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INCH-POUND

MIL-STD-186F (MI)
20 February 2002
SUPERSEDING
MIL-STD-186E (MI)
30 September 1991

DEPARTMENT OF DEFENSE STANDARD

MANUFACTURING PROCESS

PROTECTIVE FINISHING FOR ARMY MISSILE WEAPON SYSTEMS

AMSC N/A AREA MFFP

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FOREWORD

1. This military standard is approved for use by the U.S. Army Aviation and Missile Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-RD-SE-TD, Redstone Arsenal, AL 35898-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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CONTENTS

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CONTENTS

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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 rests with the activity responsible for the end item. The materials treatment and finishes will be selected from those listed herein and will 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. Where the finish or corrosion protection processes are not adequately defined, the problem will 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
Lubrication & Preservation	700 Numbers
Miscellaneous	800 Numbers

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2. APPLICABLE DOCUMENTS

2.1 General

2.2 Government Documents

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

A-A-208	-	Ink, Marking, Stencil, Opaque (Porous and Non-Porous Surfaces)
A-A-883	-	Tape, Pressure-Sensitive Adhesive, Masking
A-A-1452	-	Lacquer (Spraying, Chemical Resistant)
A-A-52408	-	Preservative Coating, Rubber: for Rubber Surfaces
A-A-53475	-	Platinum Foil (1 Pennyweight)
A-A-53884	-	Gold Alloy, Casting, Dental
A-A-56032	-	Ink, Marking, Epoxy Base
A-A-59146	-	Cleaning Compound, Alkali, Boiling Vat (Soak) or Hydrostream
A-A-59166	-	Coating Compound, Nonslip (for Walkways)
A-A-59260	-	Corrosion Removing Compound, Sodium Hydroxide Base; for Electrolytic Immersion Application
A-A-59282	-	Chemicals, Analytic; General Specification for
A-A-59293	-	Sealing Compound, Adhesive; Curing (Polysulfide Base)
A-A-59298	-	Tape, Pressure Sensitive Adhesive
A-A-59342	-	Ethyl Alcohol (for Ordinance Use)
QQ-B-639	-	Brass, Naval: Flat Products (Plate, Bar, Sheet and Strip)
QQ-B-654	-	Brazing Alloys, Silver
QQ-C-40	-	Calking: Lead Wool and Lead Pig

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QQ-L-171	-	Lead Pig
QQ-L-201	-	Lead Sheet
QQ-N-281	-	Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections
QQ-N-286	-	Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)
Q-P-416	-	Plating, Cadmium (Electrodeposited)
QQ-S-698	-	Steel Sheet and Strip, Low Carbon
QQ-T-201	-	Terneplate, for Roofing and Products
TT-C-490	-	Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
TT-P-1757	-	Primer Coating, Zinc Chromate, Low Moisture Sensitivity
TT-W-572	-	Wood Preservative: Water-Repellant
CCC-D-950	-	Dyeing and Aftertreating Processes for Cotton Cloths
MMM-A-121	-	Adhesive, Bonding Vulcanized Synthetic Rubber to Steel

DEPARTMENT OF DEFENSE

MIL-PRF-680	-	Degreasing Solvent
MIL-PRF-3150	-	Lubricating Oil, Preservative, Medium
MIL-C-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL- PRF-8116	-	Putty, General Purpose, Non-hardening
MIL-C-8514	-	Coating Compound, Metal Pretreatment, Resin-Acid
MIL-I-8574	-	Inhibitors, Corrosion, Volatile, Utilization of
MIL-A-8625	-	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-G-10924	-	Grease, Automotive and Artillery
MIL-P-11414	-	Primer Coating; Lacquer, Rust Inhibiting
MIL-DTL-13924	-	Coating, Oxide, Black, for Ferrous Metals
MIL-DTL-14538	-	Chromium Plating, Black (Electrodeposited)
DOD-P-15328	-	Primer (Wash), Pretreatment (Formula No. 117 for Metals)
MIL-B-15382	-	Bolt, Firebrick Anchor
MIL-PRF-16173	-	Corrosion Preventive Compound, Solvent Cutback, Cold-Application
MIL-DTL-16232	-	Phosphate Coatings, Heavy, Manganese or Zinc Base

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MIL-I-16923	-	Insulating Compound, Electrical, Embedding
MIL-I-17563	-	Impregnants for Aluminum, Copper, Iron, Magnesium and Zinc Alloy Castings
MIL-P-18317	-	Plating, Black Nickel (Electrodeposited) on Brass, Bronze or Steel
MIL-C-20218	-	Chromium Plating, Electrodeposited, Porous
MIL-I-22110	-	Inhibitors, Corrosion, Volatile, Crystalline Powder
MIL-S-22473	-	Sealing, Locking and Retaining Compounds: (Single-Component)
MIL-PRF-22750	-	Coating, Epoxy, High-Solids
MIL-PRF-23377	-	Primer Coating; Epoxy, High-Solids
MIL-L-23398	-	Lubricant, Solid Film, Air-Cured, Corrosion Inhibiting, NATO Code Number S-749
MIL-PRF-23586	-	Sealing Compound (with Accelerator), Silicon Rubber, Electrical
MIL-M-24041	-	Molding and Potting Compound, Chemically Cured, Polyurethane
MIL-PRF-24635		Enamel, Silicone Alkyd Copolymer
MIL-C-24707	-	Castings, Ferrous, General Specification for
MIL-C-24723	-	Castings, Nickel-Copper Alloy
MIL-C-26074	-	Coatings, Electroless Nickel, Requirements for
MIL-P-46002	-	Preservative Oil, Contact and Volatile Corrosion-Inhibited
MIL-L-46010	-	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-A-46146	-	Adhesives-Sealants, Silicone, RTV, Noncorrosive (for Use with Sensitive Metals and Equipment)
MIL-C-46168	-	Coating, Aliphatic Polyurethane, Chemical Agent Resistant
MIL-P-53022	-	Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free
MIL-P-53030	-	Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free
MIL-C-53039	-	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
MIL-C-53072	-	Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspections

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MIL-DTL-64159	-	Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant
MIL-C-81309	-	Corrosion Preventive Compounds, Water Displacing, Ultra-Thin Film
MIL-PRF-81733	-	Sealing and Coating Compound, Corrosion Inhibitive
MIL-T-81772	-	Thinner, Aircraft Coating
MIL-DTL-83488	-	Coating, Aluminum, High Purity
MIL-C-85054	-	Corrosion Preventative Compound, Water Displacing, Clear (AMLGARD)
MIL-PRF-85285	-	Coating; Polyurethane, High-Solids
MIL-PRF-85582	-	Primer Coatings; Epoxy, Waterborne

STANDARDS

FEDERAL

FED-STD-141	-	Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing
FED-STD-595	-	Colors Used in Government Procurement

DEPARTMENT OF DEFENSE

MIL-STD-276	-	Impregnation of Porous Nonferrous Metal Castings

HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-454	-	General Guidelines for Electronic Equipment
MIL-HDBK-691	-	Adhesive Bonding
MIL-HDBK-1250	-	Corrosion Prevention and Deterioration Control in Electronic Components and Assemblies
MIL-HDBK-1587	-	Material and Processes Requirements for Air Force Weapon Systems

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Ave., Bldg. 4D, Philadelphia, PA 19111-5094.)

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2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATION

ARMY

MIS 28744	-	Chromate Conversion Coating on Copper, Brass or Bronze

(Application for copies of MIS 28744 should be addressed to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5000.)

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A27	-	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36	-	Standard Specification for Structural Steel
ASTM A48	-	Standard Specification for Gray Iron Castings
ASTM A153	-	Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Standard Specification for
ASTM A108	-	Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A204	-	Standard Specification for Pressure Vessel Plates, Alloy Steel, Molybdenum
		Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
ASTM A228	-	Standard Specification for Steel Wire, Music Spring Quality
ASTM A240	-	Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels

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ASTM A302	-	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A313	-	Standard Specification for Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire
ASTM A361	-	Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding
ASTM A494	-	Standard Specifications for Castings, Nickel and Nickel Alloy
ASTM A515	-	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516	-	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A527	-	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM A575	-	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A576	-	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A580	-	Standard Specification for Stainless and Heat-Resisting Steel Wire
ASTM A584	-	Standard Specification for Aluminum-Coated Steel Woven Wire Fence Fabric
ASTM A585	-	Standard Specification for Aluminum-Coated Steel Barbed Wire
ASTM A586	-	Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand and Zinc-Coated Wire for Spun-In-Place Structural Strand
ASTM A587	-	Standard Specification for Electrical-Resistance-Welded Low Carbon Steel Pipe for the Chemical Industry
ASTM A623	-	Standard Specification for Tin Mill Products, General Requirements
ASTM A624	-	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Single Reduced

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ASTM A630	-	Standard Test Methods for Determination of Tin Coating Weights for Electrolytic Tin Plate
ASTM A653	-	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized)) or Zinc-Iron Alloy-Coated (Galvannealed)) by the Hot-Dip Process
ASTM A663	-	Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
ASTM A666	-	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A675	-	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A681	-	Standard Specification for Tool Steels Alloy
ASTM A693	-	Standard Specification for Precipitation-Hardening Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A793	-	Rolled Floor Plate, Stainless Steel, Specification for
ASTM A829	-	Standard Specification for Plates, Alloy Steel, Structural Quality
ASTM A929		Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B16	-	Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
ASTM B19	-	Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks (Blanks)
ASTM B21	-	Standard Specification for Naval Brass Rod, Bar, and Shapes
ASTM B26	-	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B30	-	Standard Specification for Copper Alloys in Ingot Form
ASTM B36	-	Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B69	-	Standard Specification for Rolled Zinc
ASTM B80	-	Standard Specification for Magnesium-Alloy Sand Castings

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ASTM B85	-	Standard Specification for Aluminum-Alloy Die Castings
ASTM B86	-	Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry Die Castings
ASTM B91	-	Standard Specification for Magnesium-Alloy Forgings
ASTM B94	-	Standard Specification for Magnesium-Alloy Die Castings
ASTM B98	-	Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes
ASTM B99	-	Standard Specification for Copper-Silicon Alloy Wire for General Applications
ASTM B105	-	Standard Specification for Hard-Drawn Copper Alloy Wires for Electrical Conductors
ASTM B107	-	Standard Specification for Magnesium-Alloy Extruded Bars, Rods, Shapes, Tubes, and Wire
ASTM B108	-	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B117	-	Standard Method of Salt Spray (Fog) Testing
ASTM B122	-	Standard Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B124	-	Standard Specification for Copper and Copper Alloy Forging Rod, Bar and Shapes
ASTM B138	-	Standard Specification for Manganese Bronze Rod, Bar and Shapes
ASTM B139	-	Standard Specification for Phosphor Bronze Rod, Bar and Shapes
ASTM B151	-	Standard Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar
ASTM B168	-	Standard Specification for Nickel Chromium-Iron Alloys (UNS N06600 and N06690) Plate, Sheet, and Strip
ASTM B176	-	Copper-Alloy Die Castings, Specification for
ASTM B179	-	Standard Specification for Aluminum-Alloys in Ingot and Molten Forms for Castings from All Casting Processes
ASTM B196	-	Standard Specification for Copper-Beryllium Alloy Rod and Bar
ASTM B197	-	Standard Specification for Copper Beryllium

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		Alloy Wire
ASTM B199	-	Standard Specification for Magnesium-Alloy Permanent Mold Castings
ASTM B206	-	Standard Specification for Copper-Nickel-Zinc (Nickel Silver) Wire and Copper-Nickel Alloy Wire
ASTM B244	-	Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B253	-	Preparation of Aluminum Alloys for Electroplating, Standard Guide for
ASTM B271	-	Standard Specification for Copper-Base Alloy Centrifugal Castings
ASTM B298	-	Standard Specification for Silver-Coated Soft Annealed Copper Wire
ASTM B339	-	Standard Specification for Pig Tin
ASTM B369	-	Standard Specification for Copper-Nickel Alloy Castings
ASTM B488	-	Standard Specification for Electrodeposited Coating for Gold for Engineering Uses
ASTM B499	-	Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metal
ASTM B545	-	Standard Specification for Electrodeposited Coatings for Tin
ASTM B584	-	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B616	-	Standard Specification for Refined Rhodium
ASTM B633	-	Electrodeposited Coatings of Zinc on Iron and Steel, Standard Specification for
ASTM B634	-	Standard Specification for Electrodeposited Coatings of Rhodium for Engineering Use
ASTM B644	-	Standard Specification for Copper Alloy Addition Agents
ASTM B661	-	Standard Practice for Heat Treatment of Magnesium Alloy
ASTM B679	-	Standard Specification for Electrodeposited Coatings of Palladium for Engineering Use
ASTM B700	-	Standard Specification for Electrodeposited Coatings of Silver for Engineering Use
ASTM B763	-	Standard Specification for Copper Alloy

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		Sand Castings for Valve Application
ASTM B850	-	Standard Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement
ASTM D295	-	Standard Test Methods for Varnished Cotton Fabrics Used for Electrical Insulation
ASTM D770 Alcohol.	-	Standard Specification for Isopropyl
ASTM D1732	-	Standard Practices for Preparation of Magnesium Alloy Surfaces for Painting
ASTM D3955	-	Standard Specification for Electrical Insulating Varnishes

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Dr, West Conshohocken, PA 19428-2959.)

