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SUPERSEDING
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MILITARY SPECIFICATION

LACQUER, LUSTRELESS, HOT SPRAY

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

1. SCOPE

1.1 Scope. This specification covers a cellulose nitrate lustreless lacquer that can be applied at either elevated or room temperatures. It provides for two compositions, one of which is suitable for use under AIR POLLUTION REGULATIONS (see 6.6).

1.2 Classification. Lacquer covered by this specification shall be of the following compositions as specified:

Composition G - General use.

Composition L - Limited use (see 6.6).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

- TT-C-490 - Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.
- TT-P-143 - Paint, Varnish, Lacquer and Related Materials; Packaging, Packing and Marking Of.
- TT-P-320 - Pigment, Aluminum; Powder and Paste for Paint.
- TT-S-735 - Standard Test Fluids; Hydrocarbon.
- PPP-T-60 - Tape: Packaging, Waterproof

FSC 8010

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STANDARDS

Federal

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

(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.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM D 476 - Specifications for Titanium Dioxide Pigments

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Qualification. Lacquers furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for the opening of bids (see 4.3 and 6.4). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under the contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Color. The lacquer shall be furnished in the Federal Standard 595 color number specified in the contract or purchase order (see 6.2). When tested as in 4.4.12 it shall match the standard color chip in Federal Standard 595.

3.3 Composition.

3.3.1 Vehicle.

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3.3.1.1 Nonvolatile vehicle. The nonvolatile vehicle shall conform to the requirements specified in Table I, when analyzed in accordance with 4.4.

TABLE I. Composition of nonvolatile vehicle

Material	Minimum	Maximum
Cellulose nitrate, percent by dry weight	30	--
Resins, phthalic alkyd type, percent by weight ^{1/}	55	--
Plasticizers, percent by weight	10	15
Rosin and phenol, percent by weight ^{2/}	--	0

^{1/}The resins shall be phthalic alkyds of the non-drying or semi-drying type containing a minimum of 30 percent phthalic anhydride.

^{2/}The test for rosin and phenol shall be negative.

3.3.1.2 Volatile vehicle. The volatile portion of the lacquer shall conform to the requirements of Table II, when analyzed in accordance with 4.4. The volatile portion shall contain no benzol, methanol, chlorinated solvents or any other solvent of a highly toxic nature.

TABLE II. Quantitative requirements of volatile portion

Material	Composition G		Composition L	
	Percent by weight		Percent by weight	
	Minimum	Maximum	Minimum	Maximum
Esters and ketones percent by weight ^{1/}	37.5	--	37.5	--
Alcohols, percent by weight ^{2/}	15	22.5	15	22.5
Aromatic hydrocarbons, percent by weight ^{3/}	--	40	--	20
Aliphatic hydrocarbons	--	--	--	20

^{1/}Minimum boiling point; 111°C.

^{2/}At least 50 percent of the alcohol content shall have a minimum boiling point of 116°C.

^{3/}Minimum boiling point; 135°C.

3.3.1.2.1 Composition L. The volatile content of composition L shall also conform to the following requirements by volume when tested as in 4.4.4.

(a) Solvents having an olefinic or cyclo-olefinic type of unsaturation: 5 percent maximum.

(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethyl benzene: 8 percent maximum.

(c) A combination of ethyl benzene, ketones having branched hydrocarbon structures or toluene: 20 percent maximum.

(d) Total of a + b + c: 20 percent maximum.

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3.3.2 Pigment. Any combination of the pigments listed in Table III for any specific color shall make up the basic hiding pigmentation for that color. Hiding pigments shall be chemically pure and free from extenders. The titanium dioxide shall be rutile chalk resisting type conforming to types III or IV of ASTM D 476. Small amounts of other shading pigments may be used when necessary to match the color chips provided these additional pigments have good color permanence. Extender pigments shall be siliceous matter or siliceous matter and barytes and shall not exceed the amount specified in Table IV. The amount of barytes shall not exceed 20 percent of the extender content by weight. Calcium sulfate or carbonate shall not be employed alone or as a component part of any pigment.

3.4 Quantitative requirements.

3.4.1 Specific quantitative requirements. Each color shall conform to its specific requirements in Table IV when tested as specified in 4.4.

