packaging and packing. Any package having one or more defects or under required fill shall be rejected. If the number of defective packages exceeds the Acceptable Quality Level of 2.5 percent defective in accordance with Inspection Level S-4 of MIL-STD-105, the lot represented by the sample shall be rejected.

4.4 The Government reserves the right to conduct tests for storage stability and weather resistance, or to conduct any or all tests of this specification at any time within 1 year from the date of manufacture of the lacquer as attested by the date appearing on the container's label. Samples for test shall be taken from previously unopened containers. Should the results be unsatisfactory, the contracting officer will be so informed, and may require the contractor to remove the entire batch and supply conforming material to replace it.

4.5 Test conditions. The laboratory testing conditions shall be in accordance with Fed. Test Method Std. No. 141 and as specified herein.

* 4.5.1 Test panels. Except as otherwise specified herein, all panels used for test purposes shall be aluminum-clad aluminum alloy conforming to QQ-A-250/5. The panels shall be 0.020 by 3 by 6 inches in size, and treated with materials conforming to MIL-C-81706 to produce coatings conforming to MIL-C-5541 and finished as follows: Spray panels with one cross-coat of epoxy-polyamide primer, MIL-P-23377, and air-dry for 3 hours; dry film thickness shall be 0.6 to 0.8 mil. Apply two cross coats of the lacquer under test to a total dry film thickness of 1.0 to 1.4 mils, with

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a one-half hour air dry interval between coats. Composition "G" lacquer shall have been reduced 1 volume package material to 1-1/2 volumes thinner composed of 2 parts toluol to one part xylol by volume. Composition "L" lacquer shall be thinned with thinner conforming to 3.4.3.3. Unless otherwise specified, air dry panels for 1 week before testing.

4.5.1.1 Application. Composition G lacquer is applied over Class 1, MIL-P-23377 primer; Composition L lacquer is applied over class 2 MIL-P-23377 primer.

4.5.2 Methods for preparing lacquer samples. Samples shall be prepared for testing in accordance with Fed. Test Method Std. No. 141 and as specified herein. All tests shall be conducted with the package lacquer, unless spray application is required. In such cases, thinning for spray application shall be accomplished by reducing the lacquer as directed in 4.5.1.

4.5.3 Control formula lacquer. The control formula lacquer of Table VI is for the gloss Insignia White color and Table VII for camouflage Light Gull Gray. The control formula must be the same color and gloss approximately as the color of the material under test. Lacquers made in other colors shall be formulated from the raw materials specified in Tables VI and VII except for the pigments which shall be in accordance with Table III. Control lacquers shall conform to this specification.

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TABLE VI

CONTROL FORMULA, INSIGNIA WHITE (GLOSS) 1/ 2/

Ingredients	Parts by weight
Titanium Dioxide (TT-P-442, Type III)	720
Acryloid A-21, (30 percent in Toluene, Rohm and Haas)	1710
Acryloid B-44 (40 percent in Toluene, Rohm and Haas)	1284
Santicizer 160 (Monsanto)	54
Cellosolve acetate	150

Grind 72 hours in white pebble mill.

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TABLE VII

CONTROL FORMULA, LIGHT GULL GRAY (CAMOUFLAGE) 1/

Ingredients	Parts by weight
Titanium Dioxide (TT-P-422, Type III)	720
Celite 266 (Johns Manville Company)	60
SF #399 Talc (Whittaker, Clark and Daniels)	180
Acryloid A-21 (30 percent in toluene, Rohm and Haas)	1710
Acryloid B-44 (40 percent in toluene, Rohm and Haas)	1284
Santicizer 160 (Monsanto)	54
Cellosolve acetate	150

Tint to Light Gull Gray (FED-STD-595 Color No. 36440) with lampblack and grind 48 hours in pebble mill.

1/ NOTE: The Tables VI and VII formulations with the specified proprietary raw materials represent products of established outdoor weathering durability. The listing of these proprietary materials is not to be construed as an endorsement thereof, or as precluding lacquers formulated with raw materials from other proprietary sources or other formulations within the compositional framework of Tables II and III. Such products may prove equivalent or even superior in performance to the test lacquers. However, the Tables VI and VII formulations should be employed as the comparison standards, for control purposes. Control lacquers in colors other than Gloss White and Light Gull Gray shall be prepared in accordance with 4.5.3.

2/ When grinding gloss colors, the use of methyl pyrrolidone and a temperature of 120°F has been found helpful (see 3.4.3.1).

* 4.5.4 Field Green pigment formula guide. The Field Green pigment formula of Table VIII is intended for use as a guide.

4.6 Test methods. The tests of this specification shall be conducted in accordance with the specified methods of Fed. Test Method Std. No. 141 and as specified herein.