AMERICAN WOOD-PRESERVERS ASSOCIATION (AWPA)

AWPA-P3	-	Standards for Solvents and Formulations for Organic Preservative Systems, Pentachlorophenol Types A, B and C

(Application for copies of publication should be addressed to American Wood-Preservers Association, P.O. Box 286, Woodstock, ND 21163-0286)

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA J-STD-001	-	Requirements of Soldered Electrical and Electronic Assemblies

(Application for copies should be addressed to the Electronic Industries Alliance, 2500 Wilson Boulevard, Arlington, VA 22201-3834)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA No. 30	-	Automotive and Marine Service Station Code
NFPA No. 33	-	Standard for Spray Application Using Flammable and Combustible Materials
NFPA No. 34	-	Standard for Dipping and Coating Processes Using Flammable or Combustible Materials

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(Application for copies should be addressed to the National Fire Protection Association, One Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS-2418	-	Plating, Copper
SAE AMS-2422	-	Plating, Gold
SAE AMS-2434	-	Plating, Tin-Zinc Alloy
SAE AMS-2770	-	Heat Treatment of Wrought Aluminum Alloy Parts
SAE AMS-2771	-	Heat Treatment of Aluminum Alloy Castings
SAE AMS-2772	-	Heat Treatment of Aluminum Alloy Raw Materials
SAE AMS-4290	-	Aluminum Alloy, Die Castings 9.5Si -0.5Mg (360.0-F) As Cast (UNS A03600)
SAE AMS-4291	-	Aluminum Alloy, Die Castings 8.5Si -3.5Cu (A380.0-F) As Cast (UNS A13800)
SAE AMS-4375	-	Sheet and Plate, Magnesium Alloy 3.0A1-1.0Zn - 0.20Mn (AZ31b-0) Annealed and Recrystallized (UNS M11311)
SAE AMS-4376	-	Plate, Magnesium Alloy 3.0Al-1.0Zn-0.20Mn (AZ31B-H26) Cold Rolled and Partially Annealed
SAE AMS 4377	-	Sheet and Plate, Magnesium Alloy 3.0A1 - 1.0Zn - 0.20Mn (AZ31B - h24) Cold Rolled, Partially Annealed
SAE AMS-4842	-	Casting, Leaded Bronze, Sand and Centrifugal 80Cu-10Sn-9.5Pb as Cast (UNS C93700)
SAE AMS-4860	-	Manganese Bronze, Sand and Centrifugal Castings 58Cu-39Zn-1.2Fe-1.0Al-0.8Mn as Cast (UNS C86500)
SAE AMS 5365	-	Steel Castings, Sand, Corrosion and Heat Resistant 24.5 Cr - 20 Ni Solution Heat-Treated
SAE AMS 5366	-	Steel Castings, Investment, Corrosion Resistant 25 Cr - 20 Ni (CK 20) as Cast
SAE AMS-5560	-	Steel, Corrosion Resistant, Seamless

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		Tubing 19Cr-10Ni (SAE 30304) Solution Heat Treated UNS S 30400
SAE AMS-5563	-	Steel, Corrosion Resistant, Seamless or Welded Tubing, 19Cr-9.5Ni (SAE 30304) Cold Drawn, Quarter-Hard Temper (UNS S 30400)
SAE AMS-5564	-	Steel, Corrosion Resistant, Tubing 19Cr-10Ni (SAE 30304) High-Pressure Hydraulic, Welded Plus Ultrasonically Tested or Seamless Cold Drawn, One-Eighth-Hard Temper UNS S 30400
SAE AMS-5565	-	Steel, Corrosion Resistant, Welded Tubing 19Cr-9.5Ni (SAE 30304) Solution Heat Treated (UNS S 30400)
SAE AMS-5566	-	Steel, Corrosion Resistant, Seamless or Welded Hydraulic Tubing 19Cr-10Ni (SAE 30304) High Pressure, Cold Drawn (UNS S 30400)
SAE AMS-5567	-	Steel, Corrosion Resistant, Seamless or Welded Tubing 19Cr-10Ni (SAE 30304) Hydraulic, Annealed (UNS S 30400)
SAE AMS-5569	-	Steel, Corrosion and Heat Resistant, Seamless and Welded Hydraulic Tubing 19Cr-9.5Ni-0.03C Max Cold Drawn, One-Eighth-Hard Temper (UNS S 30403)
SAE AMS-5570	-	Steel, Corrosion and Heat Resistant, Seamless Tubing 18Cr-11Ni-0.4Ti (SAE 30321) Solution Heat Treated (UNS S 32100)
SAE AMS-5571	-	Steel, Corrosion and Heat Resistant, Seamless Tubing 18Cr-10.5Ni-0.7Cb (SAE 30347) Solution Heat Treated (UNS S 34700)
SAE AMS-5639	-	Steel, Corrosion Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr-10Ni Solution Heat Treated (UNS S 30400)
SAE AMS-A-8576	-	Adhesive, Acrylic Base, for Acrylic Plastic FSC 8040
SAE AMS-A-25463	-	Adhesive, Film Form, Metallic

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		Structural Sandwich Construction FSC 8040
SAE AMS-C-8837	-	Coating, Cadmium (Vacuum Deposited) AREA MFFP
SAE AMS-C-81562	-	Coatings, Cadmium, Tin-Cadmium
SAE AMS-M-3171	-	Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on
SAE AMS-P-81728	-	Plating, Tin-Lead (Electodeposited)
SAE AMS-QQ-S-763-		Steel Bars, Wire, Shapes, and Forgings; Corrosion Resistant
SAE AMS-QQ-A-200/1	-	Aluminum Alloy 3003, Bar, Rod, Shapes, Tube, and Wire, Extruded UNS A93003
SAE AMS-QQ-A-200/2	-	Aluminum Alloy 2014, Bar, Rod, Shapes, Tube, and Wire, Extruded UNS A92014
SAE AMS-QQ-A-200/3	-	Aluminum Alloy 2024, Bar, Rod, Shapes, Tube, and Wire, Extruded UNS A92024
SAE AMS-QQ-A-200/8	-	Aluminum Alloy 6061 Bar, Rod, Shapes, Tube, and Wire, Extruded UNS A96061
SAE AMS-QQ-A-200/11	-	Aluminum Alloy 7075, Bar, Rod, Shapes, Tube, and Wire, Extruded UNS A97075
SAE AMS-QQ-A-225/1	-	Aluminum Alloy, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 1100 UNS A91100
SAE AMS-QQ-A-225/2	-	Aluminum Alloy, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 3003 UNS A93003
SAE AMS-QQ-A-225/3	-	Aluminum Alloy, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 2011 UNS A92011
SAE AMS-QQ-A-225/4	-	Aluminum Alloy, 2014, Bar, Rod, and Wire, and Special Shapes, Rolled, Drawn, or Cold Finished, UNS A92014
SAE AMS-QQ-A-225/5	-	Aluminum Alloy, 2017, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, UNS A92017
SAE AMS-QQ-A-225/6	-	Aluminum Alloy, 2024, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, UNS A92024

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SAE AMS-QQ-A-225/7	-	Aluminum Alloy, 5052, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, UNS A95052
SAE AMS-QQ-A-225/8	-	Aluminum Alloy, 6061, Bar, Rod, and Wire, and Special Shapes, Rolled, Drawn, or Cold Finished, UNS A96061
SAE AMS-QQ-A-225/9	-	Aluminum Alloy, 7075, Bar, Rod, and Wire, and Special Shapes, Rolled, Drawn, or Cold Finished, UNS A97075
SAE AMS-QQ-A-250/1	-	Aluminum 1100, Plate and Sheet UNS A91100
SAE AMS-QQ-A-250/2	-	Aluminum Alloy 3003, Plate and Sheet UNS A93003
SAE AMS-QQ-A-250/3	-	Aluminum Alloy Alclad 2014, Plate and Sheet UNS A82014
SAE AMS-QQ-A-250/4	-	Aluminum Alloy 2024, Plate and Sheet UNS A92024
SAE AMS-QQ-A-250/5	-	Aluminum Alloy Alclad 2024, Plate and Sheet UNS A82024
SAE AMS-QQ-A-250/8	-	Aluminum Alloy 5052, Plate and Sheet UNS A95052
SAE AMS-QQ-A-250/11	-	Aluminum Alloy 6061, Plate and Sheet UNS A96061
SAE AMS-QQ-A-250/12	-	Aluminum Alloy 7075, Plate and Sheet UNS A97075
SAE AMS-QQ-A-250/13	-	Aluminum Alloy Alclad 7075, Plate and Sheet UNS A87075
SAE AMS-QQ-A-250/15	-	Aluminum Alloy Alclad 7178, Plate and Sheet UNS A87178
SAE-AMS-QQ-N-290		Nickel Plating (Electrodeposited)
SAE-AMS QQ-C-320	-	Chromium Plating
SAE AMS-S-4383	-	Sealing Compound, Topcoat, Fuel Tank, Buna-N Type FSC 8030
SAE AMS-S-8802	-	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion and Zinc (Mechanically Deposited)
SAE AMS-S-13165	-	Shot Peening of Metal Parts
SAE AMS-T-8506	-	Tubing, Steel, Corrosion-Resistant, (304), Annealed, Seamless and Welded
SAE ARP 1	-	Surface Preparation and Priming of Aluminum Alloy Parts for High

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SAE J 452	-	Durability Structural Adhesive Bonding Phosphoric Acid Anodizing General Information – Chemical Compositions, Mechanical and Physical Properties of SAE Aluminum Casting Alloys

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI J-STD-004	-	Requirements for Soldering Fluxes
ANSI J-STD-005	-	Requirements for Soldering Pastes
ANSI J-STD-006	-	Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications

(Application for copies of ANSI specifications should be addressed to the American National Standards Institute, 1819 L Street, NW, Washington, DC 20036)

AMERICAN WELDING SOCIETY (AWS)

AWS C3.4	-	Specification for Torch Brazing
AWS C3.5	-	Specification for Induction Brazing
AWS C3.6	-	Specification for Furnace Brazing
AWS C3.7	-	Specification for Aluminum Brazing

(Application for copies of AWS specifications should be addressed to the American Welding Society, 550 N.W. LeJuene Road, Miami, FL 33126.)