TABLE III. Pigmentation

Color	Fed. Std. No. 595 Color No.	Pigmentation
Brown	30117	Red or yellow iron oxide, carbon or lampblack, titanium dioxide.
Red	31136	Toluidine red.
Light red	31158	Quinacridone red, molybdate orange, titanium dioxide.
Orange	32246	Chrome orange, molybdate orange.
Yellow	33538	Medium chrome yellow, yellow iron oxide.
Olive drab	34087	Red or yellow iron oxide, carbon or lampblack, medium chrome yellow, titanium dioxide.
Green	34108	Chrome green or chrome yellow for green and iron blue.
Light green	34558	Titanium dioxide, yellow iron oxide, chrome yellow, phthalocyanine blue or green, carbon or lampblack.
Medium blue	35109	Iron blue, titanium dioxide, lampblack, yellow iron oxide.
Light blue	35193	Iron blue, titanium dioxide, chrome yellow.
Gray	36118	Titanium dioxide, carbon or lampblack, phthalocyanine blue, red iron oxide.
Slate	26132 ^{1/}	Titanium dioxide, carbon or lampblack, yellow iron oxide.
Ocean gray	36176	Titanium dioxide, carbon or lampblack, milori blue.
Blue gray	36231	Titanium dioxide, carbon or lampblack, yellow iron oxide.
Black	37038	Black iron oxide, carbon or lampblack.
Magenta	37142	Quinacridone violet, quinacridone red, titanium dioxide.
Purple	37144	Thioindigoid maroon, titanium dioxide, dichloro-iso-dibenzanthrone violet.
Aluminum	17178 ^{1/2/}	Aluminum pigment.
White	37875	Titanium dioxide.

^{1/}The gloss of color standard 26132 and 17178 should be disregarded.

^{2/}The aluminum lacquer does not match 17178 but is a light neutral gray.

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TABLE IV. Specific quantitative requirements

Color corresponding to Table III	Solids, % by wt of lacquer			Pigment, % by wt of total pigment		Pigment volume, % of total solids volume Max.	Contrast ratio Min.
	Total solids	Pigment solids		Prime pigment ^{1/}	Extender pigment		
	Min.	Min.	Max.	Min.	Max.		
Brown	45	21	25	25 (Fe ₂ O ₃)	65	32	0.98
Red	42	18	22	--	70	34	0.89
Light red	44	21	25	15 (TiO ₂)	70	34	0.92
Orange	48	24	28	--	55	32	0.84
Yellow	46	24	28	37 (PbCrO ₄)	55	32	0.89
Olive drab	42	18	22	20 (Fe ₂ O ₃) ^{2/}	65	30	0.98
Green	46	21	25	--	65	32	0.98
Light green	48	26	30	35 (TiO ₂)	57	34	0.98
Medium blue	46	21	25	24 (TiO ₂)	65	32	0.98
Light blue	46	24	28	24 (TiO ₂)	65	32	0.98
Gray	46	24	28	35 (TiO ₂)	55	32	0.96
Slate	46	24	28	35 (TiO ₂)	55	32	0.98
Ocean gray	46	21	25	30 (TiO ₂)	65	32	0.91
Blue gray	46	24	28	37 (TiO ₂)	55	32	0.98
Black	44	18	22	15 (Fe ₃ O ₄)	83	30	0.98
Magenta	46	22	26	24 (TiO ₂)	65	34	0.93
Purple	44	21	25	24 (TiO ₂)	65	32	0.98
Aluminum	45	24	28	--	83	37	0.98
White	46	24	28	47 (TiO ₂)	50	32	0.92

^{1/}On analysis compute prime pigment as indicated in parenthesis.^{2/}Lead chromate (PbCrO₄) may be substituted on an equal weight basis.

3.4.2 General quantitative requirements. The lacquer tested as in 4.4 shall comply with the requirements of Table V.

TABLE V. General quantitative requirements

Characteristics	Requirements	
	Minimum	Maximum
Vehicle solids, percent by weight of lacquer	20	--
Phthalic anhydride, percent by weight of vehicle solids	16.5	--
Rosin and rosin derivatives	Negative	
Phenolic resins	Negative	
Water, percent by weight of lacquer	--	1.0
Coarse particles and skins, percent by weight of pigment	--	1.0
Viscosity, No. 4 Ford cup, seconds		
Package	120	190
Reduced	15	25
Fineness of grind	5	--
Specular gloss, 60 degree	2	8
Directional reflectance, white only, percent	83	--
Drying time		
Set to touch, minutes	4	8
Dry through, minutes	--	10
Full hardness, hours	--	48

3.5 Qualitative requirements.

3.5.1 Condition in container. The lacquer, tested as in 4.4.13, shall be free from grit, seeds, skinning, or livering in a freshly opened full container, and shall show no more pigment settling or caking than can be easily and completely reincorporated to a smooth homogeneous state.

3.5.2 Storage stability.

3.5.2.1 Partially full container. The lacquer shall show no skinning when tested as in 4.4.14.1. After aging as in 4.4.14.1 the lacquer shall show no livering, curdling, tough gummy sediment, nor hard caking. The lacquer shall mix readily to a smooth homogeneous state, and any skin formed shall be continuous and easily removed.

