MILITARY STANDARD

PROTECTIVE FINISHING FOR ARMY MISSILE WEAPON SYSTEMS

TO ALL HOLDERS OF MIL-STD-186D:

1. THE FOLLOWING PAGES OF MIL-STD-186D HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
1	3 December 1976	1	10 November 1975
2	3 December 1976	2	10 November 1975
3	3 December 1976	3	10 November 1975
4	10 November 1975	(REPRINTED WITHOUT CHANGE)	
5	3 December 1976	5	10 November 1975
6	10 November 1975	(REPRINTED WITHOUT CHANGE)	
7	3 December 1976	7	10 November 1975
8	3 December 1976	8	10 November 1975
9	3 December 1976	9	10 November 1975
10	10 November 1975	(REPRINTED WITHOUT CHANGE)	
11	3 December 1976	11	10 November 1975
12	3 December 1976	12	10 November 1976
12a	3 December 1976		
12b	3 December 1976		
12c	3 December 1976		
12d		(BLANK PAGE)	
15	3 December 1976	15	10 November 1975
16	10 November 1975	(REPRINTED WITHOUT CHANGE)	
17	10 November 1975	(REPRINTED WITHOUT CHANGE)	
18	3 December 1976	18	10 November 1975
19	3 December 1976	19	10 November 1975
19a	3 December 1976		
19b		(BLANK PAGE)	
20	3 December 1976	20	10 November 1975
21	3 December 1976	21	10 November 1975
22	10 November 1975	(REPRINTED WITHOUT CHANGE)	
23	10 November 1975	(REPRINTED WITHOUT CHANGE)	
24	3 December 1976	24	10 November 1975
27	3 December 1976	27	10 November 1975
27a	3 December 1976		
27b		(BLANK PAGE)	
28	3 December 1976	28	10 November 1975
29	3 December 1976	29	10 November 1975
30	3 December 1976	30	10 November 1975
30a	3 December 1975		

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
30b		(BLANK PAGE)	
31	10 November 1975	(REPRINTED WITHOUT CHANGE)	
32	3 December 1976	32	10 November 1975
41	10 November 1975	(REPRINTED WITHOUT CHANGE)	
42	3 December 1976	42	10 November 1975
43	10 November 1975	(REPRINTED WITHOUT CHANGE)	
44	3 December 1976	44	10 November 1975

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-186D will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or canceled.

Custodian:
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Review:
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Army - MI

Project No. MFFP-A114

MILITARY STANDARD

PROTECTIVE FINISHING FOR ARMY MISSILE WEAPON SYSTEMS

1. SCOPE

1.1 Scope. This standard establishes the minimum requirements for procedures, materials, and systems for cleaning, plating, painting and finishing metals, wood, electronic materials, parts and assemblies for rockets, guided missiles and components to protect them from deterioration.

1.2 Selection of finishing system. Unless otherwise specified, the responsibility for selecting the cleaning method, surface treatment, metal coating, part system or other finish shall rest with the activity responsible for the end item. The materials treatment and finishes shall be selected from those listed herein and shall be referenced on drawings, in contracts, and item specifications by the appropriate finish numbers of MIL-STD-186. This does not preclude the acceptance of a proven commercial finish selected by the manufacturer, supplier or contractor and which is concurred in by the procuring activity. Numerous finish codes are contained in tables that are not referenced in the requirement sections, i.e., sealants, conformal coatings, lubricants, adhesives, that are satisfactory for use. Where the finish or corrosion protection processes are not adequately defined, the problem shall be brought to the attention of the procuring activity.

CODE NUMBER SYSTEM

Cleaning Methods	100 Numbers
Surface Treatment	200 Numbers
Metallic Coatings	300 Numbers
Organic Coatings	400 Numbers
Sealing and Bonding	500 Numbers
Encapsulants & Potting	600 Numbers
Lubricantion & Preservation	700 Numbers
Miscellaneous	800 Numbers

1.2.1 Cross reference. A cross reference Table IX is provided to relate the present code numbers with the paint finish numbers contained in the superseded "B" issue of this standard.

2. APPLICABLE DOCUMENTS

2.1 Government documents. Issue of the following documents in effect on the date of invitation for bids form a part of the standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

O-C-1889	Cleaning Compound, Solvent
O-T-236	Tetrachloroethylene (Perchloroethylene) Technical Grade
P-C-436	Cleaning Compound, Alkali, Boiling Vat (Soak) or Hydrosteam
QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (electrodeposited)
TT-C-490	Cleaning and Pretreatment of Ferrous Surfaces for Organic Coatings
TT-E-527	Enamel, Alkyd, Lustreless
TT-E-529	Enamel, Alkyd, Semigloss
TT-E-776	Ethylene Glycol Monobutyl Ether (for use in organic coatings)
TT-I-558	Ink, Marking Stencil, Opaque, for Nonporous Surfaces (Metals, Glass, etc.)
TT-I-735	Isopropyl Alcohol
TT-L-54	Lacquer, Spraying, Acid Resistant (For Aluminum Surfaces Around Storage Batteries)
TT-P-1757	Primer Coating, Zinc Chromate, Low Moisture Sensitivity
TT-T-266	Thinner, Dope and Lacquer (Cellulose Nitrate)
TT-W-571	Wood Preservation, Treating Practices
TT-W-572	Wood Preservative, Water-Repellant
UU-T-106	Tape, Pressure-Senstive Adhesive, Masking, Paper
VV-L-800	Lubricating Oil, General Purpose, Preservative (Water Displacing Low Temperature)

DDD-T-539	Towels, Machinery Wiping (laundered)
MMM-A-121	Adhesive, Bonding Vulcanized Synthetic Rubber to Steel
MMM-A-132	Adhesive, Heat Resistant, Airframe Structural Metal-to-Metal
MMM-A-134	Adhesive, Epoxy Resin, Metal
MMM-A-1617	Adhesive, Rubber Base, General Purpose
RIAPD-636	Coating, Protective, Thermally Fused Epoxy Plastic (for Metal Surfaces)

MILITARY

MIL-T-152	Treatment, Moisture and Fungus Resistant, of Communications, Electronic, and Associated Electrical Equipment
MIL-V-173	Varnish, Moisture-and Fungus-Resistant (for the Treatment of Communications, Electronic and Associated Electrical Equipment)
MIL-E-463	Ethyl Alcohol (for Ordnance Use)
MIL-F-495	Finish, Chemical, Black for Copper Alloys
MIL-S-974	Surfacer, Sanding
MIL-L-3150	Lubricating Oil, Preservative, Medium
MIL-M-3171	Magnesium Alloy, Processes for Corrosion Protection of
MIL-L-3891	Luminescent Material and Equipment (Non-radioactive)
MIL-A-3920	Adhesive, Optical, Thermosetting
MIL-S-4383	Sealing Compound, Topcoat, Fuel Tank, Buna-N Type
MIL-W-5044	Walkway Compound, Nonslip and Walkway Matting, Nonslip
MIL-W-5050	Walkway Coating, and Matting, Nonslip, Aircraft Application of

MIL-A-5540	Adhesive, Polychloroprene
MIL-C-5541	Chemical Films for Aluminum and Aluminum Alloys
MIL-A-6091	Alcohol, Ethyl, Specially Denatured, Aircraft
MIL-P-6808	Primer Coating, Zinc Chromate, for Aircraft and Missile Applications, Application of
MIL-I-6869	Impregnants for Aluminum Alloy and Magnesium Alloy Castings
MIL-T-7003	Trichlorethylene, Stabilized Degreasing
MIL-P-8116	Putty, Zinc Chromate, General Purpose
MIL-C-8507	Coating, Wash Primer (Pretreatment) for Metals, Application of (for Aeronautical Use)
MIL-I-8574	Inhibitors, Corrosion, Volatile, Utilization of
MIL-A-8576	Adhesive, Acrylic Base, for Acrylic Plastic
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-S-8802	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion
MIL-C-8837	Coating, Cadmium (Vacuum Deposited)
MIL-A-9067	Adhesive Bonding, Process and Inspection Requirements for
MIL-M-10578	Metal Conditioner and Rust Remover (Phosphoric Acid Base)
MIL-T-10727	Tin Plating; Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals
MIL-G-10925	Grease, Automotive and Artillery
MIL-S-11030	Sealing Compound, Noncuring, Polysulfide Base
MIL-S-11031	Sealing Compound Adhesive: Curing (Polysulfide Base)