ILLUMINATING ENGINEERING SOCIETY of NORTH AMERICA (IESNA)

IES Handbook, 1987 Edition

(Application for copies should be addressed to the Illuminating Engineering Society of North America, 120 Wall St., 17th Floor, New York, NY 10005-4001.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents may also be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes

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precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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 will 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 is also defined as sealed to the extent that there is no moisture-laden air or water introduced into the sealed unit or component where subjected to a 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 -53.9° and 68.3° Celsius (C) during each 24 hour period.

(b) Leak testing either at a vacuum of 5 pounds force per square inch (lbf/in^2) or at an external pressure of 20 lbf/in^2 for not less than 2 hours. Units of measurement for leaks will be atmospheric cubic centimeters per second (Atm cc/sec), allowable limit for leaks will 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 IX and X as classification of similar bare metals which must be given prime consideration for design purposes and will, insofar as possible, be used where different metals and plating are in close proximity.

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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 activity. Numerous finish codes are contained in tables I through VIII that are not specifically referenced in this section but which are considered satisfactory for use.

4.4 Finishing requirements. Unless otherwise specified, all fabrication operations, such as cutting, drilling, punching, forming, grinding, holing, 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, or 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 non-uniform 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 occurred, 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 practical 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

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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. Organic soil shall be removed using a cleaning procedure appropriate for the contaminants and parts to be finished. Cleaning procedures include but are not limited to: pressure washing, immersion, hand wipe, ultrasonic, and vapor degreasing. Cleaning materials must meet appropriate OSHA and EPA standards.

4.7.1 Recommended cleaning materials. Cleaning materials are chosen on the basis of the effectiveness of contaminant removal, inertness to substrate material, and environmental compatibility. Vapor degreasing materials include but are not limited to: Hydrofluoroethers and Hydrofluorocarbon (HFC's). Hand wipe and immersion cleaners include but are not limited to: Acetone, Isopropyl alcohol, volatile methylsiloxanes (VMS), mineral spirits, Naptha and MIL-PRF-680. Pressure washing cleaners include aqueous and non-aqueous materials. The EPA SNAP list should be consulted for a list of environmentally acceptable cleaning materials.

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 IX & 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 as specified in table V.

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) Design Prohibitions:

1. Crevices susceptible to moisture collection.
2. Unsealed fasteners and joints.
3. Galvanic metal couples with over 100-mv potential difference.

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4. Printed circuit assemblies without conformal coatings.
5. Moisture tight designs without proper seals.
6. Unprotected bearings.
7. Untested adhesively bonded designs. (stress and humidity tests)
8. Metallic construction if nonmetallic is acceptable.
9. Hardware requiring field maintenance for corrosion control.
10. Inadequate consideration for acid fumes in battery locations.
11. Star washers, except as specified in 4.15.
12. Upset metal staking as a method of retention, except on power train and running gear.
13. Phenolic resins in enclosed assemblies without post-baking treatment.
14. Unsealed joints, except ground or lapped joints affecting accuracy of alignment.
15. Cut, unpainted, or unplated edges on metallic materials.
16. Snap rings or lock washers, except in main power train or running gear.

(b) Materials Prohibitions:

1. Aluminum alloys 2024-T3 or T4. (Use T8 or 5000/6000 series). Use of 2000 or 7000 series aluminum alloys with proper tempers in accordance with SAE AMS-H-2770, SAE AMS-H-2771 and SAE AMS-H-2772 are acceptable. MIL-HDBK-1587 may be used as guidance.
2. Aluminum alloys 7001-T6, 7278-T6 and 7075-T6. (Use T73 temper or 7050-T73).
3. Magnesium alloy, except as specified in 4.12.
4. Precipitation hardening stainless steels in the H900, H950, or H1000 tempers. (Use H1025 or higher temper).
5. Lubricants and greases that contain graphite.
6. PVC plastics and electrical insulation.
7. Corrosive type RTV adhesives/sealants (Emit acetic acid during cure).
8. Rubber that is susceptible to ozone damage.
9. The use of silver plated copper wire that has less than 40 microinches of silver and fails deterioration control tests per ASTM B298.
10. Chromate conversion coating on aluminum that fails 168 hours salt spray exposure per ASTM B117.
11. Cadmium or zinc plating without supplementary treatment. (see paragraph 4.16)
12. Gold plated electrical contacts without nickel undercoating.
13. Silver plated electrical contacts.
14. Potting and foam materials that are reversion prone.
15. Bare corrodible metal surfaces.

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16. Materials not inherently moisture and fungus resistant.
17. Nickel plated aluminum construction.
18. Polyimide insulated copper and copper alloy wire.
19. Class 1 ozone depleting chemicals (ODCs).
20. Chemical conversion treatments producing a chromate coating on aluminum, except as specified in 5.2.1 and 5.2.1.3.
21. Leather as a seal or packing material, except in contact with chromium.
22. Vinyl wire insulation, shielding, and sleeving (see paragraph 4.20).
23. Acid-core solder or corrosive flux.
24. Stainless steel wool in cleaning aluminum that will not be anodized.

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 practical. 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 practical.

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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 distribution 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 practical. Interior surfaces of large open steel tubes may be protected by application of wash primer code 401 and painted in accordance with code 402.

4.14 Rivets and threaded fasteners. Rivets and threaded fasteners in general shall be assembled with wet primer. If the fasteners are dissimilar to and can result in a direct contact with magnesium, a washer of 5056 aluminum alloy, with an overlap of not less than 0.125 inch shall be used in addition to assembling with wet primer.

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

4.16 Cadmium plating. Cadmium plating must be avoided when an alternative process can be used. Cadmium plating shall be restricted to essential applications only. Use zinc plating, tin plating, aluminum coating, zinc nickel, tin zinc, or other proven alternatives 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 lbf/in^2 (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. MIL-HDBK-1250 or MIL-HDBK-454 may be used as guidance in determining materials considered fungi-inert. 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.

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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 conjunction 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. Aniline base inks contain corrosive acids and shall not be used. (See code 805 for an alternate printing ink and marking method.)

4.23 Drainage. Attention shall be directed toward 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.

4.24 Standard parts/Government standard parts (bolts, nuts, screws, washers, etc). Standard parts (MS, AN, NAS, DS, etc.) that are procured with protective finish already applied as specified by the procurement document relating to the manufacture of the part, shall be inspected prior to assembly to determine if the part conforms to the finish requirement of the procurement document. In the event that the part does not meet the finish requirement of the procurement document, it shall be refinished and reinspected. Lots of Government standard parts shall be subjected to sampling in accordance with a plan acceptable to the contracting activity, and samples shall be subjected to the salt spray test of ASTM B 117.

4.25 Application to previously painted surfaces. When touching up damaged areas or applying a chemical agent resistant coating (CARC) topcoat to an existing CARC topcoat, the procedure to be followed shall be based on the provisions of MIL-C-53072 and depends upon the type and condition of the existing finish. (In using the provisions of MIL-C-53072, the user must obey all EPA, OSHA, and other regulations and restrictions regarding the use of solvents.) Items previously coated with alkyds, lacquers or vinyl must be stripped down to the epoxy primer if present, or to the substrate if not. For rework, polyurethane and epoxy topcoats can only be applied over for previously painted epoxy or polyurethane topcoats.

4.25.1 Surface preparation. Scratches or other light damage to polyurethane or epoxy topcoats will require scuff sanding at the immediate blemish area. Damage or corrosion extending to the substrate will require sanding and repriming. All traces

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of corrosion must be abraded from the substrate. The surface immediately surrounding exposed substrate should then be sanded, using a feathering-in technique. That is, sand away paint film (primer and topcoat) so that the thickness of the film is smoothly tapered from bare metal/substrate to the top of the paint film. Sanding of any type is followed by wiping down the exposed area to be painted using a clean rag wet with MIL-T-81772 thinner to remove all loose sanding debris, mill scale, grease, oil (including fingerprints), and diesel/gasoline residue. Do not use other petroleum or alcohol-based thinners or cleaning agents of any kind. All areas sanded down to bare metal shall be treated (sponged or damp wiped) with the appropriate solution of Appendix I or wash pretreatment on steel, or wash pretreatment or MIL-C-5541 on aluminum, allowed to react for 15 minutes. The minimum area allowed for touch-up shall be agreed upon for each contract between the Government and the applicator.

4.25.2 Finishing procedures.

4.25.2.1 Epoxy primer. Choose the appropriate primer and prepare in accordance with manufacturer directions. Apply evenly in one coat over the pretreated substrate and apply over portions of the exposed original primer coat using blend-in technique; i.e., tapering off quantity applied to a thin edge. Do not apply epoxy primer beyond the blend-in edge.

4.25.2.2 Application methods. Rework (application of CARC topcoats to sound existing topcoat) shall use the conventional techniques of spraying or brushing. For touchup, suggested procedures include brushing (see appropriate application section of primer and topcoat descriptions) or sponging/wiping (suggested for small areas requiring wash primer). Spray application by conventional techniques can be difficult, but a small, self-pressurized spray kit is available for touchup.

4.25.2.3 Film thickness. The total thickness of previous coatings shall be checked prior to reworking. Limitations on maximum film thickness to be topcoated shall be determined by an adhesion test on the existing coating. It is recommended that a total of 20 mils not be exceeded. For aircraft, the coating thickness (existing plus rework) shall not exceed 8 mils. The film thickness shall be not greater than 9 mils on a porous, cast item. If thicker prior coatings are experienced, adhesion failure and coating fissuring may result. Cracking (fissuring) of the topcoat due to too thick a film can be subtle and difficult to find (magnification is often necessary) but is cause for rejection due to chemical agent permeability.

4.25.3 Safety. For general health and safety guidance, see MIL-C-53072, Appendix B.

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5. DETAILED REQUIREMENTS

5.1 Cleaning requirements.

5.1.1 General.

5.1.1.1 Corrosion and heat resisting metals. Corrosion and heat resisting metals and alloys shall be cleaned by suitable chemical or mechanical processes, or combinations thereof, except materials that are sensitive to deleterious constituents such as hydrogen, oxygen, nitrogen, and chemical reactions such as hydrogen embrittlement, oxidation, or hardening. These materials shall be cleaned by mechanical processes only.

5.1.1.2 Flux removal. Soldering, welding, and brazing fluxes shall be completely removed. Washing with hot water, alcohol (ethyl alcohol in accordance with A-A-59282 or A-A-59342, or isopropyl alcohol in accordance with ASTM D770) shall be used. Methyl or wood alcohol (methanol) shall not be used unless approved by the procuring activity.

5.1.1.3 Rinsing. Where materials are employed that show an acid or alkaline reaction, the cleaned parts shall be given a thorough water rinse to remove all acid or alkali prior to further treatment. It is advisable as a final rinsing operation to use distilled or deionized water in order to ensure the complete removal of possible contaminants (see 5.5.3).

5.1.2 Aluminum and its alloys.

Aluminum and its alloys shall be either chemically or mechanically cleaned. The use of uninhibited alkaline materials, such as sodium hydroxide solutions, and of abrasives containing iron, steel wool, copper wool, iron oxide rouge, and steel wire which may become embedded and accelerate corrosion of aluminum alloys is prohibited. Materials conforming to A-A-59146 shall be used for chemical cleaning. Sheet stock surfaces to receive anodic conversion coating treatment, sand castings, forging and heat treated stock shall be deoxidized (all oxide film removed with a suitable etchant) after cleaning. Other materials or methods may be used after data proving freedom from damage due to etching, pitting, and stress-corrosion cracking has been submitted to the procuring activity for approval.

5.1.3 High-hardness steels.

Steels of Rockwell hardness C40 or over, including carburized and steel surfaces hardened by using other methods, shall be either sand, abrasive grit, steel shot, grit or glass bead blasted for rust or scale removal. Acid pickling or other hydrogen producing processes shall not be used.