3.5.2.2 Full container. The lacquer shall show no skinning, livering, curdling, hard caking, nor tough gummy sediment when tested as in 4.4.14.2. It shall remix readily to a smooth homogeneous state and shall have a maximum No. 4 Ford cup viscosity of 210 seconds and shall meet all other requirements of the specification.

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3.5.3 Dilution stability. The lacquer shall show no evidence of precipitation, separation or curdling when tested as in 4.4.15. Slight pigment settlement shall be permitted.

3.5.4 Heat stability. Lacquer heated and tested as in 4.4.16, shall meet the requirements of 3.5.8 through 3.5.16 and the gloss requirement of Table V.

3.5.5 Suspension properties. The lacquer shall show no more than slight settling, no caking, and shall completely redisperse to a smooth homogeneous state when tested as in 4.4.17.

3.5.6 Dipping properties. When tested as in 4.4.18, the lacquer shall show satisfactory dipping properties and shall present a smooth appearance, free from sagging, running or excessive silking.

3.5.7 Spraying properties.

3.5.7.1 Hot spray. The packaged lacquer when tested as in 4.4.19.1 shall spray satisfactorily in all respects and shall show no dusting, mottling, or color separation, and shall present a smooth lustreless finish free from seeds.

3.5.7.2 Cold spray. Lacquer, tested as in 4.4.19.2, shall spray satisfactorily in all respects and shall show no running, sagging, streaking or blushing. The dried film shall show no dusting, mottling, or color separation, and shall present a smooth lustreless finish free from seeds.

3.5.8 Flexibility. A film of lacquer tested as in 4.4.20 shall withstand bending without cracking or flaking.

3.5.9 Knife test. A film of lacquer tested as in 4.4.21 shall adhere tightly and not flake, crack, or powder from the metal. The cut shall show beveled edges.

3.5.10 Adhesion. A film of lacquer tested as in 4.4.22 shall show no removal of the coating by the adhesive tape beyond one-sixteenth inch on either side of the score line.

3.5.11 Water resistance. A film of lacquer tested as in 4.4.23 shall show no wrinkling or blistering immediately after removal of the panel from the water. The lacquer shall be no more than slightly affected when examined 2 hours after removal. After 24 hours air drying the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness, color and gloss from a panel prepared at the same time but not immersed.

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3.5.12 Hydrocarbon resistance. A film of lacquer tested as in 4.4.24 shall show no wrinkling or blistering immediately after removal of the panel from the fluid. The lacquer shall be no more than slightly affected when examined 2 hours after removal. After 24 hours air drying the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness, color and gloss from a panel prepared at the same time but not immersed. A tendency for red (No. 31136) to become milky in appearance shall be disregarded.

3.5.13 Lacquer resistance. A film of lacquer tested as in 4.4.25, shall withstand recoating with white lacquer after drying or aging for the stated time intervals. There shall be no blistering, wrinkling, film irregularities or other evidence of lifting. With the exception of red (No. 31136), the film shall contain no bleeding pigments which will discolor the white lacquer.

3.5.14 Salt spray resistance. A film of lacquer tested as in 4.4.26 and examined immediately after removal from the test shall show no rust creepage or undercutting beyond one-eighth inch from the score mark. At all other points of the panel there shall be no more than a trace of rusting and no more than 5 scattered blisters, none larger than 1 mm. in diameter. The maximum amount of rusting shall be comparable to Photo 9-1 Method 6451 of Fed. Test Method Std. No. 141. After removal of the lacquer the surface of the steel shall show no more than a trace of rusting, pitting, or corrosion.

3.5.15 Accelerated weathering. A film of lacquer tested as in 4.4.27 shall show no more than slight chalking (No. 8 Method 6411 of Fed. Test Method Std. No. 141) and a color change equivalent to a lightness index difference not exceeding 4 units. The film shall show no excessive change in chroma and no change in hue.

3.5.16 Weather resistance. A film of lacquer tested as in 4.4.28 shall show no checking, cracking or appreciable film deterioration. There shall be no more than moderate chalking (No. 4 Method 6411 of Fed. Test Method Std. No. 141) of colors light blue, medium blue, gray, slate, blue gray, ocean gray, white, purple and no more than light chalking (No. 6 Method 6411 of Fed. Test Method Std. No. 141) of all other colors. The film shall show no excessive change in value or chroma and no change in hue. After removal of any chalking which has occurred, the original color shall be substantially restored and the washed area shall show no more than slight fading or darkening. On removal of the lacquer the surface of the steel shall show no more than a trace of rusting, pitting, or corrosion. Rust creepage shall not extend beyond one-eighth inch from the score mark.