MIL-P-11414	Primer, Lacquer, Rust-Inhibiting
MIL-T-12664	Ferrous Resistant Paranitrophenol Treatment for Cork Products
MIL-S-13165	Shot Peening of Metal Parts
MIL-C-13924	Coating, Oxid, Black, for Ferrous Metal
MIL-C-14460	Corrosion Removing Compound, Sodium Hydroxide Base, for Electrolytic or Immersion Application
MIL-C-14538	Chromium Plating, Black (Electrodeposited)
MIL-C-14550	Copper Plating (Electrodeposited)
MIL-P-15328	Primer, (Wash), Pretreatment, Blue, Formula No. 117-B for Metals
MIL-S-15847	Spray Gun and Accessories, Paint and Dope, Aircraft Use
MIL-T-16070	Treatment, Mildew-Resistant, for Rope
MIL-C-16173	Corrosion Preventive Compound, Solvent Cutback, Cold Application
MIL-E-16738	Enamel, Exterior, White, Vinyl-Alkyd (Formula No. 122-82)
MIL-I-16923	Insulating Compound, Electrical, Embedding
MIL-F-18264	Finishes, Organic Weapons System, Application and Control of
MIL-P-18317	Plating, Black Nickel (Electrodeposited) on Brass
MIL-C-20218	Chromium Plating, Electrodeposited, Porous
MIL-T-21330	Treatment: Insect Resistant, for Paper
MIL-I-22110	Inhibitors, Corrosion, Volatile, Crystalline
MIL-S-22473	Sealing, Locking and Retaining Compounds, Single-Component
MIL-C-22750	Coating, Epoxy-Polyamide
MIL-C-22751	Coating System, Epoxy polyamide, Chemical and Solvent Resistant, Process for Application of

MIL-T-23142	Tape, Pressure-Sensitive Adhesive, for Dissimilar Metal Separation
MIL-C-23217	Coat, Aluminum, Vacuum Deposited
MIL-P-23377	Primer, Coating, Epoxy-Polyamide Chemical and Solvent Resistant
MIL-P-23408	Plating: Tin-Cadmium (Electrodeposited)
MIL-C-23411	Corrosion Preventive Compound, Clear
MIL-S-23586	Silicone Rubber Compound, Room Temperature Vulcanizing
MIL-L-25142	Luminescent Material, Fluorescent
MIL-A-25457	Adhesive, Air-Drying, Silicone Rubber
MIL-A-25463	Adhesive, Metallic Structural Sandwich Construction
MIL-C-26074	Coating, Nickel-Phosphorous, Electroless Nickel, Requirements for
MIL-P-27418	Plating, Soft Nickel (Electrodeposited, Sulfonate Bath)
MIL-A-40147	Aluminum Coating (Hot Dip) for Ferrous Parts
MIL-I-43553	Ink, Marking, Epoxy Base
MIL-T-45035	Treatments, Mildew-Resistant, Non-Copper Processes for Cotton Duck, Webbing and Sewed Items
MIL-S-45180	Sealing Compound, Gasket, Hydrocarbon Fluid, Water Resistant
MIL-M-45202	Magnesium Alloys, Anodic Treatment of
MIL-G-45204	Gold Plating, Electrode Deposited
MIL-P-45209	Palladium Plating (Electrodeposited)
MIL-L-46002	Lubricating Oil, Contact and Volatile Corrosion Inhibited

MIL-L-46010	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-I-46058	Insulating Compound, Electrical (for Coating Printed Circuit Assemblies)
MIL-R-46085	Rhodium Plating, Electrodeposited
MIL-E-46096	Enamel, Lusterless Quick-Drying Styrenated Alkyd Type, Solar Heat Reflecting
MIL-A-46146	Adhesive-Sealant, Silicon RTV, Non-Corrosive (For Use with Sensitive Metals and Equipment)
MIL-E-46117	Enamel, Alkyd, Lustreless, Solar Heat Reflecting, Olive Drab
MIL-C-46127	Coating, Gray, Undercoat (Solar Heat Reflecting)
MIL-E-46136	Enamel, Semigloss, Alkyd, Solar Heat Reflecting, Olive Drab
MIL-P-46843	Printed Circuit Assemblies, Design and Production of
MIL-S-46844	Solder Bath Soldering of Printed Wiring Assembly, Automatic Machine Type
MIL-L-46147	Lubricant, Solid-Film, Air-Cured (Corrosion Inhibiting)
MIL-P-46847	Plastic Material, Foamed Polyurethane for Encapsulating Electronic Components
MIL-P-46856	Primer, Coating, Epoxy, Process for Application
MIL-P-47298	Polyurethane Molding Compound Chemically Cured, (Polyether Based)
MIL-D-50000	Dioctyl-P-Phenyleniamine (antiozonant)
MIL-L-52043	Lacquer, Semigloss
MIL-P-52192	Primer, Epoxy
MIL-E-52227	Enamel, Semigloss

MIL-E-52798	Enamel, Alkyd, Camouflage
MIL-E-52835	Enamel, Alkyed, Camouflage (Bake Type)
MIL-N-55392	Nickel-Carbon, Porous, Electrodeposited, for Camouflage
MIL-A-81236	Adhesive, Epoxy Resin with Polyamide Curing Agent
MIL-C-81302	Cleaning Compound, Solvent, Trichloro-trifluoroethane
MIL-C-81309	Compound, Corrosion Preventive, Water Displacing, Ultra-Thin Compound
MIL-T-81533	Trichlorethane, 1,1,1 (Methyl Chloroform) Inhibited, Vapor Degreasing
MIL-C-81562	Coating, Cadmium and Zinc (Mechanically Deposited)
MIL-P-81728	Plating, Tin Lead (Electrodeposited)
MIL-S-81733	Sealing and Coating Compound, Corrosion Inhibitive
MIL-C-81740	Coatings, Aluminum and Aluminum Alloys (Metallic Compound Decomposition)
MIL-C-81751	Coating, Metallic Ceramic
MIL-C-81773	Coating, Polyurethane, Aliphatic Weather Resistant
MIL-C-81797	Coating, Inorganically Bonded Aluminum (Electrophoretically Deposited)
MIL-A-81801	Anodic Coatings for Zinc and Zinc Alloys
MIL-R-81841	Rotary Flap Peening of Metal Parts

STANDARDS

FEDERAL

Fed. Std. No. 595 Colors

Fed. Test Method Std. No. 141 Paint, Varnish, Lacquer, and related Materials; Methods of Inspection, Sampling and Testing

MILITARY

MIL-STD-276	Impregnation of Porous Nonferrous Metal Castings
MIL-STD-865	Brush Plating, Electrodeposition
MIL-STD-870	Cadmium Plating, Low Embrittlement (Electrodeposition)
MIL-STD-1250	Corrosion Prevention and Deterioration Control in Electronic Components and Assemblies
MIL-STD-1501	Chromium Plating, Low Embrittlement (Electrodeposition)

(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 documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

ASTM B 253	Preparation of and Electroplating Aluminum Alloys

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

NFPA No. 30	Storing
NFPA No. 33	Spray Finishing
NFPA No. 34	Dip Tank

(Application for copies should be addressed to the National Fire Protection Association, 60 Batterymarch Street, Boston, MA 02110.)

3. DEFINITIONS

3.1 Definitions. For the purposes of this standard, the following definitions apply.

3.2 Exterior surfaces. The outward or exposed surfaces of the weapon and ground support equipment after all doors, hatches, and access ports are closed shall be considered as exterior surfaces.

3.3 Hermetically sealed. A hermetically sealed system is one that is purged and filled with a dry, inert gas medium, or one where humidity is properly controlled to less than 10 percent relative humidity before sealing. Hermetic sealing shall also be defined as sealed to the extent that there shall be no moisture-laden air or water introduced into the sealed unit or component where subjected to combination of the following:

(a) Moisture resistance testing for 15 days, moisture to be maintained at 95 percent relative humidity and temperature to be cycled at a constant rate between -65°F and 155°F during each 24-hour period.

(b) Leak testing either at a vacuum of 5 pounds per square inch absolute (psia) or at an external pressure of 20 psia for not less than 2 hours. Units of measurement for leaks shall be atmospheric cubic centimeters per second (Atm cc/sec), allowable limit for leaks shall be 10^{-8} Atm cc/sec to 10^{-5} Atm cc/sec.

3.4 Supplier. The supplier is that contractor who has accepted an order from the Government or who has entered into a contract with the Government for the purpose of furnishing parts, components, and assemblies complying with the requirements of this standard.

3.5 Nonreparable. "Nonreparable" is defined as a characteristic of assemblies or components that can only be repaired at the maintenance echelon where purging, evacuation, or pressurization described in 3.3 can be accomplished.