5.1.4 Low-hardness steels.

Steels of Rockwell hardness less than C40 shall be cleaned in accordance with TT-C-490 or acid pickling as specified in table I.

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5.1.5 Magnesium and its alloys. Magnesium and its alloys shall be cleaned in accordance with SAE AMS-M-3171.

5.1.6 Titanium and its alloys. For titanium and titanium alloys, vapor degreasing shall not be used, unless approved by the procuring activity. When permitted, the titanium parts shall be pickled after vapor degreasing. Where vapor degreasing is not permitted, a mild alkaline cleaner conforming to A-A-59146 shall be used for soil removal from titanium and its alloys. For removal of contamination other than organic soil, titanium and its alloys shall be mechanically cleaned. Other cleaning methods shall not be used, unless approved by the procuring activity.

5.1.7 Copper, brass, cadmium, tin. Cleaning shall be accomplished by the applicable method of table I, or as specified.

5.1.8 Wood. Wood surfaces shall be sanded or otherwise mechanically prepared to provide a clean, smooth surface free of waxes, oils, or greases.

5.2 Surface treatments. Codes for surface treatments are enumerated in table II.

5.2.1 Aluminum and aluminum alloys. All aluminum and aluminum alloys, including clad aluminum alloy surfaces, shall be anodized to produce coatings conforming to MIL-A-8625, either type I, type II, or type III. When paint finishing systems are to be applied, chemical films in accordance with MIL-C-5541 or washer primer DOD-P-15328 may be substituted for anodic coatings.

5.2.1.1 Electrically conductive surfaces. Anodic coatings shall be omitted from surfaces which require high electrical conductivity at relatively high impedance and high frequencies (RF). These areas can be coated with MIL-C-5541 chemical film.

5.2.1.2 Surface treatment of assemblies. Surface treatment shall be applied to assemblies and detail parts prior to assembly, except where surface treatment will interfere with the joining processes such as brazing or welding. The assemblies or parts shall not contain cavities or crevices where the process solutions can be retained.

5.2.1.3 Touch-up. All surfaces which have the anodic coating or paint system removed or damaged shall be touched up with chemical film conforming to Class 1A of MIL-C-5541 by grade B application (brush or swab) with the coating being confined strictly to the damaged area. This operation is required for drilled, punched, or countersunk holes unless other corrosion prevention methods are being used with procuring activity approval.

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5.2.2 Magnesium alloys.

5.2.2.1 Method. All magnesium alloys shall receive an anodic coating in accordance with ASTM-D1732, Class II, Types II or III. Anodic coating applied in accordance with ASTM-D1732 shall be used for parts subject to abrasion, erosion, or wear. Note: SAE AMS-M-3171 treatments shall only be used for temporary protection or as a paint base.

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 SAE AMS-M-3171. Damaged or touched-up magnesium surfaces, previously anodically coated in accordance with ASTM-D-1732, 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 190.5°C 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 DOD-P-15328. Epoxy primer may be applied directly on steel that has been grit blasted to white metal.

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 (48.8° to 54.4°C) 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, or nitrided surfaces shall not be passivated. Monel, Inconel, Hastelloys, and titanium surfaces do not normally require further treatment after cleaning. Surfaces to be painted shall be coated with wash primer DOD-P-15328.

5.2.5 Cadmium. Cleaned surfaces shall be kept free of finger marks, dirt, and dust or other contaminants and 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 DOD-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. The surfaces shall be protected from all contamination prior to the paint application.

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5.2.7 Tin. Tin surfaces shall receive a supplementary treatment of organic coating, varnish ASTM-D-3955 or ASTM-D-295, conformal coating, or a paint system to prevent corrosion. Tin surfaces shall be coated with wash primer DOD-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.

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. When applying metallic coatings the following shall be considered:

a. Stress-relief heat treat prior to cleaning and plating.

b. Hydrogen embrittlement relief bake after plating per ASTM B 850.

c. Environmentally assisted cracking susceptibility of high strength alloys.

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, or in the presence or organic materials which give off corrosive and damaging vapors

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(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 SAE AMS-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 SAE-AMS-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-DTL-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 Nickel plating. Nickel plating shall be used for the following applications:

(a) Where temperatures do not exceed 537.8°C 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 SAE-AMS-QQ-N-290.

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

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5.3.8 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.

5.3.9 Tin and/or alloy plating (coating). Tin and/or alloy coatings shall be used where the properties of these materials present distinct advantages in comparison with other platings.

5.3.9.1 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 ASTM B545 and/or ASTM B339. Caution: Tin plating per ASTM B 545, shall not be used where electrical or electronic currents are involved, unless the plating is reflowed.

5.3.9.2 Hot-dip, tin, tin alloy coatings. Hot-dip or flowed coatings are preferred where tin-lead (solder) or tin coating is required. Hot-dip tin shall be in accordance with ASTM B339. Hot-dip or flow soldering (tin-lead) shall be in accordance with EIA J-STD-001. Tin-lead plating may be applied per SAE AMS-P-81728.

5.3.10 Tin-cadmium plating. This plating has an advantage over cadmium plating by being more corrosion-resistant.

5.3.11 Silver plating. Silver plating shall be in accordance with ASTM B700.

5.3.12 Gold plating. Gold plating shall be in accordance with ASTM B488 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. MIL-HDBK-1250 may be used as guidance to determine further precautions on gold plating for electrical use. Gold plating of less than 50 microinches (Class 1) is considered to provide inadequate functional characteristics. Class 1 thickness is considered inadequate without a suitable underplate of nickel.

5.3.13 Rhodium plating. Rhodium plating shall be in accordance with ASTM B634.

5.3.14 Palladium plating. Palladium plating shall be in accordance with ASTM B679.

5.3.15 Copper plating. Copper plating shall be in accordance with SAE AMS-2418.

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5.3.16 Selective engineering plating (brush). Selective plating shall be in accordance with 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 shall subsequently be painted, shall conform to type I of TT-C-490.

5.4.2 Black oxide treatment. Black oxide treatments, conforming to MIL-DTL-13924 for ferrous metals and best industry methods 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, as a minimum, 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, wash primer, phosphate coating and grit blast), primer, and topcoats. These requirements may have been specified previously in the surface treatment paragraphs on the metal surfaces. The use of wash primer on high hardness Rockwell C40 steels is prohibited. Rockwell C40 steel should be cleaned, primed, and top coated. Exterior surfaces of tactical equipment shall have a camouflage finish that meets the color, gloss, chemical agent resistance, and spectral reflective characteristics of MIL-C-46168. Code 448 provides a callout for the green 383 color with these properties. The green 383 color can be molded-in, provided the surfaces meet the color, gloss, chemical agent resistance, and spectral reflectance requirements of MIL-C-46168.

5.5.2 Equipment and facilities.

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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 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 a 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 practical, 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 shall 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 1987 Illuminating Engineering Society of North America 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.

5.5.2.2 Spray equipment. 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 thinning the particular paint or an approved alternative, at the end of each working day and before changing color or type of paint. (Cleaners should adhere to all EPA, OSHA, and other regulations and restrictions regarding the use of solvents.) 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 health 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 NFPA No. 33 regarding storage of finishing materials and thinners, fire prevention, nonsparking floors and equipment, vapor and explosion-proof requirements, are hereby applicable. The above should not be construed as covering all the requirements, but are illustrative of general safety requirements.

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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 openings 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 surfaces.

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.

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. If the paper turns blue, apply a 0.20 to 0.25 percent chromic acid solution 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 5.5.4.13.2. Litmus test is not required on chromated surfaces.

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. Chromated surfaces are exempt from this test unless the chromate finish is older than 72 hours or suspected of having been contaminated by shop processing. Recleaning or rechromating in such cases is required to meet the waterbreak requirement.

5.5.3.2.3 Waterbreak test procedures. A mist of distilled water shall be atomized (using any convenient atomizing device) upon a representative surface of the item to be painted. If the water gathers into discrete droplets within 25 seconds,

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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, etc., shall be corrected prior to large scale application. This check is a one-time requirement at the start of a production painting contract.

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

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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 best industry practices.

5.5.4.3.1 Enamel. For enamel topcoats, polyurethane paint, epoxy primer, wash primer, and epoxy topcoats, air temperatures shall be not less than 15.5°C and not greater than 37.7°C, and the relative humidity shall be not greater than 90 percent.

5.5.4.3.2 Lacquer. Air temperatures shall be not less than 15.5°C and not greater than 32.7°C, and the relative humidity shall be not greater than 85 percent except in the case where lacquer is used with blush-retardant thinner, then 90 percent is permissible, in accordance with 5.5.4.3.

5.5.4.4 Time of application of paint-type materials.

5.5.4.4.1 First coat. Surfaces shall first receive a coat of wash primer, or where other preparatory treatment has been provided previously, then the first primer coat shall be applied in not more than 2 hours 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 (over week-ends, holidays, etc.) this time may be extended as necessary, but shall not be greater than 72 hours, provided the adhesion is unaffected thereby, as determined by the wet tape scratch adhesion inspection test described in 6.5.4. 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 for not less than 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 top coats.

5.5.4.4.4 Drying time (primer). When TT-P-1757 zinc chromate primer, MIL-P-53022/MIL-P-53030 primer, or MIL-PRF-23377 epoxy polyamide primer is used, the minimum and maximum drying times shall be those prescribed by the primer manufacturer. The minimum drying time for lacquer-type primer, under ideal atmospheric conditions, shall be not less than 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

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in the topcoats. The precautions outlined by the primer manufacturer 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 the lacquer manufacturer.

5.5.4.5 Spraying over bare metal. Wash primer, when required, shall be applied in accordance with the wash primer manufacturer. Epoxy primers may be applied directly on steel that has been grit blasted to white metal.

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 limits given in Table XI. The general finish shall be maintained below the maximum thickness specified to avoid cracking, flaking, checking, and excess weight of the paint finish. Where sanding surfaces 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 inches. 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. The upper limits on film thickness are not mandatory for surface areas on which such limits are impractical to maintain; for example, contoured areas. Be aware that previously applied coatings to the test area must be identified prior to topcoating, such as repair or rework areas. These previous coatings must be measured and recorded in sequence to accommodate each progressive coating thickness determination.

5.5.4.7 Application of enamel. A thin coat or "tack" of enamel shall be applied with a light pass of the paint 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.

5.5.4.8 Application of lacquer. Lacquer shall be applied in accordance with applicable manufacturers recommended procedures.

5.5.4.9 Application of insignia and markings. Paint used for the application of insignia and markings shall be of the same specification as the background material. On bare metal the insignia shall be applied by means of a complete wash primer plus primer plus topcoat finish scheme. On painted surfaces coated with a complete finish scheme only the top coat material is required for marking. The additional thickness of finish resulting from the application of insignia and marking shall be within the limits prescribed in 5.5.4.6. Workmanship shall be of high quality with clear, sharp outlines of characters. Any method that cause ridges in the application of insignia and markings shall be avoided as much as possible, and the use of a knife or any metal blade on the part in the application procedure is prohibited.

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Masking tape used in the application of insignia and markings shall be removed as soon as practical to avoid staining of the painted surfaces.

5.5.4.10 Application of luminescent material. Luminescent material shall be the phosphorescent or fluorescent types and applied as specified by the supplier.

5.5.4.11 Application of walkway material. Walkway material shall be applied as specified by the manufacturer.

5.5.4.12 Use of masking tape. Masking tape used in the application of insignia and markings shall not impair the properties of, or discolor, the paint film when such tape is used in the particular painting process employed. Absence of these defects shall be verified by examining the painted surface after the tape has been removed and the surface exposed to sunlight for not less than 48 hours. Verification is permissible on test panels and should be conducted prior to large scale masking applications.

5.5.4.13 Miscellaneous requirements.

5.5.4.13.1 Tack-ragging. To insure that all areas to be painted are free from foreign matter, they shall be "tack-ragged" immediately before painting. The "tack-ragging" shall be accomplished on each area to be finished immediately prior to the application of finishing material to that area. Tack-ragging is more applicable to those surfaces requiring sanding to obtain aerodynamically smooth properties.