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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 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 that supplies and services conform to the prescribed requirements.

4.2 Sampling, inspection and testing. Unless otherwise specified, sampling, inspection and testing shall be in accordance with method 1031 of Fed. Test Method Std. No. 141.

4.3 Classification of tests. Testing under this specification shall be for the purpose of:

- (a) Qualification.
- (b) Acceptance of individual lots.

4.3.1 Qualification testing shall consist of tests for all requirements specified in section 3 (see 6.4).

4.3.2 Acceptance tests shall normally consist of tests for all requirements specified in section 3 with the exception of storage stability in a full container (3.5.2.2), weather resistance (3.5.16), and the lacquer resistance after outdoor exposure (4.4.25.3).

4.4 Test methods.

4.4.1 Test conditions. The routine and referee testing conditions shall be in accordance with section 7, Fed. Test Method Std. No. 141 except as otherwise specified herein.

4.4.2 The following tests shall be conducted in accordance with applicable methods of Fed. Test Method Std. No. 141 or as hereinafter specified.

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TABLE VI. Index

Tests	Test Method		
	Applicable	Paragraph of	Paragraph of
	method in Fed. Test Method Std. No. 141	this specifica- tion giving fur- ther references	this specifica- tion giving requirements
Isolation of vehicle (super centrifuge)	4032	--	--
Nitrocellulose	5205	4.4.3.1	Table I
Phthalic anhydride	7024	4.4.3.2	Table V
Plasticizer	7371	--	Table I
Rosin in isolated vehicle	5031	--	Table I
Phenolic resin	5141	--	Table I
Solvents, quantitative	7360	4.4.4	Table II
Benzol	5091	--	3.3.1.2
Methanol	5133	--	3.3.1.2
Chlorinated solvents	5132	--	3.3.1.2
Total solids	4044	--	Table IV
Pigment content	4022	--	Table IV
Pigment analysis	4021	4.4.5	Table IV
Fe ₂ O ₃ - Iron oxide	7141	4.4.5.1	Table IV
Fe ₃ O ₄ - Iron oxide	7141	4.4.5.2	Table IV
TiO ₂ - Titanium dioxide	7083	4.4.5.3	Table IV
PbCrO ₄ - Lead chromate	7131	4.4.5.4	Table IV
Other prime pigments	--	4.4.5.5	Table III
Extender pigment, total	5271	4.4.6.1	Table IV
Extender pigment, analysis	7281	4.4.6.2	3.3.2
Pigment volume	4312	4.4.7	Table IV
Hiding power (contrast ratio)	4122	4.4.8	Table IV
Vehicle solids	4044	--	Table V
Water	4082	--	Table V
Coarse particles and skins	4092	--	Table V
Viscosity	4282	4.4.9	Table V
Fineness of grind	4411	--	Table V
Specular gloss, 60°	6101	4.4.10	Table V
Directional reflectance	6121	--	Table V
Drying time	4061	4.4.11	Table V
Set to touch	4061	4.4.11.1	Table V
Dry through	4061	4.4.11.2	Table V
Full hardness	4061	4.4.11.3	Table V
Color	4250	4.4.12	3.2
Condition in container	3011	4.4.13	3.5.1
Storage stability	--	4.4.14	3.5.2
Partially full container	3021	4.4.14.1	3.5.2.1
Full container	3022	4.4.14.2	3.5.2.2

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TABLE VI. Index (continued)

Tests	Test Method		
	Applicable method in Fed. Test Method Std. No. 141	Paragraph of this specification giving further references	Paragraph of this specification giving requirements
Dilution stability	--	4.4.15	3.5.3
Heat stability	--	4.4.16	3.5.4
Suspension properties	--	4.4.17	3.5.5
Dipping properties	4341	4.4.18	3.5.6
Spraying properties	4331	4.4.19	3.5.7
Hot spray	4331	4.4.19.1	3.5.7.1
Cold spray	4331	4.4.19.2	3.5.7.2
Flexibility	6221	4.4.20	3.5.8
Knife test	6304	4.4.21	3.5.9
Adhesion	--	4.4.22	3.5.10
Water resistance	6011	4.4.23	3.5.11
Hydrocarbon resistance	6011	4.4.24	3.5.12
Lacquer resistance	--	4.4.25	3.5.13
Salt spray resistance	6061 (2011)	4.4.26	3.5.14
Accelerated weathering	6152 (6122)	4.4.27	3.5.15
Weathering resistance	6160	4.4.28	3.5.16

4.4.3 Analysis of non-volatile vehicle.

4.4.3.1 Nitrocellulose content. Determine nitrocellulose content as in method 5205 of Fed. Test Method Std. No. 141 and check for compliance with Table I.