3.6 Similar and dissimilar metals. For the convenience of the user this standard provides tables X and XI as classification of similar bare metals which must be given prime consideration for design purposes and shall, insofar as possible, be used where different metals and platings are in close proximity.

4. GENERAL REQUIREMENTS

4.1 Applicability of requirements. The requirements specified herein shall be applicable to all parts of the weapon system except components which are encapsulated or enclosed in hermetically sealed containers.

4.2 Design usage. Reference to this standard (MIL-STD-186) and callouts of the code numbers on engineering drawings are mandatory. This is required to simplify preparation of drawings and facilitate in updating drawings affected by a major finishing change.

4.3 Materials. Materials shall conform to applicable specifications as specified herein. Materials not covered by applicable specifications shall not be used unless approved by the procuring authority.

4.4 Finishing requirements. Unless otherwise specified, all fabrication operations, such as cutting, drilling, punching, forming, grinding, honing, welding, joining, and any other operations which will affect the finish of the item as well as cleaning (see 4.6), shall be completed prior to the application of any surface treatments, metallic and nonmetallic coatings required for finishing of the metals and alloys.

4.5 Surfaces. Unless otherwise specified, parts shall conform to specified dimensions, surface roughness and condition prior to cleaning, surface treatment and plating. In the case of metals which may respond in a nonuniform manner when metal removal is accomplished with mechanical, chemical, electromechanical methods, appropriate inspection procedures shall be established and used to insure that each part has a uniform surface, including freedom from pits, intergranular attack and significant etching. Where etching has occured, the degree found shall be demonstrated not to affect the serviceability of the parts.

4.6 Cleaning of surfaces. Prior to application of the surface treatments and metallic coatings covered by this specification, cleaning shall be as specified herein, using materials and processes which have no damaging effect on the metal, including freedom from pits, intergranular attack and significant etching. Appropriate inspection procedures shall be established and used. After cleaning, all parts shall be completely free of corrosion products, scale, paint, grease, oil, flux, and other foreign materials including other metals, and shall be given the specified treatment as soon as practicable after cleaning. Particular care shall be exercised in the handling of parts to assure that foreign metals are not inadvertently transferred to the clean surfaces as may occur when steel is allowed to come into contact with zinc surfaces. Parts having high residual tensile stresses, which are to be cleaned by chemical or electrochemical methods, shall be stress-relieved prior to cleaning. Parts which may have high sustained tensile stresses as the result of assembly, or crevices which can retain cleaning solutions, shall be cleaned prior to assembly.

4.7 Organic soil removal. Vapor degreasing shall be done with trichlorethylene conforming to MIL-T-7003 or perchloroethylene conforming to O-T-236, or trichlorethane 1,1,1, conforming to MIL-T-81553. Carbon tetrachloride shall not be used for degreasing. Use and handling of all chlorinated solvents must meet OSHA standards. The use of alcohol and freon are permitted for cleaning electronic assemblies.

4.7.1 Vapor degreasing procedure. Excess amounts of contaminants shall be removed by wiping off, immersing in or flushing with solutions listed in paragraph 4.7 before lowering the parts into the solution vapors at rate of approximately 11 feet per minute. The vapors shall be allowed to condense on and flow from the surfaces until the item has reached the vapor temperature. Condensation will cease at this point. The parts shall be removed from the vapor at a rate no greater than 11 feet per minute. When visible solid particles adhere to the surface after removal from the vapors, it shall be sprayed with liquid solvent and the vapor treatment repeated until the parts are determined by visual examination to be completely clean. Surfaces may be statically or forced air dried at 180 $\pm$ 20°F for 30 to 60 minutes.

4.8 Painting. Unless otherwise specified herein, interior and exterior surfaces of the weapon system shall be primed and painted.

4.9 Plating. All plating with the exception of nickel, chromium, gold, palladium, platinum, and rhodium shall receive a supplementary treatment such as phosphate, chromate, wash primer, varnish, or conformal coating.

4.10 Metal coupling compatibility. Metals in contact, exhibiting a potential difference greater than allowed by Table X, shall be avoided. If dissimilar metals are necessary, such galvanic couples shall be protected with compatible platings, paint, insulating tapes, or sealants.

4.10.1 Reduction of corrosion at faying surfaces. To prevent corrosion at faying surfaces, particularly joints of corrosion resistant steel, under washers, and at fasteners where there is a lack of oxygen, such faying surfaces shall be sealed with polysulfide, polyurethane, epoxy, silicone rubber, wet primer, or similar sealant.

4.11 Weapon system prohibitions. Unless otherwise specified herein, the following materials and techniques shall be prohibited in the design of missile weapon systems:

(a) Star washers, except as specified in 4.15.

(b) Upset metal staking as a method of retention, except on power train and running gear.

(c) Phenolic resins in enclosed assemblies without post-baking treatment.

(d) Chemical conversion treatments producing a chromate coating on aluminum, except as specified in 5.2.1 and 5.2.1.3.

(e) Zinc plating (see paragraph 4.16).

(f) Unsealed joints, except ground or lapped joints affecting accuracy of alignment.

(g) Leather as a seal or packing material, except in contact with chromium.

(h) Undrained hardware that is prone to any moisture collection or retention, except gear boxes, etc., containing grease or oil.

(i) Vinyl wire insulation, shielding, and sleeving (see paragraph 4.20).

(j) Cut, unpainted, or unplated edges on metallic materials.

(k) Acid-core solder or corrosive flux.

(l) Stainless steel wool in cleaning aluminum that will not be anodized.

(m) Snap rings or lock washers, except in main power train or running gear.

(n) Magnesium alloy, except as specified in 4.12.

(o) Dry-film lubricants containing graphite.

4.12 Magnesium alloys. whenever the contractor determines that magnesium alloys are to be used in a component, subassembly, or assembly, the contractor will, in each instance, furnish sufficient justification for the use of these alloys and obtain user approval prior to design incorporation. When magnesium alloys are used, the contractor shall specify a protective system that will insure long duration deterioration prevention, and so design the structures that extensive disassembly will not be required, during the life of the equipment, whenever corrosion inspections are performed.

4.13 Tubing.

4.13.1 Plumbing lines. No paint coating shall be applied to the interior surfaces of plumbing lines.

4.13.2 Copper, corrosion-resisting, and heat resisting alloy tubing. Interior and exterior surfaces of copper, corrosion-resisting, and heat-resisting alloy tubing need not be painted, except as required for dissimilar metal contact.

4.13.3 Steel, aluminum, and magnesium alloy tubing (small). Interior surfaces of sealed steel, aluminum, and magnesium alloy tubing used in structural applications shall be corrosion protected in accordance with the general schedule, insofar as practicable. Assemblies completely closed shall be treated after assembly with a volatile crystalline corrosion inhibitor, code 711, or by a corrosion preventive compound, code 702, with preference given to the VCI (code 711) material. The corrosion-inhibiting material shall be applied through appropriately drilled holes. When using the code 702 treatment, the member(s) shall be thoroughly drained after treatment and wiped free of corrosion preventive compound on all exterior surfaces. Access holes drilled in the member(s) shall be closed with cadmium plated self-tapping screws, code 304, installed with wet zinc chromate primer, code 504. The interior surfaces of open tubes shall be given the treatment specified for exteriors wherever practicable.

4.13.4 Steel, aluminum, and magnesium alloy tubing (large). Interior surfaces of sealed steel, aluminum, and magnesium alloy tubing which, due to size, weight, or geometry, are impractical to protect with corrosion preventive compound code 702, shall be protected by an application of volatile crystalline corrosion inhibitor. The crystalline inhibitor VCI material shall be applied at a rate of 2 grams per cubic foot of volume to be protected, code 711. The VCI material shall be applied to the enclosure through access holes in a manner that shall insure uniform distirbution over the area to be protected. (A tube with an inside diameter of 5 inches and a length of 7.5 feet has a volume of approximately 1 cubic foot.) Access holes shall be sealed as specified in 4.13.3. Interior surfaces of large open tubes shall be given the treatment specified for exteriors wherever practicable. Interior surfaces of large open steel tubes may be protected by application of wash primer code 401 and paint per code 402.

4.14 Rivets and threaded fasteners. Rivets and threaded fasteners in general shall be assembled with zinc chromate primer, code 504. If the fasteners are dissimilar to and can result in a direct contact with magnesium, a washer of 5056 aluminum alloy, with a minimum over lap of 1/8-inch, shall be used in addition to assembling with wet zinc chromate primer, code 504.

4.15 Star washers. Star washers may be used for electrical contacts provided they are protected after assembly, code 497.