5.5.4.13.2 Cloths, tack-rags. Only clean, soft, dry, contaminant-free, lint-free, desized, wiping cloths shall be employed in all steps of surface preparation, chemical surface treatment, cleaning, tack-ragging, and painting operations. Use of commercial rental wiping cloths is prohibited. Laundered shop cloths are permitted when the following conditions are met:

(a) The cloths returned from laundering shall be only those originally sent to the laundry by the paint shops of the contractor or overhaul station. Suitable marking by permanent marking inks or dyes shall be employed to insure segregation and return of cloths used for paint shop purposes.

(b) The laundered cloths shall have a complete absence of any trace of silicone-type material as determined by laboratory tests, including Soxhlet extraction.

5.5.4.13.3 Touch-up. The use of aerosol spray cans of finishing materials is permitted for touch-up of scratches and heads of fastenings, as well as small areas not exceeding four square inches. When necessary to touch-up or refinish a bare spot on an assembly, the edges of the finish adjacent to the bare spot shall be tapered by sanding. Surfaces previously treated with chemical film shall be touched up in the damaged area with brush-up type 1A treatment in accordance with MIL-C-

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5541; all others shall be spotted-in over the bare area and feathered over the old finish with wash primer. The wash primer will adhere to an acceptable degree to the adjacent finish but the adhesion will not be as outstanding at these edges as it is to bare metal. The wash primer may be omitted if thin scratches or small areas are involved.

5.5.4.13.4 Smoothness of wash primer and primer coats. The wash primer should be dry scuffed with kraft paper. The primer should be applied as smoothly as possible, since specks and occlusions will carry through to the topcoat and impart undesirable roughness to the final finish. In spraying primer, proper spray techniques are necessary to avoid dry overspray which results in excessive roughness. A properly applied primer film should be free from streaks, blisters, seeds, excessive silking, or other irregularities. 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 susceptibility to corrosion. Should this occur, 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.

5.5.4.13.5 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 ensure 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.

5.5.4.14 Application of CARC polyurethane paint. It is essential that MIL-C-46168 and MIL-C-53039 green 383 and MIL-DTL-64139 paint be applied at a dry film thickness of not less than 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 to 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 non-uniformity 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

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an end item shall not be based specifically on color. It shall be based on whether the paint was approved by the Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM, Aberdeen Proving Ground, MD 21005, and whether application techniques are correct. As specified above, the paint must be applied at not less than 1.8 mils dry film thickness. A dust coat should be applied first before the second application for solvent flash-off. A single application of not less than 1.8 mils is permissible, provided the paint film is free of imperfections such as runs, sags, or orange peel.

Since this paint is extremely flat 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 painting shall be adhered to assure that optimum adhesion is achieved. (See 5.5.4.6 and 4.25.2.3 for maximum limitations.)

5.5.4.15 Application to previously painted surfaces. When touching up damaged areas or applying a CARC topcoat to an existing topcoat, the procedure to be followed depends upon the type and condition of the existing finish. Items previously coated with lacquers or vinyls must be stripped down to the epoxy primer if present, or to the substrate if not. For rework, polyurethane and epoxy topcoats can only be applied over previously painted alkyd (two weeks cure minimum), epoxy or polyurethane topcoats.

5.5.4.15.1 Surface preparation. Scratches or other light damage to polyurethane or epoxy topcoats will require scuff sanding at the immediate blemish area, except as described in 6.5.9. Damage or corrosion extending to the substrate will require sanding and repriming. All traces of corrosion must be abraded from the substrate. The surface immediately surrounding exposed substrate should then be sanded, using a feathering-in technique, that is, sand away paint film (primer and topcoat) so that the thickness of the film is smoothly tapered from bare metal/substrate to the top of the paint film. Sanding of any type is followed by wiping down the exposed area to be painted using a clean rag wet with MIL-T-81772 thinner to remove all loose sanding debris, mill scale, grease, oil (including fingerprints), and diesel/gasoline residue. Do not use other petroleum or alcohol-based thinners or cleaning agents of any kind. All areas sanded down to bare metal shall be treated (sponged or hand wiped) with code 105 of Table I or wash pretreatment on steel, or wash pretreatment or MIL-C-5541 on aluminum, allowed to react for 15 minutes. The minimum area allowed for touch-up shall be agreed upon for each contract between the Government and the applicator.

5.5.4.15.2 Finishing procedures.

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5.5.4.15.2.1 CARC topcoat. Ensure that the surface to which the topcoat is applied is clean and dry. The surface temperature should be between 15.5° and 37.7°C at application and for a period of time after application sufficient to assure adequate cure prior to exposure to adverse conditions. Apply evenly to blend with the original surface around the area to be touched up using the blend-in technique (see 4.25.2.1). Allow epoxy primer to dry a minimum of 1 hour or until dry to the touch before topcoating. For MIL-P-53030, all water must evaporate prior to top-coating. If the primer has dried for more than 168 hours, it should be lightly scuff sanded and solvent wiped to promote adhesion. Application of CARC topcoats to surfaces previously painted with CARC (e.g., in repair of light topcoat damage) may proceed while the original coat is still tacky. Polyurethane which has fully cured should be thoroughly cleaned prior to refinishing. Epoxy which has fully cured should be cleaned, scuff sanded, and solvent wiped prior to refinishing. The surface shall be thoroughly cleaned of absorbed/deposited carbon, salt, fuel, oil, hydraulic/transmission fluid, fingerprints and wax. Scuff sand to remove any visible paint defects such as chalk, then solvent wipe prior to application of new topcoat. Do not apply CARC topcoats to surfaces which will be subjected to temperatures greater than 204°C, such as exhaust systems or turbochargers.

5.5.5 Inspection requirements.

5.5.5.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections as specified herein. Except as otherwise specified, the contractor 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.

5.5.5.2 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 specifications shall be regarded as defective.

5.5.5.2.1 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 CARC paint, e.g., MIL-C-46168, 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 Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM, Aberdeen Proving Ground, MD 21005, for testing. Samples of surfaces with molded-in color shall also be sent to the above laboratory.

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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.

5.6 Applications inspection.

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

5.6.2 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 5.5.3.2.2 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 material residues. If representative test areas fail these tests, the parts shall be returned to the cleaning process and recleaning accomplished.

5.6.3 Hiding power, gloss, and smoothness. Inspectors shall conduct regular and frequent inspection tests to insure smoothness of the 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 shaded 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 comparison with an approved sample. Comparison samples can be made up by the applicator and approved by the procuring activity or obtained from the Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM, Aberdeen Proving Ground, MD 21005.

5.6.4 Adhesion. Inspectors shall conduct regular and frequent wet tape adhesion tests on the exterior finish after drying for a period of not less than 48 hours for a lacquer system and 72 hours for an enamel system. The test will be conducted on a sufficient number of samples to ensure 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 not less than 24 hours with tap or distilled water. The test areas shall have a diameter of not less than 3 inches. Remove the wet cloth and blot up the surface water. Immediately thereafter, apply a 1-inch strip of tape, A-A-883 (only newly manufactured tape shall be used), adhesive down. Press the tape down, using two passes of a 2.5 pound rubber covered roller or apply 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.

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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 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 in accordance with method 6301.2 of FED-STD-141 shall be conducted on these panels after a 24-hour soaking period in distilled water. The test will 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. Production items shall be stripped and repainted if adhesive failure is judged by the procuring activity to be severe.

5.6.5 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 single coat thickness limits as specified in 5.5.4.6. Inspectors shall conduct regular and frequent paint thickness measurements on the production parts or panels with a suitable measuring device on a sufficient number of selected areas to assure thickness requirements for the individual paints and the overall thickness. At the start of production, the painter shall spray 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 painter may proceed with painting.

5.6.6 Dry film thickness. The upper limits on film thickness are not mandatory for surface areas on which such limits are impractical to maintain; for example, contoured areas. However, film thickness should be controlled in these areas, to prevent excessive deposition of paint. Film thickness tests shall be performed on uniform coated surfaces. Thickness testing shall be performed using a conventional nondestructive measuring device such as a magnetic tester in accordance with ASTM B 499, an eddy current tester in accordance with ASTM B244, or other acceptable standard methods. Recommended thickness requirements for CARC primers and topcoats are listed in table XI; however, the upper limits may be exceeded as long as remaining quality assurance provisions are met. Be aware that previously applied coatings to the test area must be identified prior to topcoating, such as repair or rework areas. These previous coatings must be measured and recorded in sequence to accommodate each progressive coating thickness determination. Unless otherwise specified, rejection will not be made based on the recommendations of table XI, but on subsequent performance failure of any another quality assurance provision.

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5.6.7 Sampling frequency. Sampling for the inspection tests of Section 5 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

(d) Not less than one inspection a week for those weeks when painting facilities are used.

The quality control tests of 5.6.2, 5.6.3, 5.6.4 and 5.6.5 of this standard shall be conducted not less than once a week in the production painting of parts. The results of the inspection tests shall be reviewed by the Government inspector for conformance with established quality criteria.

5.6.8 Laundering of shop cloths. When laundered shop cloths are used, 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 ensure compliance with the provisions of 5.5.4.13.2 herein.

5.6.9 Inspection and acceptance of CARC painting. The following are inspections that must take place before acceptance can be made on the end item, provided the pretreatment and primer meet the adhesion requirement (see 5.6.4):

(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 Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM, Aberdeen Proving Grounds, MD 21005.

(b) Cleaning and treatment requirements shall comply with this standard.

(c) The CARC paint shall be applied to a dry film thickness of 1.8 to 2.4 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.

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(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.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The intended use of this standard is to establish minimum requirements for the protective finishing systems of rockets, guided missiles, all support equipment, and related materials.

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1).

6.3 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 corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may be in any way related thereto.

6.4 Metrication. Metric equivalents in accordance with FED-STD-376 are acceptable for use in this standard.

6.5 Subject term (keyword) listing.

Cleaning methods
Encapsulants and potting materials
Lubrication and preservation
Metallic coatings
Nonmetallic coatings
Organic coatings

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Painting
Sealing and bonding

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - MI

Preparing activity:
Army - MI

Review activities:
Army – MR

Project No. MFFP-0679

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TABLE I. Cleaning methods.

Code No.	Method
101	Cleaning, mechanical or abrasive (TT-C-490, Method I)
102	Solvent cleaning (TT-C-490, Method II). The user must use an environmentally friendly solvent per EPA and OSHA regulations and restrictions.
103	Hot alkaline cleaning (TT-C-490, Method III)
104	Emulsion cleaning (TT-C-490, Method IV)
105	Phosphoric acid corrosion removing and metal conditioning treatment, 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 (A-A-59146), nonetch to aluminum.
107	Immersion cleaning (A-A-59260) (for steel)
108	Electrolytic leaning (A-A-59260) (for steel)
109	Sand lightly with number 400 grit paper.
110	Abrade lightly with aluminum wool; immerse for not less than 3 minutes 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 (SAE AMS-M-3171).
112	Prepare surfaces for bonding using procedures of Appendix I. Preference for cleaning method where multiple methods are given for a particular surface shall be designated on the drawing immediately following the code number.
113	Vapor blast clean

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

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TABLE II. Surface treatments.