4.4.3.2 Phthalic anhydride content. Determine phthalic anhydride content as in method 7024 of Fed. Test Method Std. No. 141 and check for compliance with Table V.

4.4.4 Analysis of volatile vehicle (composition L). Determine solvent as in method 7360 of Fed. Test Method Std. No. 141. Samples that fail to meet the requirements of 3.3.1.2.1 shall be subject to further examination using a six foot silicone nitrile column (20 percent XF-1150 on 60 to 80 mesh Chromosorb W).

4.4.5 Analysis of pigment. Extract the pigment as in method 4021 of Fed. Test Method Std. No. 141.

4.4.5.1 Iron oxide (Fe₂O₃) content. Determine the iron oxide (Fe₂O₃) content on the extracted pigment in accordance with method 7141 of Fed. Test Method Std. No. 141.

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4.4.5.2 Iron oxide (Fe_3O_4) content. Determine the iron oxide (Fe_3O_4) content on the extracted pigment in accordance with method 7141 of Fed. Test Method Std. No. 141 and calculate the total iron to Fe_3O_4 .

4.4.5.3 Titanium dioxide (TiO_2) content. Determine the titanium dioxide (TiO_2) content on the extracted pigment in accordance with method 7082 of Fed. Test Method Std. No. 141.

4.4.5.4 Lead chromate (PbCrO_4) content. Determine the lead chromate (PbCrO_4) content on the extracted pigment in accordance with method 7131 of Fed. Test Method Std. No. 141.

4.4.5.5 Other permissible prime pigments. Make appropriate qualitative and quantitative tests on the extracted pigment to determine if permissible prime pigments were used in formulating the different colors of lacquer.

4.4.6 Extender pigment.

4.4.6.1 Total extender pigment content. Determine matter insoluble in acid in the extracted pigment by method 5271 of Fed. Test Method Std. No. 141.

4.4.6.2 Extender pigment analysis. Determine barium sulfate, siliceous material, and calcium (sulfate or carbonate) by the applicable portions of method 7281 of Fed. Test Method Std. No. 141.

4.4.7 Pigment volume. Extract the pigment by washing with lacquer thinner conforming to that in Table VII instead of the benzol specified in method 4312 of Fed. Test Method Std. No. 141.

TABLE VII. Thinner

Ingredient	Composition G		Composition L	
	Percent by weight	Approx. Percent by volume	Percent by weight	Approx. Percent by volume
Methyl isobutyl ketone	31	31	--	--
Methyl isobutyl carbinol	8	8	--	--
Isopropyl alcohol (99 percent)	11	11	--	--
Toluene	25	23	19	17
Low flash naphtha (dry point below $108^\circ\text{C}.$)	25	27	--	--
Normal butyl acetate	--	--	35	32
Normal butyl alcohol	--	--	15	15
Heptane	--	--	31	36

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4.4.8 Hiding power (contrast ratio). Determine the contrast ratio in accordance with method 4122 of Fed. Test Method Std. No. 141. For red (31136), orange (32246), yellow (33538) and white (37875) use a film applicator that will deposit a 3 inch wide film with a dry film thickness of 0.0015 inch maximum and for all other colors a dry film thickness of 0.0010 inch maximum. Air dry for 48 hours. Determine the reflectance and verify the film thickness in the area in which the reflectance was measured. Calculate the contrast ratio and check for compliance with Table IV.

4.4.9 Viscosity (reduced). Reduce two parts by volume of the packaged lacquer with one part by volume of thinner conforming to Table VII. Check for compliance with Table V.

4.4.10 60° specular gloss. Draw down the package material on glass using a 0.002 inch (0.004 inch gap clearance) film applicator. Measure the gloss as specified in method 6101 of Fed. Test Method Std. No. 141.

4.4.11 Drying time. Determine drying time in accordance with method 4061 of Fed. Test Method Std. No. 141 using referee conditions.

4.4.11.1 Set to touch time. Draw down the package material using a 0.002 inch (0.004 inch gap clearance) film applicator. Determine the set to touch time for compliance with Table V.

4.4.11.2 Dry through time. Draw down the package lacquer using a 0.002 inch (0.004 inch gap clearance) film applicator. Determine the dry through time for compliance with Table V.

4.4.11.3 Full hardness time. Condition the packaged lacquer as specified in 4.4.16. Phosphoric acid etch a 4 by 12 inch steel panel as in procedure B, method 2011 of Fed. Test Method Std. No. 141. Coat the panel immediately with the conditioned lacquer using a 0.002 inch (0.004 inch gap clearance) film applicator. Determine full hardness for compliance with Table V.