* 4.6.1 The tests listed in Table IX shall be conducted in accordance with the specified methods of Fed. Test Method Std. No. 141 and as specified therein. Panels shall be prepared as specified in 4.5.1 unless otherwise specified in the applicable test methods.

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TABLE VIII

FIELD GREEN CONTROL LACQUER 1/, 2/

Ingredients	Percent by weight
Medium chrome yellow <u>3/</u>	34.5
Phthalocyanine blue <u>4/</u>	1.8
Antimony sulfide <u>5/</u>	13.7
Silica <u>6/</u>	15.8
Magnesium silicate <u>7/</u>	34.2

- 1/ The Table VIII formulation with the specified proprietary raw materials represents a product of established color match. The listing of these proprietary materials is not to be construed as an endorsement thereof or as precluding pigments formulated with raw materials from other proprietary framework of Tables II and III. Such products may prove equivalent or even superior in performance to the test pigments. However, the Table VIII formulation should be employed as the comparison standard for control purposes.
- 2/ For production purposes, the pigments and extenders may not be in exactly the same proportions of Table VIII since mass tone and tinting strength of the pigments may vary slightly among different batches. These pigments shall be the sole prime pigments. No tinting pigments are permissible. However, flatting pigments are required to achieve the required gloss.
- 3/ Imperial X1810 or equal.
- 4/ DuPont BT284D or equal.
- 5/ Rare Metals Products Co., precipitated Grade No. 1 (MIL-A-15197) or equal.
- 6/ Johns Manville Celite No. 266 or equal.
- 7/ Whitaker, Clarke and Daniels SF Talc 399 or equal.

4.6.1.1 Field Green color. When measured on a suitable spectrophotometer, the infra-red reflectance of the panel shall conform to the limits specified in 3.5.4.

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TABLE IX - INDEX

TEST METHOD

Item	Applicable Method in Fed. Test Method Std. No. 141	Paragraph giving further references	Requirement Paragraph
Resin	--	4.3.3.3.2	3.4.1
Plasticizer	7371	3.4.2	3.4.2
Pigment content (Supercentrifuge)	4022	--	Table II
Solvent content	7360	--	3.4.3
Volatile and Non- volatile content	4041	--	Table II
Vehicle solids	4052	--	3.4.4
Condition in container	3011	--	3.5.1
Storage stability	--	4.6.2	3.5.2
Odor	4401	--	3.5.3
Color	4250	--	3.5.4
Color (Photoelectric Tristimulus) (White only)	4252	--	3.5.4 and Table IV
Working properties	--	4.6.3	3.5.5
Self-lifting properties	--	4.6.4	3.5.6
Drying time	4061	--	3.5.7
Surface appearance	--	4.6.5	3.5.8
Primer lifting	--	4.6.6	3.5.9
Coating anchorage	--	4.6.7	3.5.10

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TABLE IX - INDEX

TEST METHOD (Continued)

Item	Applicable Method in Fed. Test Method Std. No. 141	Paragraph giving further references	Requirement Paragraph
Infrared reflectance (34087 Olive Drab only)	6242	--	3.5.11
Anchorage (tape test)	--	4.6.8	3.5.12
Lubricating oil resistance	--	4.6.9	3.5.13.1
Weather resistance	6161	4.6.10	3.5.13.2
Resistance to heat	--	4.6.11	3.5.13.3
Water resistance	--	4.6.12	3.5.13.4
Hydrocarbon resistance	--	4.6.13	3.5.13.5
Coarse particles	4092	--	Table IV
Fineness of grind (use gage having minimum path length of 4 inches)	4411	--	Table IV
Viscosity (No. 3 Ford Cup) (except clear)	4282	--	Table IV
Specular Gloss 60° <u>1/</u>	6101	--	Table IV
Hiding Power	--	4.6.14	3.6.1 and Table V

1/ Panels shall conform to QQ-A-250/5, 0.020 by 3 by 6 inches, and anodized in accordance with MIL-A-8625, Type I. Lacquer under test shall be applied directly to unprimed panels.

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4.6.2 Storage stability. A full, closed container of lacquer shall be stored under warehouse conditions at a temperature of 21° to 32°C (70° to 90°F) for 1 year, at the end of which time it shall be opened and inspected and tested for conformance to this specification, except for weather resistance (see 3.5.2).

4.6.3 Working properties. A panel prepared in accordance with 4.5.1 and 3.5.5, 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.

4.6.4 Self-lifting properties. Three panels shall be prepared in accordance with 4.5.1. The first coat of the lacquer under test applied to the three panels shall be allowed to air-dry for 1/2, 1, and 2 hours, respectively. After application of the second coat there shall be no evidence of lifting in the system (see 3.5.6).

4.6.5 Surface appearance. The film on a panel prepared as specified in 4.6.3 shall be examined under a magnification of 10 to 15 diameters (see 3.5.8).