Code No.	Treatment
201	Anodize, aluminum, chromic acid, type I, class 1 (MIL-A-8625)
202	Anodize, aluminum, sulfuric acid, type II, class 1 (MIL-A-8625)
203	Anodize, aluminum, sulfuric acid, type II, class 2 (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) in accordance with FED-STD-595.
204	Anodize, hard coat, type III, class 2 (MIL-A-8625), Color Black 37038 in accordance with FED-STD-595. Color requirements other than black shall be designated on the drawing immediately following the code number.
205	Use Code 203
206	Use Code 203
207	Anodize, hard coat, type III, class 1 (MIL-A-8625)
208	Chromate conversion coat (MIL-C-5541, class 1A)
209	Anodic coating, magnesium (ASTM D1732). Class, type, and grade shall be delineated on the drawing immediately following the code number (i.e., code 209, Class II, Type II, etc.).
210	Phosphate coating (TT-C-490, type I) (zinc)
211	Phosphate coating (TT-C-490, type II)
212	Use Code 401
213	Black oxide for copper alloys
214	Black oxide for ferrous metals including stainless steels (MIL-DTL-13924). Class shall be delineated on the drawing immediately following the code 214 (i.e., code 214, class 2).
215	Zincate treatment (ASTM B 253), preplate for aluminum.

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TABLE II. Surface treatments - Continued.

Code No.	Treatment
216	Passivate by immersion for 30 minutes in a hot (48.8° to 54.4°C) aqueous solution containing 20 percent by volume nitric acid (specific gravity 1.42) and 2 percent by weight of sodium dichromate, rinsed in clean hot water and then thoroughly dried (for 200/300/400 series and precipitation hardening corrosion-resistant steels).
217	Vacuum Pressure or Vacuum Soak Treatment. The clean, dry, well-seasoned wood, freed of bark, shall be surfaced to the correct cross-sectional dimensions and then treated by vacuum and pressure, or vacuum and soak. The treating material shall conform to Composition C of TT-W-572. Retention on treatment shall be not less than 0.3 pounds per cubic foot. The temperature of the preservative during the treating process is to be at the discretion of the contractor, so long as the requirements of AWPA-P3 as to penetration and the above retention requirements are met.
218	Immersion treatment. Dress the wood part to correct cross-sectional dimensions. Immerse in composition C of TT-W-572 for not less than 4 hours. Allow the treated wood to air-dry or kiln-dry before it is painted.
219	Surface treatment. Dress the wood part to correct cross-sectional dimensions. Apply one liberal coat of zinc naphthenate reduced with water down to 3 percent zinc metal. Where practical, apply the solution by immersion for not less than 3 minutes. Otherwise, brushing or low pressure spraying (no atomization) is acceptable. Allow the treated wood to air-dry or kiln-dry before it is painted.
220	(No longer used.)
221	(No longer used.)
222	Treatment, mildew-resistant, noncopper process for cotton duck, webbing, and sewed items (CCC-D-950). Class to be designated on drawing immediately following code number.
223	Treatment, insect-resistant for paper

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TABLE II. Surface treatments - Continued.

Code No.	Treatment
224	Anodic coating for zinc and zinc alloys.
225	Apply chromate treatment for brass (MIS-28744). Class to be designated on drawing immediately following the code number.
226	Heavy phosphate coating (MIL-DTL-16232, type M, class 1) (Supplementary preservative treatment to be delineated on drawing immediately following the code).
227	Heavy phosphate coating (MIL-DTL-16232, type M, class 2) (Supplementary treatment with lubricating oil MIL-L- 3150).
228	Heavy phosphate coating (MIL-DTL-16232, type M, class 3) (No supplementary treatment).
229	Heavy phosphate coating (MIL-DTL-16232, type M, class 4) (Chemically converted; may be dyed to color as specified).
230	Heavy phosphate coating (MIL-DTL-16232, type Z, class 1) (Supplementary preservative treatment to be delineated on drawing immediately following the code).
231	Heavy phosphate coating (MIL-DTL-16232, type Z, class 2) (Supplementary treatment with preservative conforming to MIL-C-16173, grade 1 or MIL-L-3150).
232	Heavy phosphate coating (MIL-DTL-16232, type Z, class 3) (No supplementary treatment).
233	Heavy phosphate coating (MIL-DTL-16232, type Z, class 4) (Chemically converted; may be dyed to color as specified).

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TABLE II. Surface treatments - Continued.

Code No.	Treatment
234	Water-Repellant Preservative (WRP) Treatment. Apply one liberal coat of WRP solution to the wood surfaces. The solution shall contain copper naphthenate, boiled linseed oil or exterior-grade varnish, paraffin, and solvent. Where practical, apply the solution by immersion for not less than 3 minutes. Otherwise, brushing or low pressure spraying is acceptable. Allow the treated wood to air dry or kiln dry before it is painted.
235	Phosphoric acid anodize (SAE ARP 1524) (preferred treatment for critical aluminum adhesively bonded joints).

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TABLE III. Metallic coatings.

Code No.	Coating	Type	Other Treatment	Thickness, minimum (inch)
*301	Cadmium plate (QQ-P-416)	Type I, Class 1	No supplementary treatment.	0.005
*302	Same	Type I, Class 2	No supplementary treatment.	0.0003
*303	Same	Type I, Class 3	No supplementary treatment.	0.0002
304	Cadmium plate (QQ-P-416)	Type II, Class 1	Chromate supplementary treatment.	0.0005
305	Same	Type II, Class 2	Chromate supplementary treatment.	0.0003
306	Same	Type II, Class 3	Chromate supplementary treatment.	0.0002
307	Cadmium plate (QQ-P-416)	Type III, Class 1	Phosphate supplementary treatment.	0.0005
308	Same	Type III, Class 2	Phosphate supplementary treatment.	0.0003
309	Same	Type III, Class 3	Phosphate supplementary treatment.	0.0002
310	Cadmium plate, vacuum deposited (SAE AMS-C-8837)	Type I, Class 1	No supplementary treatment.	0.0005
311	Same	Type I, Class 2	No supplementary treatment.	0.0003

* Not to be used without prior approval of procuring activity.

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum (inch)
312	Same	Type I, Class 3	No supplementary treatment.	0.0002
313	Cadmium plate, vacuum deposited, (SAE AMS-C-8837)	Type II, Class 1	Chromate supplementary treatment.	0.0005
314	Same	Type II, Class 2	Chromate supplementary treatment.	0.0003
315	Same	Type II, Class 3	Chromate supplementary treatment.	0.0002
316	Same	Type III, Class 1	Phosphate supplementary treatment.	0.0005
317	Same	Type III, Class 2	Phosphate supplementary treatment.	0.0003
318	Same	Type III, Class 3	Phosphate supplementary treatment.	0.0002
319	Chromium plate (SAE-AMS-QQ-C-320 Type I, Class 1) (Usually applied over copper and nickel undercoats or applied directly to the less corrosion-resistant grades of stainless steel)			0.00001
320	Chromium plate (SAE-AMS-QQ-C-320)	Type II, Class 2		0.001
321	Use Code 380			
322	Black chromium plate (MIL-DTL-14538)			

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
323	Chromium plate (MIL-C-20218) Porous (For surfaces operating in lubricating oil). (Type shall be delineated on the drawing immediately following the Code 323.)			
324	Nickel plate (SAE-AMS-QQ-N-290)	Class 1, Grade A		0.0016 inch
325	Same	Class 1, Grade B		0.0012 inch
326	Same	Class 1, Grade C		0.0010 inch
327	Same	Class 1, Grade D		0.0008 inch
328	Same	Class 1, Grade E		0.0006 inch
329	Same	Class 1, Grade F		0.0004 inch
330	Same	Class 1, Grade G		0.0002 inch
331	Use Code 325			
332	Use Code 327			
333	Use Code 328			
334	Nickel plate (SAE-AMS-QQ-N-290)	Class 2, Engineering plating		0.002 inch

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
335	Use Code 374			
336	Use Code 375			
337	Nickel Plate (MIL-P-18317)	Black (similar to Color27038 of FED-STD-595)		0.002 inch
338	Silver Plate (ASTM B700)	Matte, Chrome anti-tarnish		0.0005 inch
*339	Silver Plate (ASTM B700)	Matte w/o anti-tarnish		0.0005 inch
340	Gold plate (ASTM-B-488)	Type 3, Code C Class 2.54		0.0001 inch
341	Same	Type 3, Code C Class 5.08		0.0002 inch
342	Same	Type 3, Code C Class 7.62		0.0003 inch
343	Same	Type 3, Code C Class 12.7		0.0005 inch
344	Tin plate (ASTM B 545)	(Electro-deposition)		0.0003 inch

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
345	Tin, Pig Grade A (ASTM B 339)	(Hot dipped)		0.0003 inch
346	Solder (EIA J-STD-001)		Tinning to meet the requirements of EIA J-STD-001	
347	Rhodium plate (ASTM B 634)	Class 0.254		0.00001 inch
348	Same	Class 0.508		0.00002 inch
349	Copper plate (SAE AMS-2418)	AMS 2418-10		0.001 inch
350	Same	AMS 2418-5	(Undercoat for nickel and other plate)	0.0005 inch
351	Same	AMS 2418-2	(Same)	0.0002 inch
352	Same	AMS 2418-1	(Same)	0.0001 inch
353	Gold plate (ASTM-B-488)	Type II, Code A, Class 5.08		0.0002 inch
354	Same	Type II, Code A, Class 7.62		0.0003 inch
355	Same	Type II, Code A Class 12.7		0.0005 inch

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
356	Soft nickel plate	Electrodeposited, sulfanate bath		0.002 inch
357	Chromium plate	Low embrittlement, electrodeposition		
358	Cadmium plate	Low embrittlement, electrodeposition		
359	Tin-cadmium plate	Class 1		0.0005 inch
360	Same	Class 2		0.0003 inch
361	Same	Class 3		0.0002 inch
362	Tin-lead plate (SAE AMS-P-81728)			
363	Cadmium, mechanically deposited (SAE AMS-C-81562)	Material C, Type II, Class 1	Chromate supplementary treatment.	0.0005 inch
364	Same	Material C, Type II Class 2	Chromate supplementary treatment.	0.0003 inch
365	Same	Material C, Type II, Class 3	Chromate supplementary treatment.	0.0002 inch

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
366	Metallic-ceramic coatings to provide corrosion and oxidation protection			
367	Aluminum vacuum deposited			
368	Same			
369	(Not used)			
370	Aluminum and aluminum alloys	Metallic/ organometallic compound decomposition		
371	Inorganically bonded aluminum	Electrophoretically deposited		
372	Palladium plate (ASTM B679)		Steel parts with a hardness > Rockwell C40 shall be given a suitable stress-relief heat treatment, prior to cleaning and plating, at a temperature which will produce maximum stress relief without reducing the hardness to less than the specified minimum. Embrittlement relief steel parts after plating per ASTM B 850.	0.00001 inch

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
373	Brush plating	Electrodeposition; deposit and thickness to be designated on drawing following code number		
374	Electroless nickel plate (MIL-C-26074)	Class 1, Grade A (for iron and aluminum based alloys) Class 1, Grade B (for copper, nickel, cobalt, beryllium and titanium based alloys)		0.001 inch
375	Same	Class 2, Grade A (heat treated for extreme hardness)		0.0005 inch
376	Same	Class 3, Grade A (aluminum alloys non-heat-treatable and beryllium alloys processed to improve adhesion of the nickel deposit)		0.001 inch

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
377	Same	Class 4, Grade A (aluminum alloys, heat-treatable, processed to improve adhesion of the nickel deposit)		
378	Same	Class 1, Grade C		0.0015 inch for severe corrosion environments
380	(Not used)			25 micrometers
381	Zinc plate (ASTM B 633)	Type II, Class Fe/Zn 25	Supplementary Chromate	13 micrometers
382	Same	Type II, Class Fe/Zn 13	Supplementary Chromate	8 micrometers
383	Same	Type II, Class Fe/Zn 8	Supplementary Chromate	25 micrometers
384	Same	Type IV, Class Fe/Zn 25	Supplementary Chromate	13 micrometers
385	Same	Type IV, Class Fe/Zn 13	Supplementary Chromate	

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TABLE III. Metallic coatings - Continued.