4.4.12 Color. In accordance with method 4250 of Fed. Test Method Std. No. 141, match the specified color chip of Fed. Test Method Std. No. 595 with the pigmented coating on the white carrara glass panel prepared for the hiding power test (4.4.8). Observe for compliance with 3.2.

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4.4.13 Condition in container. Determine package condition on acceptance testing in accordance with method 3011 of Fed. Test Method Std. No. 141. On qualification testing determine pigment settling or caking as follows: Proceed as in method 3011 of Fed. Test Method Std. No. 141, but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker^{1/}. On re-examination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Observe for compliance with 3.5.1.

4.4.14 Storage stability.

4.4.14.1 Partially full container. Determine 48 hour skinning in accordance with method 3021 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.2.1. Reseal and age for 7 days at 60°C. and observe for compliance with 3.5.2.1.

4.4.14.2 Full container. In accordance with method 3022 Fed. Test Method Std. No. 141, allow a full standard quart can of the packaged lacquer to stand undisturbed for 6 months and then examine the contents. Evaluate pigment settling or caking as in 4.4.13 but agitate the can for 5 minutes on the paint shaker prior to re-examination. Determine viscosity and examine for compliance with 3.5.2.2.

4.4.15 Dilution stability. Reduce one volume of lacquer with one volume of thinner of the following composition:

<u>Ingredient</u>	<u>Percent by volume</u>	
	<u>Composition G</u>	<u>Composition L</u>
Normal butyl acetate	15	24
Normal butyl alcohol	15	15
Toluene	70	17
Heptane	--	44

Observe after reduction and after standing 24 hours for compliance with 3.5.3.

4.4.16 Heat stability. Place seven ounces of the packaged lacquer in an 8-ounce glass jar, close tightly, and immerse half-way in a water bath at $77 \pm 2^\circ\text{C}$. ($170 \pm 3^\circ\text{F}$.) for 24 hours. At the end of this time allow the lacquer to return to room temperature. Then check for change in gloss and use in tests as specified in 4.4.20 through 4.4.28. Observe for compliance with 3.5.4.

^{1/}An apparatus of this type, powered by 1/4 hp motor, operates at a rate of 1350 shakes per minute, and is manufactured by Red Devil Tools, Irvington, N.J.

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4.4.17 Suspension properties. Reduce two parts by volume of lacquer with one part by volume of thinner conforming to Table VII. Place 6 ounces of the reduced lacquer in an 8-ounce glass jar. Allow the stoppered jar to remain undisturbed for 24 hours and then place the unopened jar on a paint shaker as in 4.4.13 and agitate the contents for 20 seconds. Re-examine the material for any evidence of nonhomogeneity or undispersed pigment. Observe for compliance with 3.5.5.

4.4.18 Dipping properties. Reduce two parts by volume of lacquer with one part by volume of thinner, conforming to Table VII. Test the dipping properties in accordance with method 4341 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.6.

4.4.19 Spraying properties.

4.4.19.1 Hot spray. In accordance with method 4331 of Fed. Test Method Std. No. 141 spray the packaged lacquer, heated in an Underwriters' Laboratory approved hot spray unit, under the conditions specified below and then observe for compliance with 3.5.7.1.

Atomization air temperature	Room temperature, 21.1 to 32.2°C. (70 to 90°F.)
Atomization air pressure	50 pounds, maximum
Cold lacquer feed tank pressure	10 - 15 pounds
Fluid and air adjustment valves on spray gun	Wide open
Air cap and fluid tip	De Vilbiss Type FX tip and No. 704 air cap (or equivalent)
Lacquer temperature at spray gun	160 ± 5°F. (71 ± 3°C.)
Distance of spray gun from work	6 - 8 inches
Lacquer flow rate at nozzle	10 - 20 fluid ounces per minute
Thermostatic setting on lacquer heating unit	175°F. maximum

4.4.19.2 Cold spray. Reduce two parts by volume of lacquer with one part by volume of thinner conforming to Table VII. Spray on a steel panel to give a dry film thickness between 0.0008 and 0.0011 inch and observe for spraying properties in accordance with method 4331 of Fed. Test Method Std. No. 141 and for compliance with 3.5.7.2. For referee test use automatic application per method 2131.