4.16 Zinc plating. Zinc plating of any type shall not be used. Use cadmium plating instead.

4.17 Cables, chains, close-wound springs. Control cables, chains, and close-wound springs shall be protected by coating with a corrosion preventive compound, code 701. Springs made of music wire or steel heat treated to 200,000 pounds per square inch (psi) (or higher ultimate tensile strength) shall not be plated, but shall be treated in accordance with code 701.

4.18 Plastics. In the selection of nonmetallic materials, every effort shall be made to select fungus-inert materials. Materials considered fungi-inert shall be those listed in MIL-STD-1250 or MIL-STD-454. In the event that fungus-inert materials are not available, the materials selected shall be treated with moisture- and fungus-resistant varnish, code 497.

4.19 Elastomers. Elastomers, such as natural rubber, that are subject to ozone attack shall be treated with an anti-ozonant in accordance with code 712, but shall not be painted.

4.20 Wire covering. Vinyl wire insulation, shielding, and sleeving shall not be used. Tetrafluoroethylene, chloro-sulfonated polyethylene, and other materials compatible with their environment shall be used.

4.21 Lubrication. Dry-film lubricants containing graphite shall not be used. For an acceptable dry-film lubricant, see codes 708 and 709. Oils and greases used in conjuction with dry-film lubricants negate the effect of dry-film lubricant.

4.22 Identification marking. Epoxy type printing inks shall be used for identification purposes, code 806. Analine base inks contain corrosive acids shall not be used. See code 805 for an alternate printing ink and marking method.

4.23 Drainage. Attention shall be directed towards the elimination of crevices, pockets, hollows, walls, etc. that permit water to collect. Provisions such as drain holes shall be provided to allow suitable drainage of the design. Where possible, finishing of parts shall be done prior to fabrication. Where this is not possible, the finishing and fabrication of items shall be handled in such a way that processing solutions shall not become trapped within any of the assemblies such as lock seams, lap joints, spot welds, rivets, bolts, or other places where processing solutions will remain on the parts.

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5.2.2.2 Touch-up. All surfaces which have the anodic coating removed or damaged shall be touched up, using either the type I or type VI process of MIL-M-3171. Damaged or touched-up magnesium surfaces, previously anodically coated in accordance with MIL-A-45202,may be reanodized.

5.2.3 Iron and steel. Immediately following cleaning and before the surfaces show any evidence of rusting or other soiling, all iron and steel surfaces to be painted shall be zinc base phosphate treated in accordance with TT-C-490, type I. Iron base phosphate treatment, TT-C-490, type II, shall be used if the paint system to be applied requires baking at temperatures exceeding 375°F or if the part is to be formed or shaped after phosphating. In the event that phosphating cannot be applied, the clean surfaces shall be coated with wash primer conforming to MIL-P-15328.

5.2.4 Corrosion and heat resistant alloys. The 200, 300, and 400 corrosion-resistant steels shall be passivated by immersion for 30 minutes in a hot (120° to 130°F) aqueous solution containing 20 percent by volume of nitric acid (specific gravity 1.42) and 2 percent by weight of sodium dichromate, rinsed in clean hot water, then thoroughly dried. This is normally the final finish requirement for the 300 grades of stainless steel. The 400 grades of stainless steel will not accept passivation unless fully hardened. Precipitation hardening stainless steels require certain preparations, if and when passivated, such as baking or shot peening. Stainless steels other than the 300 series usually require additional protective finishes. Monel, Inconel, nitrided surfaces shall not be passivated. Monel, Inconel, Hastelloys and titanium do not normally require further treatment after cleaning. Surfaces to be painted shall be coated with wash primer, MIL-P-15328.

5.2.5 Cadmium. Cleaned surfaces shall be kept free of finger marks, dirt, and dust or other contaminants and before corrosion occurs they shall be chromate treated according to QQ-P-416, type II. In the event that chromate treatments cannot be used, the surfaces shall be treated with wash primer MIL-P-15328 prior to applying a paint system.

5.2.6 Copper and copper alloys. Surfaces to be painted shall be given a black oxide coating according to MIL-F-495. The surfaces shall be protected from all contamination prior to the paint application.

5.2.7 Tin. Tin surfaces shall receive a supplementary treatment of organic coating, varnish MIL-V-173, conformal coating MIL-I-46058, or a paint system to prevent corrosion. Tin surfaces shall be coated with wash primer MIL-P-15328 prior to receiving a paint system.

5.2.8 Wood. Wood surfaces shall be treated with wood preservative conforming to composition A of TT-W-572, applied in accordance with applicable treating methods delineated by table II of TT-W-571.

5.3 Metallic coatings. Codes for metallic coatings are enumerated in table III. Metallic coatings shall be applied by electrodeposition, electroless deposition, spray metallized, or vacuum deposited methods in conformance with applicable specifications listed herein. Other processes may be used, subject to approval by the procuring activity. Necessary process and quality control requirements shall be established and technical data developed which shall be submitted to the procuring activity substantiating that the proposed coatings are equivalent to the coatings they are intended to replace relative to corrosion resistance, wear, and other functional characteristics and effect on static and dynamic properties of the metals and alloys to which they are applied. The surface roughness of the surface to be plated shall be as specified on the applicable drawing. All sharp edges shall be broken and all burrs shall be removed before coating.

5.3.1 Cadmium plating. Cadmium plating shall be in accordance with QQ-P-416. Supplementary treatments are required to provide corrosion resistance. Cadmium plating shall not be used in the following applications:

(a) Parts of hydraulic equipment which may be in contact with hydraulic fluid.

(b) Parts in frictional contact where gouging or binding may be a factor, or where corrosion would interfere with normal functioning.

(c) In confined spaces, in the presence of organic materials which give off corrosive and damaging vapors.

(d) On exterior exposed fasteners that are not to receive a subsequent paint or sealer coat.

5.3.2 Vacuum deposited cadmium. Parts which cannot be thoroughly cleaned to insure removal of the plating solution shall be vacuum coated with cadmium in accordance with MIL-C-8837. Vacuum deposited cadmium shall be used for high hardness (Rockwell C-40 or above) subject to the deleterious effects of hydrogen embrittlement.

5.3.3 Chromium plating. Chromium plating shall be used for surfaces subject to wear, abrasion or erosion, except when other surface hardening processes are used such as nitriding and carburizing, or where other wear and abrasion resistant coatings are specified. Chromium plating shall be in accordance with QQ-C-320.

5.3.4 Black chromium plating. Black chromium plating shall be used where nonreflective, abrasion- or corrosion-resistant surfaces are required. Black chromium plating shall be in accordance with MIL-C-14538.

5.3.5 Porous chromium plate. Porous chromium plate is another form of engineering chromium. The process produces etched channels or pores in the surface of the plating to retain miniature pools of lubricating oil. Porous chromium plate shall be in accordance with MIL-C-20218.

5.3.6 Gray nickel-carbon plate. Gray nickel-carbon plate is a durable, protective camouflage finish used on aluminum, copper alloys and steel such as rotary dials and knobs for improved durability under frictional contact. Gray nickel-carbon plate shall be in accordance with MIL-N-55392.

5.3.7 Nickel plating. Nickel plating shall be used for the following applications:

(a) Where temperatures do not exceed 1000°F and other coatings would not be suitable.

(b) To minimize the effects of dissimilar metal contacts, such as mild steel with unplated corrosion-resisting steel or stainless steel in contact with other stainless steel.

(c) As an undercoat for other functional coatings.

(d) As a protective finish on metals without further supplementary treatment.

Nickel plating of parts and surfaces shall be in accordance with QQ-N-290.

5.3.8 Black nickel plating. Black nickel plating shall be in accordance with MIL-P-18317.

5.3.9 Electroless nickel coating. Where specified, electroless nickel coating shall be in accordance with MIL-C-26074. Type II shall be specified where the combination of high hardness and corrosion resistance are required.

5.3.10 Tin, tin alloy plating (coating). Tin, tin alloy coatings shall be used where the properties of these materials present distinct advantages in comparison with other platings.

5.3.10.1 Tin plating (coating). A plating of tin is preferred in lieu of cadmium for use on parts that are subsequently soldered. Where tin plating is specified, it shall be applied in accordance with MIL-T-10727. Caution: Tin plating per type I, MIL-T-10727, shall not be used where electrical or electronic currents are involved, unless the plating is reflowed.

5.3.10.2 Hot-dip tin, tin alloy coatings. Hot-dip or flowed coating are preferred where tin-lead (solder) or tin coating is required. Hot-dip tin shall be in accordance with type II, MIL-T-10727. Hot-dip or flow soldering (tin-lead) shall be in accordance with MIL-S-46844(MI). Tin-lead plating may be applied per MIL-P-81728.