Code No.	Coating	Type	Other Treatment	Thickness, minimum
386	Same	Type IV, Class Fe/Zn 8	Supplementary Chromate	8 micrometers
387	Zinc coating, hot-dip (ASTM A 153)		Supplementary Chromate (MIL-T-12879)	
388	Aluminum, ion vapor deposited (MIL-DTL-83488)	Type II, Class 1	Supplementary Chromate	0.001 inch
389	Same	Type II, Class 2	Supplementary Chromate	0.0005 inch
390	Same	Type II, Class 3	Supplementary Chromate	0.0003 inch
391	Gold plate (ASTM-B-488)	Type III, Code C, Class 1.27		0.00005 inch
392	SAE AMS 2434 (Plating, Tin-Zinc Alloy)			
393	Plating, Zinc-Nickel Alloy			

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TABLE IV. Organic coatings. 1/

Code No.	Procedures
401	Apply wash primer, DOD-P-15328, 0.3 to 0.5 mil dry film thickness. Apply Resin-Acid, Metal Pretreatment Coating Compound, MIL-C-8514, 0.3 to 0.7 mil dry film thickness.
402	Apply zinc chromate primer, TT-P-1757, one coat, 0.3 to 0.4 mil dry film thickness. 2/
403	Apply zinc chromate primer, TT-P-1757, two coats, 0.6 to 0.8 mil dry film thickness. 2/
404	Apply air-drying epoxy primer, MIL-P-53022/MIL-P- 53030, dry film thickness of 0.8 to 1.2 mils.
405	Apply two coats of air-drying primer, MIL-P-53022/MIL- P-53030, dry film thickness of 1.6 to 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). 2/
407	Apply one coat of air-drying epoxy primer, MIL-PRF- 23377, 0.6 to 0.9 mils. 2/
408	Apply two coats of air-drying epoxy primer MIL- PRF-23377, 1.6 to 2.4 mils. 2/
409	Use Code 448.
410	Use Code 402.
411	Use Code 448.
412	Use Code 448.
413	Use Code 448.
414	Use Code 448.

1/ Application and inspection shall meet all requirements of 5.5 and section 6 of this standard. This note applies to all finish codes 401 through 497.

2/ MIL-P-53022 (thickness 0.8 to 1.5 mils) or MIL-P-53030 epoxy primers may be used as alternates where safety and air regulations are enforced.

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TABLE IV. Organic coatings - Continued.

Code No.	Procedures
415	Apply lusterless enamel MIL-PRF-24635, one coat (0.8 to 1.2 mils), color olive drab 34088, FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following Code 415.
416-419	Reserved for future use.
420	Apply lusterless enamel MIL-PRF-24635, two coats (1.6 to 2.4 mils), color olive drab 34088, FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following Code 420.
421-424	Reserved for future use.
425	Apply low gloss enamel MIL-PRF-24635, one coat (0.8 to 1.2 mils), color olive drab 24084, FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following Code 425.
426-436	Reserved for future use.
437	Apply low gloss enamel MIL-PRF-24635, two coats (1.6 to 2.4 mils), color olive drab 24084, FED-STD-595. Color other than olive drab shall be delineated on the drawing immediately following Code 437.
438	Apply polyurethane aliphatic, weather resistant camouflage coating, MIL-PRF-85285, one coat (1.0 to 1.2 mils), color and code number, FED-STD-595, shall be delineated on the drawing immediately following Code 438.
439	Apply polyurethane, aliphatic, weather resistant camouflage coating, MIL- PRF-85285, two coats (1.6 to 2.4 mils). Color and code number, FED-STD-595, shall be delineated on the drawing immediately following Code 439.
440	Apply polyurethane, aliphatic weather resistant, semigloss coating, MIL- PRF-85285, one coat, 1.0 to 1.2 mils. Color and code number, FED-STD-595, shall be delineated on the drawing immediately following Code 440.

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TABLE IV. Organic coatings - Continued

Code No.	Procedures
441	Apply polyurethane, aliphatic, weather resistant semigloss coating, MIL- PRF-85285, two coats, 1.6 to 2.4 mils. Color and code number, FED-STD-595, shall be delineated on the drawing immediately following Code 441.
442	Apply polyurethane, aliphatic weather resistant gloss coating, MIL-PRF-85285, one coat (1.0 to 1.2 mils) color and code number, FED-STD-595, shall be delineated on the drawing immediately following Code 442.
443	Apply polyurethane, aliphatic weather resistant gloss coating, MIL-PRF-85285, two coats (1.6 to 2.4 mils). Color and code number, FED-STD-595, shall be delineated on the drawing immediately following Code 443.
444	Use Code 445.
445	Use Code 448.
446	Use Code 447.
448	Apply polyurethane, aliphatic, CARC, MIL-C-46168 two coats (1.8 to 2.4 mils) color green 383, FED-STD-595. Color other than green 383 shall be delineated on the drawing immediately following Code 448. MIL-C-53039 single component polyurethane paint or MIL-DTL-64159 water reducible polyurethane paint may be used as an alternate.
449	Use Code 448.
450-460	Reserved for future use.
461	Use Code 448.
462-472	Reserved for future use.
473	Use Code 448.
474-484	Reserved for future use.
485	Apply epoxy-polyamide coating, MIL-PRF-22750, one coat, 0.8 to 1.7 mils. Color number, FED-STD-595, shall be designated on the drawing immediately following Code 485.

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TABLE IV. Organic coatings - Continued

Code No.	Procedures
486	Apply epoxy-polyamide coating, MIL-PRF-22750, two coats, 1.6 to 3.4 mils. Color number, FED-STD-595, shall be designated on the drawing immediately following Code 486.
487	Use Code 485.
488	Use Code 486.
489	Luminescent material and equipment (non-radioactive). Type, form, and color shall be designated on the drawing immediately following Code 489.
490	(Not used)
491	Coating Compound (nonslip) for Walkways, A-A-59166
492	Walkway coating and matting in accordance with manufacturers instructions. Type shall be designated on the drawing immediately following Code 492.
493-494	Reserved for future use.
495	Acid-resistant lacquer, A-A-1452, (black, color 17038, FED-STD-595, 0.8 to 1.2 mils dry film thickness).
496	Alkali-resistant vinyl enamel, white, color 27886, FED-STD-595 (0.8 to 1.2 mils dry film thickness).
497	Moisture and fungus resistant varnish. Depending on the application ASTM D3955 and ASTM D295 may be used as guidance in selecting a moisture resistant varnish. In order to make the material fungus resistant, a fungistatic agent such as salicylanilide (7 +/- 1.0%) or copper 8-quinolinolate (1.0%) should be added to the formulation.

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TABLE V. Sealing and bonding.

Code No.	Procedures
501	Use code 503.
502	Seal with single-component retaining compound, MIL-S-22473; specify grade and primer on drawing.
503	Assemble with sealing compound, SAE AMS-S-8802, polysulfide type; class and dark number shall be delineated on the drawing immediately following Code 503.
504	Apply wet, unthinned zinc chromate primer, TT-P-1757, for sealing thread areas and interface capillaries.
505	Apply zinc chromate paste, MIL-PRF-8116, for sealing in threaded, adjustable parts.
506	Impregnation for aluminum alloys and magnesium alloy castings, MIL-STD-276, method B, using MIL-I-17563.
507	Seal with SAE AMS-S-4383, Buna-N rubber compound.
508	Seal with silicone sealant, one component, MIL-S-46146. Type and primer, if required, shall be specified on the drawing immediately following Code 508.
509	Apply silicone compound, two-component, MIL-PRF-23586. Type, class and grade to be specified on the drawing.
510	Apply tape, A-A-59298, dissimilar metal protection.
511	Apply sealant, polysulfide, noncuring, for helicoils and steel inserts (type to be specified on drawing).
512	Apply sealant, A-A-59293, two-component, polysulfide (adhesive/sealant).
513	Sealing compound, hydrocarbon and water resistant, for sealing gaskets.
514	Adhesive, optical, thermosetting (for bonding glass to glass).

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TABLE V. Sealing and bonding - Continued

Code No.	Procedures
515	Adhesive, SAE AMS-A-8576, acrylic base, for acrylic plastics. Type shall be delineated on the drawing immediately following Code 515.
516	Adhesive epoxy resin, metal-to-metal, structural bonding (MIL-HDBK-961 may be used as guidance)
517	Adhesive heat-resistant, airframe, structural, metal-to-metal (MIL-HDBK-691 may be used as guidance)
518	Epoxy resin adhesive with polyamide curing agent. The cured system shall have a minimum tensile shear strength of 1500 pounds per square inch (psi) at 75 +/- 5 degrees F when cured per manufacturers instruction.
519	Adhesive, SAE AMS-A-25463, metallic structural sandwich construction (type and class shall be delineated on the drawing immediately following Code 519).
520	Adhesive, MMM-A-121, bonding, vulcanizing synthetic rubber to steel.
521	(Not used)
522	Adhesive rubber base, general purpose (MIL-HDBK-691 may be used as guidance.)
523	Adhesive, bond, rubber adhesive polychloroprene.
524	Sealing and coating compound, inhibitive, MIL-PRF-81733, polysulfide type. Type and dash number shall be delineated on the drawing immediately following Code 524.

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TABLE VI. Encapsulants and potting compounds.

Code No.	Coating
601	Insulating compound, MIL-I-16923, electrical embedding
602	Potting compound, MIL-M-24041, polyurethane (non- carcinogenic)
603	Conformal coating, printed circuit board, epoxy.
604	Conformal coating, printed circuit board, polyurethane.
605	Conformal coating, printed circuit board, silicone.
606	Conformal coating, printed circuit board, paraxylylene.
607	Use Code 602.

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TABLE VII. Lubrication and preservation.

Code No.	Treatment
701	Corrosion preventive compound, MIL-PRF-16173, grade 1 (hard film)
702	Corrosion preventive compound, MIL-PRF-16173, grade 2 (soft film)
703	Apply medium preservative lubricating oil, MIL-PRF-3150.
704	Apply lubricating oil, general purpose MIL-PRF-32033, water displacing, low temperature.
705	Use Code 706.
706	Apply corrosion preventive compound, MIL-C-81309, water displacing, ultra-thin; grade to be designated on drawing.
707	Apply lubricating grease, MIL-G-10924.
708	Apply lubricant, dry film, MIL-L-46010, bake-type.
709	Apply lubricant, dry film, MIL-L-23398, air-drying.
710	Apply lubricating oil, VCI, MIL-P-46002. Specify grade on the drawing immediately following Code 710.
711	Use solid, VCI corrosion inhibitor, MIL-I-22110, per MIL-I-8574, Type I or II as applicable.
712	Apply antiozonant, A-A-52408.
713	Apply corrosion prevention compound, MIL-C-85054 (AMLGUARD).

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TABLE VIII. Miscellaneous.

Code No.	Treatment
801	Stress relieve prior to plating at 357.2° ± 11°C or 10°C below the tempering temperature, whichever is lower, for 2 to 3 hours (for ferrous alloys having a hardness greater than Rockwell C40).
802	Hydrogen embrittlement relieve at 190.5° ± 11°C for 23 hours within 8 hours after plating.
803	Hydrogen embrittlement relieve at 190.5° ± 11°C for 3 hours within 8 hours after phosphating.
804	Hydrogen embrittlement relieve at 190.5° ± 11°C for 3 hours after initial plating, then at 190.5°C ± 11°C for 23 hours after final plating.
805	Apply marking ink, A-A-208, color to be specified on drawing if other than black; for metal and glass, coat with varnish (consult ASTM D 3955 and ASTM D 295-58) (Code 497).
806	Apply marking ink, A-A-56032, color to be specified on drawing if other than mat black, for metal and glass.
808	Shot peening of metal parts, SAE AMS-S-13165.
809	Use code 808.

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TABLE IX. Galvanic couples.