4.4.20 Flexibility. Determine flexibility in accordance with method 6221 of Fed. Test Method Std. No. 141. After conditioning the lacquer as specified in 4.4.16, apply a 2 inch wide film of lacquer with a film applicator that will give a dry film thickness between 0.0009 and 0.0011 inch on a smooth finish steel panel prepared in accordance with method 2011 of Fed. Test Method Std. No. 141 using the aliphatic naphtha ethylene glycol monoethyl ether mixture. The panel shall be prepared from new cold rolled carbon steel rust-free 0.010 ± 0.001 inch thick with a Rockwell 15-T maximum hardness of 82 and finished with a surface roughness of 8 to 12 microinches. Allow the test panel to air dry one half hour and then bake for 24 hours at $105 \pm 2^{\circ}\text{C}$. ($221 \pm 4^{\circ}\text{F}$.). Condition the panel for one half hour at $23 \pm 1^{\circ}\text{C}$. Bend over a $1/8$ inch mandrel and examine for compliance with 3.5.8.

4.4.21 Knife test. Perform the knife test in accordance with method 6304 of Fed. Test Method Std. No. 141 using a flat portion of the baked panel from the flexibility test. Observe for compliance with 3.5.9.

4.4.22 Adhesion, tape test.

4.4.22.1 Panel preparation. Condition the lacquer as in 4.4.16. Using a 0.0025 inch (0.0050 inch gap clearance) film applicator, draw down a 2 inch wide film of the lacquer on a steel panel, phosphoric acid etched as in procedure B, method 2011 of Fed. Test Method Std. No. 141.

4.4.22.2 Procedure. Air dry the specimen for 1 hour under referee conditions and then score a line through to the metal across the width of the film using a sharp pointed knife. The film shall then be taped perpendicular to and across the score line with waterproof, pressure-sensitive adhesive tape ($3/4$ inch wide) conforming to PPP-T-60, Type IV. The tape shall be pressed in firm contact with the film and shall extend for approximately one inch on each side of the score line. All air bubbles shall be rolled out by firm pressure of the thumb. Allow approximately 10 seconds for the test area to return to room temperature. Grasp a free end of the tape, and at a rapid speed, strip it from the specimen by pulling the tape back upon itself at 180° . Observe the specimen for compliance with 3.5.10.

4.4.23 Water resistance. Prepare two panels as in 4.4.22.1 and air dry for 48 hours. Coat all exposed, uncoated metal surfaces with wax or other suitable coating and immerse one of the panels for 18 hours in distilled water at $23 \pm 1^{\circ}\text{C}$. ($73.4 \pm 2^{\circ}\text{F}$.) in accordance with method 6011 of the Fed. Test Method Std. No. 141. At the end of the test period remove the panel from the water and inspect for compliance with the requirements of 3.5.11.

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4.4.24 Hydrocarbon resistance. Prepare two panels as in 4.4.22.1 and air dry for 48 hours. Immerse one panel in a hydrocarbon fluid conforming to TT-S-735, Type III at $23 \pm 1^\circ\text{C}$. ($73 \pm 2^\circ\text{F}$.) for 4 hours in accordance with method 6011 of Fed. Test Method Std. No. 141. At the end of the test period remove the panel from the hydrocarbon fluid and examine for compliance with the requirements of 3.5.12. Any gum line above the level of the test fluid should be disregarded.

4.4.25 Lacquer resistance. Immerse each lacquer test specimen described below to a depth of 2-1/2 inches in white lacquer, conforming to this specification and reduced for spraying as in 4.4.9. At the end of 5 seconds remove the test specimen, dry in a vertical position and examine for compliance with 3.5.13.

4.4.25.1 After air drying. Prepare 4 panels as in 4.4.22.1 and dry under referee conditions, 4, 8, 24, and 48 hours respectively. At the end of its drying period test each panel as in 4.4.25.

4.4.25.2 After accelerated weathering. Upon completion of the accelerated weathering test (see 4.4.27) test the exposed panel as in 4.4.25.

4.4.25.3 After weather resistance. Upon completion of the weather resistance test (see 4.4.28) cut a 2 by 4 inch portion from the center area of one of the exposed panels and test it as in 4.4.25.

4.4.26 Salt spray resistance. Three 4 by 12 inch steel panels, solvent cleaned in accordance with method 2011 using the petroleum naphtha-ethylene glycol monoethyl ether mixture, shall be given a phosphate coating conforming to the requirements of TT-C-490, Type I. Condition the lacquer as specified in 4.4.16 and then reduce it for spray application as in 4.4.9. Spray the test panels to a uniform dry film thickness between 0.0009 and 0.0011 inch. Air dry for 48 hours, score all specimens and expose to 5 percent salt spray for 120 hours as specified in method 6061 of Fed. Test Method Std. No. 141. Upon removal, wash the panels gently in running water not warmer than 100°F . until free from any visible salt deposits and examine immediately for compliance with the requirements of 3.5.14. Strip the lacquer from the panels by means of lacquer thinner and inspect the steel for rust, pitting or corrosion.