5.3.11 Tin-cadmium plating. Tin-cadmium plating shall be in accordance with MIL-P-23408. This plating has an advantage over cadmium plating of being more corrosion-resistant.

5.3.12 Silver plating. Silver plating shall be in accordance with QQ-S-365.

5.3.13 Gold plating. Gold plating shall be in accordance with MIL-G-45204 and shall be used only where its electrical and corrosion-resistant characteristics are required. Gold plating shall not be used on surface areas to be soldered. If a part requires gold plating for plug-in connections, corrosion resistance, or other electrical reasons, the gold shall be removed from these surfaces to be soldered. Further precautions on gold plating for electrical use are outlined in MIL-STD-1250 and shall be observed.

5.3.14 Rhodium plating. Rhodium plating shall be in accordance with MIL-R-46085.

5.3.15 Palladium plating. Palladium plating shall be in accordance with MIL-P-45209.

5.3.16 Copper plating. Copper plating shall be in accordance with MIL-C-14550.

5.3.17 Selective engineering plating (brush). Selective plating shall be in accordance with MIL-STD-865 or the most recent state-of-the-art approved methods.

5.4 Nonmetallic coatings. Codes for nonmetallic coatings are enumerated in table II.

5.4.1 Phosphate treatments. Phosphate treatments for ferrous parts, which are subsequently to be painted, shall conform to type I of TT-C-490.

5.4.2 Black oxide treatment. Black oxide treatments, conforming to MIL-C-13924 (for ferrous metals) and MIL-F-495 (for copper alloys) are primarily used for decorative purposes, to decrease light reflectance

and on moving parts that cannot tolerate the dimensional build-up of more corrosion-resistant finishes. When black oxide is applied to exterior surfaces, it shall be overcoated with clear lacquer or varnish, with paint or dry-film lubricant. When used on interior surfaces it shall be treated at least with a supplementary oil or wax coating.

5.4.3 Hard anodic coatings for aluminum and its alloys. Where hard anodic coatings are specified, they shall conform to type III of MIL-A-8625.

5.4.4 Metallo-ceramic and ceramic coatings. Metallo-ceramic and ceramic coatings shall not be used prior to approval by the procuring activity. Necessary process and quality control requirements shall be established, and technical data developed which shall be submitted to the procuring activity substantiating that the proposed coatings are entirely satisfactory for the intended use.

5.5 Organic coatings. Codes for organic coatings are enumerated in table IV.

5.5.1 General priming and painting of surfaces. Interior and exterior surfaces of the weapon system shall be painted with the materials specified herein. The painting sequence for all metals shall be preparatory treatment (i.e., anodized, chemical conversion coating, plating, or wash primer), primer, and top coats. These requirements may have been specified previously in the surface treatment paragraphs on the metal surfaces. The use of wash primer on high hardness Rc 40 steels is prohibited. High hardness Rockwell C 40 steels should be cleaned, primed, and top coated. Exterior surfaces of tactical equipment shall have a lusterless forest green finish that meets the color, gloss, and spectral reflectance characteristics of MIL-E-52798. Codes 445 and 447 provide callouts for the forest green color in an air dry and bake type paint formulation. The forest green color can be molded-in, provided the surfaces meet the color, gloss, and spectral reflectance requirement of MIL-E-52798.

5.5.2 Equipment and facilities.

5.5.2.1 General. The equipment and facilities used in applying surface finishes shall be suitable and adequate for the purpose and shall be subject to approval of the procuring activity. All safety precautions contained in Standard NFPA Nos. 30, 33, and 34 shall be observed. Painting shall be conducted in properly ventilated spray rooms or areas. Paint spray rooms shall be ventilated by means of a forced draft, effecting at least three complete changes of air every hour. Doors and windows shall be kept closed to exclude dirt and dust. The air shall be introduced into the room in such manner as not to cause turbulence or excessive air currents which would have the effect of causing orange peel in the paint film. Sufficient ventilation shall, however, be maintained to keep dried overspray from settling on surfaces which have already been painted and are still tacky. Where practicable, water-washed exhaust systems or grilled flooring over flowing water should be used. Humidity and temperature indicators shall be installed in a proper operation. Controls shall be employed for humidity and temperature or for temperature alone if a satisfactory ratio of temperature and humidity can be maintained, as defined herein. To insure that dirt and dust are kept to a minimum, all air entering spray booths or rooms shall be filtered; spray areas are to be kept clean; lint-bearing rags shall not be allowed in such areas; a positive air pressure shall be maintained in the spray booth or room. Lighting conditions shall be in accordance with the 1968 Illuminating Engineering Society Handbook. Lights in the floor, as well as coatings of high light reflectance, shall be used where required to increase lighting efficiency. The paint spray room floors shall be cleaned as frequently as required to insure good housekeeping.

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5.5.2.2 Spray equipment. Spray guns and accessories shall conform to MIL-S-15847. All lines shall be kept free from condensation of oil and water by filtering the lines as necessary. It is essential that good housekeeping be practiced. Paint lines shall be cleaned with the same solvent used for thining the particular paint, at the end of each working day and before changing color or type of paint. Traps shall be included in all air lines used with spray painting equipment in order to entrap any condensed moisture, oil, or foreign materials. Paint pressure pots shall be thoroughly cleaned at least once each week.

5.5.2.3 Personnel safety requirements. All requisite safety precautions shall be taken by painters, under supervision of the Safety Engineer and Industrial Health Officers, with regard to toxicity or industrial healt hazards in accordance with existing instructions and regulations. Adequate paint spray respirators, nonsparking shoes, and other safety devices, shall be made available for and used by painters.

5.5.2.4 Electrical grounding. All safety precautions contained in Standard NFPA No. 33 regarding storage of finishing materials and thinners, fire prevention, nonsparking floors and equipment, vapor and explosiion-proof requirements, are hereby applicable. The above should not be construed as covering all the requirements, but are illustrative of general safety requirements.

5.5.2.5 Infrared lamps. In the use of infrared lamps, the size of the lamps and their number and spacing shall be such as to effect a distribution of heat as evenly as possible over the painted surface. Adequate precautions shall be taken to avoid concentration of flammable vapors in the immediate area of the infrared lamps and the parts being painted. In addition, wire mesh screen with suitable opening approximately 2 inches wide shall be rigidly fixed about 3 or 4 inches above the lamps to prevent their breakage by falling objects. The individual lamps shall be tightened at frequent intervals to prevent arcing in the sockets.

5.5.3 Preparation of surface.

5.5.3.1 Cleaning, general. All metal surfaces shall be thoroughly clean and dry at the time of application of any paint-type coating. Meticulous cleaning prior to all painting operations cannot be over-emphasized since this factor is of prime importance in obtaining a satisfactory paint finish. Reclaimed paint thinner or other reclaimed thinners shall not be used for cleaning purposes, since these materials may leave a grease film which will cause poor adhesion of the next coat. All abrasive or foreign particles and rough edges shall be removed after sanding or cutting operations before application of paint-type materials. Cleaning shall be accomplished with solvents, detergents, and processes which have no deleterious effect on the surface and which produce surfaces satisfactory for receiving subsequent finishes. After general cleaning to remove the major contaminants, such as paints, oil, soil, grease, etc., the following procedures have been employed successfully. Immediately prior to painting, to obtain a surface capable of supporting an unbroken film of water:

(a) Swab on O-C-1889 solvent, disbursed from plunger-type safety cans, using clean cloths complying with the requirements of 5.5.4.14.2. Do not dip the cloths in the container of solvent, as this would contaminate the bulk of the solvent and result in transfer of the contaminant to the surface being prepared for painting.

(b) Next, check the surface with red litmus paper, moistened with distilled water, which should not turn blue. If the litmus paper turns blue, it will be necessary to treat the surface in accordance with the procedure specified in 5.5.3.2.1.

(c) Finally, check the surface for absence of waterbreak, employing the test procedure described in 5.5.3.2.3.

5.5.3.2 Tests for surface condition before painting. The following tests shall be conducted before actual painting:

5.5.3.2.1 Reaction of surface. The surface shall have a neutral or slightly acid reaction. Moistened red litmus paper when applied to the surface shall not turn blue, otherwise a 0.20 to 0.25 percent chromic acid solution shall be applied to achieve a neutral or slightly acid surface. The chromic acid solution shall be permitted to remain on the surface for 2 to 5 minutes followed by a water rinse, and the surface then wiped dry with clean, lint-free cloths meeting the requirements of 5.5.4.14.2.