4.6.6 Primer lifting. Four panels shall be prepared in accordance with 4.5.1 except topcoats shall be applied as follows: One coat of the lacquer under test shall be applied to the four panels after the primer has air-dried 3, 6, 16 and 48 hours respectively. After application of the lacquer coat there shall be no evidence of lifting, bleeding, excessive embrittlement, blistering, wrinkling or other surface irregularities in the system (see 3.5.9).

4.6.7 Coating anchorage. Panels prepared as specified in 4.5.1, using both lacquer under test and control lacquer shall be air-dried for 1 week and then tested in accordance with Method 6304 of Fed. Test Method Std. No. 141 and examined (see 3.5.10).

4.6.8 Anchorage (tape test). Panels shall be prepared as specified in 4.5.1. Two of the panels shall be coated with two coats of the lacquer under test, and two panels with two coats of the control lacquer of corresponding color. After application of the second coat of lacquer, the panels shall be air-dried for 1 week. All four panels shall then be partially immersed in distilled water, at a temperature of 23° \pm 1.1°C (73.5° \pm 2°F), for 24 hours. The panels shall then be removed from the water and wiped dry with a soft cloth. Immediately thereafter two parallel scratches, 1 inch apart, and penetrating to the metal, shall be made with a stylus upon a previously immersed part of each panel. A 1-inch wide strip of masking tape, taken from a fresh sample of Minnesota Mining and Manufacturing Co. Code No. 250 masking tape or equal, shall be applied across each set of scratches, adhesive side down. The tape shall be pressed down with

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two passes of a 4-1/2 pound 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 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 \pm 5 seconds. Stripping of the tape from the panel shall be done immediately after application thereof (see 3.5.12).

4.6.9 Lubricating oil resistance. Panels shall be prepared as specified in 4.5.1. The panels shall then be immersed in diester lubricating oil composed of 95 percent di-2 ethyl-hexyl sebacate $\frac{1}{2}$, and 5 percent tricresyl phosphate, by weight, at a temperature of 176° \pm 2°C (350° \pm 4°F) for a period of 24 hours. Four hours after removal, the panels shall be compared (see 3.5.13.1).

4.6.10 Weather resistance. Panels, 5 by 16 inches, shall be prepared as specified in 4.5.1. Panels shall be prepared for exposure with the lacquer under test, and separate panels shall be prepared with the control lacquer of the corresponding color. The panels shall be exposed in accordance with Method 6161 of Fed. Test Method Std. No. 141 for 1 year in the vicinity of Miami, Florida (see 3.5.13.2). After the exposed panels have been examined they shall be over-coated with the following systems:

- (1) One set of panels sprayed with test lacquer.
- (2) One set sprayed with one coat of epoxy primer MIL-P-23377 plus one coat test lacquer.

After drying, the intercoat adhesion shall be determined in accordance with Method 6304 of Fed. Test Method Std. No. 141.

4.6.11 Resistance to heat. Panels prepared as specified in 4.5.1, shall be heated in a circulating oven at 350°F for 24 hours and examined for gloss retention, color change and film irregularities. Reflectance of Insignia White panels shall be determined. Adhesion of exposed panels shall be determined in accordance with Method 6304 of Fed. Test Method Std. No. 141 (see 3.5.13.3).

4.6.12 Water resistance. Panels, prepared as specified in 4.5.1 air dried for 1 week, shall be immersed in distilled water in accordance with Method 6011 of Fed. Test Method Std. No. 141 for 24 hours at room temperature. Five minutes after removal from the water, the lacquer shall be examined (see 3.5.13.4).

$\frac{1}{2}$ di-2 ethyl-hexyl sebacate may be obtained commercially as "Plexol 201" from Rohm and Haas.

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4.6.13 Hydrocarbon resistance. Panels shall be prepared as specified in 4.5.1. The panels shall then be immersed in test fluid consisting of 85 percent iso-octane and 15 percent toluene at room temperature, for 4 hours, in accordance with Method 6011 of Fed. Test Method Std. No. 141. The film shall be examined immediately after removal and again 24 hours after removal from the fluid (see 3.5.13.5).

4.6.14 Hiding.

4.6.14.1 Panel preparation. A representative portion of the lacquer under test shall be cast on a smooth flat metal surface utilizing a suitable doctor blade so that a dry-film thickness of 1 mil is obtained. The metal plate shall be held firm when the film is cast with the doctor blade. An excess of the coating being tested shall be poured on the metal plate just in front of the film applicator. The plate shall be lowered and drawdown made immediately, continuing the motion down the plate until the lower end is reached. The film should be homogeneous and free of film irregularities which would affect the overall accuracy of the determination. The lacquer coating shall be dried in a horizontal position for at least 24 hours in a dust-free cabinet. An average of five film-thickness readings shall be taken in the central portion of the coated panel with a suitable film meter. The doctor-blade clearance which gave the desired film thickness shall be utilized in casting the coating on the black and white Carrara glass. The application technique and dry procedure is similar to the one utilized in the preparation of the metal panels. The black Carrara glass shall have a daylight 45-degree, 0-degree apparent reflectance of less than 1 percent; the white Carrara glass shall have a daylight 45-degree, 0-degree apparent reflectance of 86 ± 2 percent (relative to MgO).