4.4.27 Accelerated weathering. Using a 0.0025 inch (0.0050 inch gap clearance) film applicator draw down a 2 inch wide film of the lacquer on two flat tin plate panels and air dry for 48 hours. Measure the directional reflectance and expose the panel to accelerated weathering for 168 hours in accordance with method 6152 of Fed. Test Method Std. No. 141 using a twin arc apparatus. Examine the exposed panel for chalking by rubbing with a piece of velvet or cheesecloth wrapped around the finger. Using moderate pressure, draw the cloth across the width of the panel in two different directions. Measure the directional reflectance (method 6121) on an unrubbed area of the exposed panel and determine the amount of color change, expressed as lightness index difference (ΔL), using method 6122 of Fed. Test Method Std. No. 141. Then test the panel for lacquer resistance as in 4.4.25.2. Check accelerated weathering test results for compliance with 3.5.15.

4.4.28 Weather resistance. Prepare two scored test panels as in 4.4.26. Air dry for 48 hours and place on outdoor exposure for 18 months at an angle of 45° south in the climate of Washington, D. C. At the conclusion of the exposure period inspect the panels for compliance with 3.5.15. Determine chalking as in 4.4.27. Wash the panels with a warm soap solution using a soft sponge or cloth; rinse, dry, and examine for color change. Test the coating for lacquer resistance as in 4.4.25.3. Completely strip the lacquer from the panels by means of lacquer thinner and inspect the steel for rust, pitting or corrosion.

5. PREPARATION FOR DELIVERY

5.1 Packaging, packing and marking. The lacquer shall be packaged, packed and marked in accordance with TT-P-143. 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). The lacquer shall be furnished in 1 quart or 1 gallon multiple friction top containers, in 5 gallon lug cover steel pails or in 55 gallon steel drums as specified (see 6.2).

5.2 Additional marking. In addition to the markings required by TT-P-143 each container of lacquer containing lead chromate pigment shall bear the following precautionary markings:

CAUTION: Contains lead chromate. Take adequate precautions when spraying. Avoid inhalation and repeated or prolonged skin contact.

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6. NOTES

6.1 Intended use. The lacquer covered by this specification is intended for use as a finish coat on phosphated or primed shells, bombs, grenades, tanks, trucks, ammunition and automotive components. While developed primarily for hot spray application, the lacquer may be reduced with lacquer thinner and sprayed at room temperature.

6.1.1 For automotive applications, insufficient preparation of the surface may result in defective adhesion of the lacquer. Surfaces to be painted for automotive applications should be prepared by use of either a wash primer treatment conforming to MIL-C-15328 or a phosphate metal treatment and should then be given a coat of primer conforming to MIL-P-11414, prior to application to the finish coat of lacquer.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Composition required (see 1.2).
- (c) Color and color number (see 3.4.1).
- (d) Level of packaging and level of packing (see section 5).

6.3 The lacquer should be purchased by volume, the unit being one U.S. liquid gallon of 231 cubic inches at 60°F. (15.6°C.).

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the U. S. Army, Mobility Equipment Research and Development Center, Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland 21005 and information pertaining to qualification of products may be obtained from that activity.

6.5 The olive drab lacquer is contemplated to be comparable in performance to the following approximate composition by weight:

340 lbs.	Synthetic yellow orange iron oxide
25 lbs.	Carbon black
150 lbs.	Rutile titanium dioxide
6 lbs.	Synthetic medium red iron oxide
285 lbs.	Fibrous magnesium silicate
668 lbs.	Acicular talc
450 lbs.	35 percent phthalic anhydride, castor oil alkyd (W - Z at 65 percent solids in xylol)
1041 lbs.	Xylol

Grind 18 - 24 hours in a porcelain ball mill using a 2 - 1 ratio of porcelain balls by weight and reduce as follows:

1335 lbs.	35 percent phthalic anhydride, castor oil alkyd (W - Z at 65 percent solids in xylol)
195 lbs.	Tricresyl phosphate
3082 lbs.	Nitrocellulose solution prepared as follows:
893 lbs.	1/2 second R. S. nitrocellulose (65 percent in ethanol)
1565 lbs.	Methyl isobutyl ketone or butyl acetate
110 lbs.	Ethanol
514 lbs.	Butanol or methyl isobutyl carbinol

At low viscosities the use of small amounts of suspension agents will improve settling properties.

6.6 Composition L lacquer should be specified for use in areas with regulations controlling the emission of solvents into the atmosphere.

Custodians:

Army - MR
Navy - SH
Air Force - 84

Preparing activity:

Army - MR

(Project No. 8010-0439)

Review activities:

Army - EL, MU

User activities:

Army - WC

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐ VENDOR☐ USER☐ MANUFACTURER☐ OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS:

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)