5.5.3.2.2 Waterbreak test. Representative areas of the surface to be painted shall be tested by the procedure described in 5.5.3.2.3 for ability to support an unbroken film of distilled water.

5.5.3.2.3 Waterbreak test procedures. A mist of distilled water shall be atomized (employing any convenient atomizing device) upon a representative surface of the item to be painted. If the water gathers into discrete droplets within 25 seconds, the surface will be considered to have shown a "water break" and it shall be presumed to be contaminated with impurities such as free alkali, residual detergents, etc., and the surface shall be considered to have failed the test. The surface shall have passed the waterbreak test when the water droplets do not flash-out suddenly, but coalesce into a continuous film of water.

5.5.3.2.4 Special precautions. Solvent cleaning of the surface is a requirement if there is a break in the painting sequence of overnight or longer. A final hand wipe-down shall be performed immediately before painting to insure scrupulous cleanliness and a proper paintable surface. After cleaning, particularly after stripping operations or steam cleaning, special precautions shall be taken to assure thorough draining of all liquids from between faying surfaces, crevices, inspection doors and pockets. Preferably, this shall be accomplished by permitting the part to stand for a sufficient time to permit such drainage, after which the affected area shall be recleaned as necessary. It will be found advantageous to seal crevices, joints, seams, etc. with a plastic composition which will resist the action of paint stripper and cleaners and which subsequently can be easily removed.

5.5.4 Application of paint-type materials.

5.5.4.1 General. Unless otherwise specified herein or in the detail process specifications, paint-type protective coatings may be applied by spraying, brushing, tumbling, roller coating, flow coating, or any other approved method which will insure the application of a smooth, continuous film that is free of imperfections, such as dried overspray, runs, sags, blisters, or orange peel. The use of dipping is subject to such hazards to the quality of the finish that the use of dip coating is strongly discouraged. If, however, dipping of primer is employed, the precautions stated in the applicable specification shall be observed. PRIOR TO SPRAYING OF PAINT, THE SAFETY PRECAUTIONS WITH REGARD TO GROUNDING, AS PRESCRIBED BY 5.5.2.4 SHALL BE STRICTLY ENFORCED.

5.5.4.2 Production spray test panels. Prior to the spraying operation, the suitability of materials for the entire system shall be determined experimentally on panels approximately 4-by-7 inches in size of the same materials to be used for the finished item. The panel shall be coated under prevailing conditions with the finish system that is to be applied. If the finish system applied to the experimental panel is satisfactory, then full-scale operations may begin. Defects found in the experimental application, such as blushing, incorrect thickness, excessive orange peel, sagging, shall be corrected prior to large scale application.

5.5.4.3 Air and weather conditions. Coatings shall not be applied under unfavorable atmospheric conditions, such as high humidity, strong drafts, or low temperatures. In the event the following conditions cannot be met, painting operations shall be suspended until acceptable conditions are re-established. Data for thinning materials for spray application at other than standard room temperature and humidity conditions shall be as specified in the applicable process specifications, or shall be determined experimentally by the applicator. The application of lacquers under other than normal conditions shall be performed in accordance with MIL-F-18264.

5.5.4.3.1 Enamel. For enamel topcoats, epoxy primer, wash primer, and epoxy topcoats, air temperatures shall not be less than 15.5 degrees C (60 degrees F) nor greater than 37.7 degrees C (100 degrees F) and the relative humidity shall not be greater than 90 percent.

5.5.4.3.2 Lacquer. Air temperatures shall not be less than 15.5 degrees C (60 degrees F) nor greater than 32.2 degrees C (90 degrees F) and the relative humidity shall not be greater than 85 percent except in the case where lacquer is used with blush-retardant thinner, then 90 percent is permissible, per paragraph 5.5.4.3.

5.5.4.4 Time of application of paint-type materials.

5.5.4.4.1 First coat. Surfaces shall receive a coat of wash primer, or where other preparatory treatment has been provided previously, the first primer coat shall be applied within a 2-hour maximum period after final cleaning.

5.5.4.4.2 System. Surface coatings shall be applied as follows: Preparatory coating plus primer plus first enamel or lacquer coat shall be applied on the exterior surfaces within 24 hours. Where production operations are suspended for short periods; e.g., over week-ends, holidays, etc., this time may be extended as necessary, but not to exceed 72 hours, provided the adhesion is unaffected thereby, as determined by the wet tape scratch adhesion inspection test described in 6.3.4. OUTDOOR STORAGE OF PRIMED PARTS BEFORE SUBSEQUENT FINISHING OPERATIONS IS PROHIBITED.

5.5.4.4.3 Dry time (wash primer). The wash primer coat shall be allowed to dry a minimum of 60 minutes (although it may dry to handle within a few minutes), but not more than 4 hours prior to application of the paint system. The primer may impair the adhesion of the paint system if prematurely applied. The wash primer shall be capable of resisting removal with the fingernail prior to application of the topcoats.

5.5.4.4.4 Drying time (primer). When specification TT-P-1757 zinc chromate primer; MIL-P-52192 epoxy primer, or MIL-P-23377 epoxy polyamide primer is used, the minimum and maximum drying times shall be those prescribed by the specifications MIL-P-6808, MIL-P-46856, or MIL-C-22751 respectively. The minimum drying time for lacquer-type primer, under ideal atmospheric conditions shall be at least one hour. Under other conditions, the drying time of the lacquer-type primer shall be extended as necessary to avoid lifting, embrittlement, and adhesion difficulties induced by the high solvency thinners in the topcoats. The precautions outlined in specification MIL-P-6808 to avoid degradation of the primer prior to topcoating, as a result of outdoor exposure, especially in sunlight, shall be scrupulously observed.

5.5.4.4.5 Lacquer topcoating. Lacquer topcoating shall be accomplished in accordance with the requirements of MIL-F-18264.

5.5.4.5 Spraying over bare metal. Wash primer shall be applied in accordance with MIL-C-8507. Zinc chromate primer shall be applied over the wash primer in accordance with MIL-P-6808. Epoxy primer shall be applied in accordance with MIL-P-46856. Epoxy-polyamide primer shall be applied in accordance with MIL-C-22751.

5.5.4.6 Thickness of finish (dry thickness). The film thickness of each single dried coat of paint-type material shall be controlled within the following limits: 0.0003 to 0.0005 inch for wash primer, 0.0006 inch for one coat of zinc chromate primer, 0.0005 to 0.0008 inch for one coat of lacquer, and 0.0008 to 0.0012 inch for one mist plus one wet coat of enamel or varnish, or as specified in the applicable finishing specification. The thickness of two coats of zinc chromate primer shall not exceed 0.0007 inch on surfaces which are to be topcoated. Because of the greatly reduced corrosion-inhibiting effectiveness and coverage in dried film thickness of less than 0.0003 inch, solitary zinc chromate primer films below this thickness should be avoided. The general finish shall be maintained below the maximum thickness specified to avoid cracking, flaking, and checking of the paint finish. Where sanding surfacers is used, which is permitted only on limited areas and subject to the restrictions contained in 5.5.4.11, the thickness of the finish may be increased in these areas by 0.0006 inch. Where insignia and markings are added by painting, the total thickness of finish on these areas may be increased by approximately 0.001 inch. Where decalcomanias are used, the additional thickness is controlled by the decalcomania specification.

5.5.4.7 Application of enamel. A thin coat or "tack" of enamel shall be applied with a light pass of the gun and, while it is still tacky, followed with one full wet coat. No mist coat shall be used after application of the wet enamel coat.

streaks, blisters, seeds, excessive silking, or other irregularities of surface. Dry scuff sanding by hand, using No. 400 or No. 320 sandpaper should be employed, as necessary, to remove specks of roughness that might carry through to the topcoats, but extreme care should be exercised to avoid removing the primer down to the pretreatment coating. Great caution is necessary to avoid gouging the surface of rivets and other protuberances and edges of faying surfaces with the sandpaper, and thus remove the primer to bare metal, which results in subsequent susceptiblity to corrosion. Should this be, normal touch-up with primer should be accomplished. Areas where primer presents a distinctly rough appearance not removable by sanding should be stripped and new primer applied to the area involved. If bubbling of the wash primer and subsequent coatings are encountered on magnesium, it may be taken as evidence of inadequate surface treatment of the magnesium. Such bubbled coatings should be removed immediately and the surface given a manually applied chemical surface treatment, followed by wash primer.