4.6.14.2 Reflectance determination. The reflectance of the coated black and white Carrara glass shall be determined in accordance with Method 6121 of Fed. Test Method Std. No. 141. The Hunter reflectometer used with the green filter in the manner described in the National Bureau of Standards Research Paper (RP1345, November 1940), meets these requirements as does the Photovolt Lumetrom reflectometer. The reflectance of the film over the black shall be divided by the reflectance of the film over the white to obtain the contrast ratio (see 3.6.1).

5. PREPARATION FOR DELIVERY

* 5.1 Packaging and packing. The lacquer shall be packaged, packed, and marked in accordance with TT-P-143 and as specified in 5.2. The level of packaging shall be A or C, and the level of packing shall be A, B, or C as specified (see 6.2).

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* 5.2 Marking and labeling. In addition to the marking required by TT-P-143, individual cans or containers shall bear a label including the following instructions for use, the applicable thinning directions, and aluminum lacquer information when required:

INSTRUCTIONS FOR USE: This lacquer is for application over epoxy primer, MIL-P-23377, with or without pretreatment coating, MIL-C-8514. The primer shall be mixed and applied in accordance with MIL-C-22751. A cross-coat of primer, 0.6 to 0.9 mil dry-film thickness, shall be applied and allowed to dry two to three hours before the application of the topcoat lacquer.

Thinning Directions:

For Composition G, the acrylic lacquer should be thinned for spraying by mixing one volume lacquer with one and one-half volumes of thinner. This thinner is composed of:

<u>Ingredients</u>	<u>Parts by Volume</u>
Toluene	2
Xylene	1

For improved leveling, one pint of ethylene glycol monoethyl ether acetate, Specification MIL-E-7125 may be added to each gallon of the above thinner. In addition, small additions of thinner beyond the quantity called for may be made. The topcoats should be applied in two spray coatings to a total dry-film thickness of 1-1.2 mils, allowing one-half hour dry between coats. Thick films should be avoided. Six hours dry should be allowed before application of insignia markings using lacquers or acrylic colors.

For Composition L, the manufacturer shall modify the above directions to specify the nonphotochemically reactive thinner to be employed.

"Precautions:

1. Composition L acrylic lacquer from one vendor shall only be thinned with a nonphotochemically reactive thinner supplied by the same vendor".

The information below is intended for the label for clear acrylic lacquer packages only:

"Aluminum lacquer: Prepare by incorporating 12 ounces of aluminum paste conforming to Type II, Class A of TT-P-320 in 1 gallon of clear lacquer, with the aid of thinner required. Aluminum powder of comparable fineness, purity, and physical properties may be employed in the production of aluminized finishes. In such instances where powder is used, the amount shall be equal to that contained in the amount of aluminum content of the aluminum paste specified".

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6. NOTES

* 6.1 Intended use. The lacquer conforming to this specification is intended for use as a general-purpose, exterior, protective coating for metal surfaces, and is particularly formulated for resistance to diester lubricating oil. The lacquer is primarily intended for use only over a system of epoxy-polyamide type primer, MIL-P-23377. This lacquer may also be used as an insignia and marking lacquer directly over freshly applied epoxy-polyamide topcoat, MIL-C-22750. A thin cross-coat of epoxy-polyamide primer, MIL-P-23377 is necessary over polyurethane topcoat, MIL-C-81773, before application of the acrylic lacquer. Scuff-sand any aged epoxy film before applying the acrylic lacquer.

6.2 Ordering data. Procurement documents should specify:

- (a) Title, number, and date of this specification.
- (b) Composition, Color number and name (see 1.2).
- (c) Size of container for lacquer. The lacquer should be purchased by volume, the unit being a US gallon, (231 cubic inches) at 15.5°C (60°F).
- (d) Levels of packaging and packing required (see 5.1).

* 6.3 Composition L lacquers should be specified for use in areas with regulations controlling the emission of solvents into the atmosphere.

6.4 Marginal indicia. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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<p>INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.</p>		
SPECIFICATION		LACQUER, ACRYLIC (FOR NAVAL WEAPONS SYSTEMS)
MIL-I-81352A(AS)		
ORGANIZATION		
CITY AND STATE		CONTRACT NUMBER
MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE? <input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.)		
SUBMITTED BY (Printed or typed name and activity - Optional)		DATE

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