5.5.4.14.5 Final dry of the finish. The parts, after painting, shall be permitted to dry in a dust-free atmosphere for a sufficient time prior to moving to insure that the paint is adequately dry and to avoid damage of the finish. Painted parts shall also be protected from condensing moisture and rain during the first 24 hours after painting. This time may vary somewhat depending on the temperature and type of paint used.

5.5.4.15 Application of camouflage paint. It is essential that MIL-E-52798 forest green paint be applied at a minimum dry film thickness of 1.80 mils to achieve color uniformity and optimum camouflage characteristics. Because of the higher degree of transparency of this paint in both the visual and infrared regions of the spectrum, an application of 0.8-1.0 mils dry, which is the normal application for an olive drab paint, would allow both the visual and infrared light to partially penetrate the surface and reflect the substrate or base coating. This would cause both nonuniformity in visual color and poor camouflage properties. Due to the extreme flatness of the paint, the color will vary to a degree, depending upon the texture and type of substrate, plus the orientation of the film and the direction by which the light hits the film. Acceptance of an end item shall not be based specifically on color. It shall be based on whether the paint was approved by the USA Mobility Equipment Research and Development Command, ATTN: DRXFB-VO, Fort Belvoir, VA 22060, and whether application techniques are correct. As specified above, the paint must be applied at least 1.8 mils dry film thickness. A dust coat should be applied first before the two 1-mil dry films are applied. Allow a 15-minute dry time before the second application for solvent flash-off. A single application of 1.8 mils minimum is permissible, provided the paint film is free of imperfections such as runs, sags, or orange peel.

Since this paint is extremely flat and is softer than other alkyd type paints, it will tend to mar and scratch to a slight degree when handled. As long as the marring and scratching is a small percentage of the paint film and it does not break through to the substrate, the piece of equipment shall not be rejected. This slight marring and scratching will not affect the camouflage properties when observed by photographic means. Before any painting is performed, proper cleaning, pretreatment, and priming shall be adhered to to assure that optimum adhesion is achieved. This specification was primarily developed to be applied by the troops in the field. The recommended solvent to thin the paint for spray application is Mineral Spirits. This solvent is recommended with the specification, but it may be necessary to modify this when painting takes place within a contractor's plant. In a controlled atmosphere, the addition of Mineral Spirits may cause the paint to dry too slowly. This could cause running the paint and thus blotchiness. If the addition of Mineral Spirits causes problems, it is recommended that the solvent system for thinning be changed to xylene or a combination of xylene and V.M. & P. naptha. Not only would this probably solve the drying deficiency, it would also solve the running and blotching problems. The faster dry would produce a more uniform color. Adhesion would also be better.

6. INSPECTION

6.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in this standard where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

6.2 General inspection requirements. All equipment being processed shall be inspected at the various stages of cleaning, surface treating, electroplating, and application of other types of finishes and coatings, to ascertain that each process is done in strict accordance with this standard and individual specifications. The inspections and tests covered in this section shall not be considered restrictive. Any condition not in full accord with the applicable drawings and specification shall be regarded as defective.

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6.2.1 Tests. Materials, prior to their use, shall be inspected, sampled, and tested in accordance with the applicable specification and standard to determine compliance with the requirements of the particular specification. When purchasing camouflage paint, e.g. MIL-E-52798 or MIL-E-52835, production samples from the first lot of each color of the subject paint and a sample from each lot of paint manufactured shall be submitted to the USA Mobility Equipment Research and Development Command, ATTN: DRXFB-VO, Fort Belvoir, VA 22060, for testing. Samples of surfaces with molded-in forest green color shall also be sent to the above laboratory. The submission of these samples is for validation of the paint or surfaces for spectral and gloss characteristics. With this information, the inspector will have the means, along with the painting procedures, to accept or fail an end product.

6.3 Applications inspection.

6.3.1 General. Inspectors shall conduct frequent and regular checks to assure compliance with the requirements of this standard. The items specifically detailed below shall receive the most scrupulous attention by inspectors and quality control personnel.

6.3.2 Cleanliness. Inspectors shall conduct tests just prior to application of paint-type coatings to assure that the surface is thoroughly clean and free from contaminants. The water break test described in 5.5.3.2 and the litmus paper test described in 5.5.3.2.1 shall be applied to questionable surfaces to assure that adequate cleaning and rinsing procedures have been employed and to check for freedom from residual steam-cleaning compound and other cleaning materials residues. If representative test areas fail these tests, the parts shall be returned to the cleaning process and recleaning accomplished.

6.3.3 Hiding power, gloss, and smoothness. Inspectors shall conduct regular and frequent inspection tests to insure smoothness of finish system. Regardless of whether the finish is high gloss or low gloss, specks and bumps detected visually or by drawing the fingertips across the snaded or rubbed finish in various directions shall be removed. There shall be no seediness or roughness caused by dried overspray, improper thinning, or improper gun adjustment. The painted surfaces (when dry) shall be checked visually for hiding power and gloss by comparision with an approved sample.

6.3.4 Adhesion. Inspectors shall conduct regular and frequent wet tape adhesion tests on the exterior finish after drying for a period of at least 48 hours for a lacquer system and 72 hours for an enamel system, the test to be conducted on a sufficient number of samples to assure maintenance of a satisfactory level of adhesion on full production. In performing this test, it is suggested that a piece of cloth or plastic be taped on the area under inspection. The test area shall be kept soaked 24 hours minimum with tap or distilled water. The test areas shall have a minimum diameter of 3 inches. Remove the wet cloth and blot up the surface water. Immediately thereafter, apply a 1-inch strip of tape, UU-T-106 (only newly manufactured tape shall be used), adhesive down. Press the tape down, using two passes of a 2-1/2 pound rubber covered roller or emply firm pressure with the thumb. In general, the tape shall not be applied over rivets, skin laps, holes, slots, or screw heads. Repeated application of the tape on one area is not necessary. Remove the tape in one abrupt motion and examine the tested area for any paint damage, such as removal of paint at one of the layers of the finish system or removal of the entire system from the metal. Test panels shall be sprayed with the complete finish, along with production items, and scratch wet tape adhesion tests per method 6301.1 of FED-STD Test Method 141 conducted on these panels after a 24-hour soaking period in distilled water, the test to be conducted immediately after removal from the water. Suitable adjustments shall be made in the materials and processes, based on the results of these tests.

6.3.5 Film thickness. Contractors, inspectors, and painters shall exercise constant diligence to maintain careful control of the thickness of paint finish during the production process to insure continual adherence to the established thickness limits as specified in 5.5.4.6. Inspectors shall conduct regular and frequent paint thickness measurements on the production parts with a suitable measuring device on a sufficient number of selected areas to assure maintenance of the overall thickness measurement of the paint film shall be taken after all scuffing and sanding operations are completed on the paint coat being measured. When the painter has the gun adjusted and is ready to start spray painting, he shall first spray paint test panels as prescribed in 5.5.4.2. The thickness of the paint should then be measured on the panels with a micrometer or an Ames thickness gauge or equivalent, allowing 0.0001 to 0.0002 inch for further contraction in thickness to be expected during the drying of the paint. If the film thickness exceeds the allowable maximum, as specified above, necessary adjustments shall be made of the spray gun, paint viscosity, etc., and the trial spraying repeated until proper thickness is obtained. Then the painters may proceed with painting. The approved sprayed test panels may also be utilized for verifying the process for quality control and qualifying the individual painters.

6.3.6 Sampling frequency. Sampling for the inspection tests of Section 6 shall be accomplished: (a) when a new supplier furnishes materials used in the product process, (b) when evidence occurs of deterioration in the quality of the finish, (c) when a change of process or sequence is affected, and (d) a minimum of one inspection a week for those weeks when painting facilities are used. The quality control tests of 6.3.2, 6.3.3, 6.3.4 and 6.3.5 of this standard shall be conducted at least once a week in the production painting of parts, as a mininum requirement. The results of the inspection tests shall be reviewed by the Government inspector for conformance with established quality criteria.

6.3.7 Laundering of shop cloths. When laundered shop cloths are employed, inspectors shall conduct regular and frequent inspection tests at the laundry, or after return of the laundered cloths, or both; and spot-tests of the cloths just prior to actual usage in the shop, in sufficient numbers to assure compliance with the provisions of 5.5.4.14.2 herein.

6.3.8 Inspection and acceptance of camouflage painting. The following are inspections that must take place before acceptance can be made on the end item:

(a) The acceptance of the color of the paints shall not be based upon a color match to a standard color chip. Total acceptance of this paint shall be based only upon whether the individual lot of subject paint was approved by the USA Mobility Equipment Research and Development Command, ATTN: DRXFB-VO, Fort Belvoir, VA 22060.

(b) Clean and treatment requirements shall comply to this standard.

(c) The camouflage paint shall be applied at a total dry film thickness of no less than 1.80 mils.

(d) Proper solvent selections and application techniques shall be adhered to.

(e) The dry color shall be uniform for each individual part, but not necessarily from part to part.

(f) There shall be no running of the paint.

(g) The end product shall not be blotchy.

(h) Upon application, the paint shall not be applied in a dry spray. The paint shall be allowed to flow when applied to the substrate. A dry spray would produce a chalky effect which would allow the paint to be removed just by light rubbing.

(i) Isolated marring and scratching from handling shall be allowed as long as the substrate is not exposed. This slight marring and scratching will not affect the camouflage properties when observed by either visual or photograph means.

Patent 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, otherwise as in any other manner licensing the holder or any other person or comporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may be in any way related thereto.

Custodian:
Army - MI

Review:
Army - ME, MR, WC

Preparing Activity:
Army - MI

Project No. MFFP-A114

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TABLE I - CLEANING METHOD

Code No.	Method
101	Cleaning, mechanical or abrasive, per TT-C-490, Method I.
102	Solvent cleaning per TT-C-490, Method II.
103	Hot Alkaline cleaning per TT-C-490, Method III.
104	Emulsion cleaning per TT-C-490, Method IV.
105	Phosphoric acid corrosion removing and metal conditioning treatment, MIL-M-10578, for ferrous and non-ferrous metals, slight etch, type shall be delineated on the drawing immediately following the code 105.
106	Alkaline cleaner for ferrous and non-ferrous alloys, boiling vat or steam cleaning, per P-C-436, nonetch to aluminum.
107	Immersion cleaning, per MIL-C-14460, Type I (for steel).
108	Electrolytic cleaning, per MIL-C-14460, Type II (for steel).
109	Sand lightly with number 400 grit paper.
110	Abrade lightly with aluminum wool; immerse for 3 minutes minimum in a solution of equal parts of nitric acid (specific gravity 1.42) and water. Follow with a water rinse and dry.
111	Magnesium cleaning, MIL-M-3171.
112	Prepare surfaces for bonding using procedures of MIL-A-9067.

Note: The above methods listed shall be specified only when applicable and when the detail finishing specification does not contain a cleaning requirement.

TABLE II - SURFACE TREATMENTS

Code No.	Treatment
201	Anodize, aluminum, chromic acid, type I, Class 1, per MIL-A-8625.
202	Anodize, aluminum, sulfuric acid, type II, class 1, per MIL-A-8625.
203	Anodize, aluminum, sulfuric acid, type II, class 2, per MIL-A-8625. Applicable colors shall be designated on the drawing immediately following the code number by delineating the color and chip code number (i.e., black, 27038; red, 31336) per FED-STD-595.
204	Use Code 203.
205	Use Code 203.
206	Use Code 203.
207	Anodize, hard coat, type III, class 1, per MIL-A-8625.
208	Chromate conversion coat per MIL-C-5541, class 1A.
209	Anodic coating, magnesium, per MIL-M-45202. Type, class, and grade shall be delineated on the drawing immediately following the code number (i.e., code 209, type I, class A, grade 2, etc.).
210	Phosphate coating per TT-C-490, type I (zinc).
211	Phosphate coating per TT-C-490, Type II.
212	Use Code 401.
213	Black oxide for copper alloys per MIL-F-495.
214	Black oxide for ferrous metals including stainless steels, per MIL-C-13924. Class shall be delineated on the drawing immediately following the code 214 (i.e., code 214, class 2).
215	Zincate treatment, ASTM B253, preplate for aluminum.

TABLE III, CONTINUED

CODE NO.

380 Nickel-carbon plate, porous, per MIL-N-55392, gray (similar to color 36440 per FED-STD-595) over nickel, over initial undercoat of copper, for aluminum copper alloys, and steel.

TABLE IV - ORGANIC COATINGS

NOTE: Application and inspection shall meet requirements of section 5.5 and section 6 of this standard. This note applies to all finish codes 401 thru 497.

Code No.

401 Apply wash primer per MIL-P-15328, 0.3 to 0.5 mil dry film thickness.

402 Apply zinc chromate primer, TT-P-1757, one coat, 0.3 to 0.4 mil dry film thickness.

403 Apply zinc chromate primer, TT-P-1757, two coats, 0.6 to 0.8 mil dry film thickness.

404 Apply air-drying epoxy primer per MIL-P-52192, dry film thickness of 0.8-1.2 mil.

405 Apply two coats of air-drying primer per MIL-P-52192, dry film thickness of 1.6-2.4 mils.

406 Apply lacquer primer, MIL-P-11414, one coat (0.6 to 0.8 mil dry film thickness, for use with thermoplastics).

407 Apply one coat of air-drying epoxy primer MIL-P-23377, 0.8-1.2 mils.

408 Apply two coats of air-drying epoxy primer MIL-P-23377, 1.6-2.4 mils.

409 Apply lusterless MIL-E-46096, Type I, Composition L, solar heat reflecting top coat, one coat, 0.9-1.1 mils, olive drab color number 34087 per FED-STD-595.

410 Apply one coat of solar heat reflecting undercoat MIL-C-46127 (dry film thickness of 0.9-1.1 mils).

411 Apply lusterless MIL-E-46117 solar heat reflecting top coat, one coat, 0.8-1.2 mils.

412 Apply semigloss MIL-E-46136, type I, solar heat reflecting top coat, one coat, 0.9-1.1 mils, olive drab, color number 24087 per FED-STD-595.

413 Apply semigloss MIL-E-46136, type II, solar heat reflecting top coat, one coat, 0.9-1.1 mils, olive drab, color number 24087 per FED-STD-595.

Code No.

414	Apply semigloss MIL-E-46136, type III, solar heat reflecting topcoat, one coat, 0.9-1.1 mils, olive drab, color number 24087 per FED-STD-595.
415	Apply lusterless enamel TT-E-527, one coat (0.8-1.2 mils), color olive drab 34087 per FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following the code 415.
416-419	Reserved for future use.
420	Apply lusterless enamel TT-E-527, two coats (1.6-2.4 mils), color olive drab 34087 per FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following the code 420.
421-424	Reserved for future use.
425	Apply semigloss enamel TT-E-529, one coat (0.8-1.2 mils), color olive drab 24087 per FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following the code 425.
426-436	Reserve for future use.
437	Apply semigloss enamel TT-E-529, two coats (1.6-2.4 mils), color olive drab 24087 per FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following the code 437.
438	Apply polyurethane aliphatic, weather resistant camouflage coating per MIL-C-81773, one coat (1.0 to 1.2 mils), color and code number per FED-STD-595 shall be delineated on the drawing immediately following the enamel code 438.
439	Apply polyurethane, aliphatic, weather resistant camouflage coating per MIL-C-81773, two coats (1.6 to 2.4 mils). Color and code number per FED-STD-595 shall be delineated on the drawing immediately following the enamel code 439.
440	Apply polyurethane, aliphatic weather resistant, semigloss coating per MIL-C-81773, one coat, 1.0 to 1.2 mils. Color and code number per FED-STD-595 shall be delineated on the drawing immediately following the enamel code 440.

Code No.

441 Apply polyurethane, aliphatic, weather resistant semigloss coating per MIL-C-81773, two coats, 1.6 to 2.4 mils. Color and code number per MIL-STD-595 shall be delineated on the drawing immediately following the enamel code 441.

442 Apply polyurethane, aliphatic weather resistant gloss coating per MIL-C-81773, one coat (1.0 to 1.2 mils) color and code number per MIL-STD-595 shall be delineated on the drawing immediately following the enamel code 442.

443 Apply polyurethane, aliphatic weather resistant gloss coating per MIL-C-81773, two coats (1.6 to 2.4 mils). Color and code number per MIL-STD-595 shall be delineated on the drawing immediately following the enamel code 443.

444 Use Code 445

445 Apply lusterless camouflage enamel MIL-E-52798, two coats, 1.8-2.4 mils, color forest green. Color other than forest green shall be delineated on the drawing immediately following the code.

446 Use Code 447

447 Apply lusterless camouflage enamel MIL-E-52835 (Bake Composition), two coats, 1.8-2.4 mils, color forest green.

448 Reserved for future use.

449 Apply semigloss enamel MIL-E-52227, one coat (0.8-1.2 mils) color olive drab 24087 per FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following the code 449.

450-460 Reserved for future use.

461 Apply semigloss enamel, MIL-E-52227, two coats (1.6-2.4 mils), color olive drab 24087 per FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following the code 461.