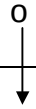
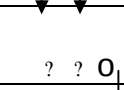
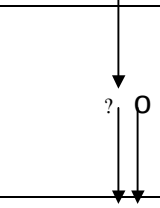
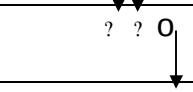
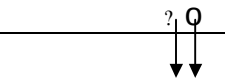
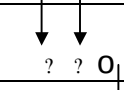
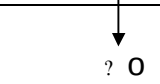
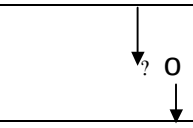
Group No.	Metallurgical category	E.M.F. (Volt)	Permissible couples*
1	Gold, solid and plated; gold-platinum alloys; wrought platinum	+0.15	
2	Rhodium, graphite	+0.05	
3	Silver, solid or plated; high silver alloys	0	
4	Nickel, solid or plated; monel metal, high nickel-copper alloys, titanium	-0.15	
5	Copper, solid or plated; low brasses or bronzes; silver solder; German silver: high copper-nickel alloys; nickel chromium alloys; austenitic stainless steels	-0.20	
6	Commercial yellow brasses and bronzes	-0.25	
7	High brasses and bronzes; Naval brass Muntz metal	-0.30	
8	18% chromium type corrosion-resistant steel	-0.35	
9	Chromium, plated; tin, plated; 12% chromium type corrosion-resistant steels	-0.45	
10	Tin-plate; terneplate; tin-lead solders	-0.50	
11	Lead, solid or plated; high lead alloys	-0.55	
12	Aluminum, wrought alloys of the 2000 series types	-0.60	
13	Iron, wrought, gray, or malleable; plain carbon and low alloy steels, armco iron	-0.70	
14	Aluminum, wrought alloys other than 2000 series types aluminum, cast alloys of the silicon type	-0.75	

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TABLE IX. Galvanic couples. - Continued.

Group No.	Metallurgical category	E.M.F. (Volt)	Permissible couples*
15	Aluminum, cast alloys other than silicon type; cadmium, plated and chromated	-0.80	? o
16	Hot-dip-zinc plate; galvanized steel	-1.05	? ? o
17	Zinc, wrought; zinc-base die-casting alloys; zinc, plated	-1.10	?
18	Magnesium and magnesium-base alloys cast or wrought	-1.60	?

* Members of groups connected by lines are considered as permissible couples; however, this should not be construed as being devoid of galvanic action. Permissible couples represent a low galvanic effect.

0 Indicates the most cathodic member of the series, 0 an anodic member, and the arrows the anodic direction.

Permissible couples are based on 0.10 E.M.F. (Volt) limitation except groups 2, 3, 4, 14, 15, and 16.

All stainless steels for use in missile systems are required to be passivated. All stainless steels within this table are passivated.

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TABLE X. Group amplification of galvanic couples.

Group No. (See Table X)	Metal or Alloy Description
1	Gold, solid or plated, SAE AMS-2422 and ASTM B488. Gold foil and Gold leaf. Gold alloys, A-A-53884. Platinum, wrought. Platinum foil, A-A-53475.
2	Rhodium, ASTM B634 (Plated) and ASTM B616 (Refined).
3	Silver, solid, or plated, ASTM B700. Silver alloys
4	Nickel, solid. Nickel plate, SAE-AMS-QQ-N-290 or MIL-C-26074. Nickel-copper alloys, QQ-N-281, QQ-N-286, ASTM A494 and MIL-C-24723 Constantin and monel.
5	Copper, solid or plated, SAE-AMS-2418. Silicon bronze, phosphor bronze, naval bronze,leaded bronze, hydraulic bronze, valve bronze,manganese bronze, red brass, acid-resistant bronze, manganin, gun metal, and Parr's alloy. Copper-beryllium, ASTM B 196 and ASTM B 197. Copper-nickels, ASTM B369 Copper-silicons, ASTM-B30, ASTM-B98, ASTM-B98M, ASTM-B99, ASTM-B99M, ASTM-B105, ASTM-B124, ASTM-B271, ASTM-B584, ASTM-B644, ASTM-B763. Phosphor-coppers, ASTM B644. Phosphor-bronze, ASTM B139. Aluminum bronze, QQ-B-654. Brazing alloys, silver base, AWS C3.5 (Torch brazing), AWS C3.5 (Induction brazing), AWS C3.6 (Furnace brazing) & AWS C3.7 (Aluminum brazing)]. Nickel silvers, ASTM B122, ASTM B151, ASTM-B151M, ASTM-B206, ASTM-B206M. Nickel-chromium, ASTM B 168 and MIL-B-15382. Austenitic stainless steels within the AISI 300 series: SAE-AMS-T-8506, SAE AMS5560, SAE AMS5563, SAE AMS5564, SAE AMS5565, SAE AMS5566, SAE AMS5567, SAE AMS5569, SAE AMS5570, SAE AMS5571, SAE AMS5639, and ASTM A 793, SAE-AMS-QQ-S-763; classes I, II, III of MIL-C- 24707/3, FS designators 302, 304, 304L, 309, 310, 316, 316L, 321, 347 of ASTM A240, ASTM A666, ASTM A693, SAE AMS 5365, SAE AMS 5366; ASTM A 580, ASTM A 313.

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TABLE X. Group amplification of galvanic couples - Continued.

Group No. (See Table X)	Metal or Alloy Description
6	Commercial yellow brasses and bronzes. Admiralty metal. Cartridge brass, ASTM B19. Commercial brass, ASTM B36, SAE AMS 4860. High copper yellow and naval brass.
7	Medium copper leaded brass and low copper brass compositions Commercial brass ASTM-B16, ASTM-B16M, ASTM-B124. Commercial yellow brass, SAE AMS 4842. Manganese bronzes, ASTM B138 Naval brasses, ASTM B21, ASTM-B21M and QQ-B-639 Die-cast brasses, ASTM B 176. Muntz meal and Tobin bronze
8	18 ± 2% corrosion resistant chrome-steels (passivated) within the AISI 300 and 400 series, SAE-AMS-QQ-S-763, ASTM A240, ASTM A666, ASTM A 580, ASTM A 313.
9	12 ± 2% corrosion resistant chrome-steels (passivated) within the AISI 400 series SAE AMS-QQ-S-763, MIL-C-24707/6, ASTM A240, and ASTM A693 Chromium plate, SAE-AMS-QQ-C-320, MIL-DTL-14538 Tin and tin plate products ASTM B545, ASTM B339, ASTM A623, ASTM A623M, ASTM A624, ASTM A624M, ASTM A630
10	Terneplate, QQ-T-201. Tin-lead solders, ANSI J-STD-004, ANSI J-STD-005, ANSI J-STD-006.
11	Electrical lead. Sheet lead, QQ-L-201. Pig lead, QQ-L-171. Calking lead, QQ-C-40. Lead alloys.

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TABLE X. Group amplification of galvanic couples - Continued.

Group No. (See Table X)	Metal or Alloy Description
12	Aluminum, wrought alloys of 2000 series Aluminum alloy 2014, SAE-AMS-QQ-A-200/2 and SAE-AMS-QQ-A-225/4 Aluminum alloy 2024, SAE-AMS-QQ-A-200/3, SAE-AMS-QQ-A-225/6 and SAE-AMS-QQ-A-250/4 Aluminum alloy 2017, SAE-AMS-QQ-A-225/5
13	Wrought iron. Gray iron, ASTM A 48. Steels within the AISI series 1000, 1100, 1300, 2000, 3100, 3200, 3300, 4000, 4100, 4300, 4600, 4800, 5000, 5100, 6100, 8600, 8700, 8900, 9200, 9300, 9400, 9700, and 9900. Steels, ASTM A 829, ASTM A 681, ASTM A 108, ASTM A 575, ASTM A 576, ASTM A 663, ASTM A 675, QQ-S-698, ASTM A 27, ASTM A 515, ASTM A 516, ASTM A 204, ASTM A 302, ASTM A 36, and ASTM A228.
14	Aluminum, wrought alloys other than 2000 series types. Aluminum, cast alloys of silicon type. Aluminum alloy 1100, SAE-AMS-QQ-A-225/1 and SAE-AMS-QQ-A-250/1. Aluminum alloy 2011, SAE-AMS-QQ-A-225/3 Aluminum alloy 3003, SAE-AMS-QQ-A-225/2, SAE-AMS-QQ-A-250/2, and SAE-AMS-QQ-200/1 Aluminum alloy 6061, SAE-AMS-QQ-A-200/8, SAE-AMS-QQ-A-225/8 and SAE-AMS-QQ-A-250/11. Aluminum alloy 7075, SAE-AMS-QQ-A-200/11, SAE-AMS-QQ-A-225/9 and SAE-AMS-QQ-A-250/12. Aluminum alloy 5052, SAE-AMS-QQ-A-225/7 and SAE-AMS-QQ-A-250/8 Clad aluminum, SAE-AMS-QQ-A-250/3, SAE-AMS-QQ-A-250/5, SAE-AMS-QQ-A-250/13 and SAE-AMS-QQ-A-250/15 Aluminum cast alloy compositions 300 and 400 series, ASTM B26, ASTM B26M, ASTM B85, ASTM B108, ASTM B179, SAE AMS 4290, SAE AMS 4291, SAE SAE J452

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TABLE X. Group amplification of galvanic couples - Continued.

Group No. (See Table X)	Metal or Alloy Description
15	Aluminum, cast alloys other than silicon type. Cadmium, plated, QQ-P-416 and SAE-AMS-C-8837. Aluminum cast alloy compositions 200, 500, 700, and 800 series, ASTM B26, ASTM B26M, ASTM B85, ASTM B108, ASTM B179, SAE J452
16	Galvanized iron or steel, ASTM A361, ASTM A527, ASTM A653, ASTM A929.
17	Zinc plating, ASTM B633 Wrought zinc alloys, ASTM B69. Die-casting zinc alloys, ASTM B86.
18	All magnesium alloys including ASTM B107, ASTM B94, ASTM B91, ASTM B661, SAE AMS 4375, SAE AMS 4377, SAE AMS 4376, ASTM B199, ASTM B80.

TABLE XI. Single coat dry film thickness (mils) of paint-type materials

MIL-C-8514	0.3 - 0.7
DOD-P-15328	0.3 - 0.7
MIL-P-23377	0.6 - 0.9
MIL-P-53022	0.8 - 1.5
MIL-P-53030	0.8 - 1.5
MIL-PRF-85582	0.8 - 1.2 1/
MIL-C-46168	0.9 - 1.2 2/
MIL-DTL-53039	0.9 - 1.2 2/
MIL-DTL-64159	0.9 - 1.1 2/
MIL-PRF-22750	0.8 - 1.7
Other Primers	0.8 - 1.2 mils
Other Topcoats	0.8 - 1.2 mils

1/ Except for aircraft, then 0.6 - 0.9

2/ 1.8 mils minimum total dry film thickness must be maintained for color uniformity and optimum camouflage characteristics. A single application of not less than 1.8 mils is permissible in some cases. See paragraph 5.5.4.14.

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Appendix I
Suggested Surface Preparation Procedures Prior to Bonding of Metal Faying Surfaces

1. Wrought aluminum and aluminum alloys (except sandwich cores). Degrease surfaces with an organic solvent, immerse for 10 minutes at 150° to 160°F (65.6° to 71.1° C) in a chromic acid solution of approximately the following composition by weight:
   30 parts clean, demineralized, oil free water
   10 parts concentrated sulfuric acid (1.84 specific gravity (sp gr))
   1 part sodium dichromate ($Na_2Cr_2O_7 – 2H_2O$ – technical grade).

   Rinse in demineralized water at a temperature no higher than 150°F (65.6°C) and with a pH no greater than 7.5. Observe immediately for water breaks on the surfaces as evidenced by the water not cascading from the parts or specimens in a smooth, continuous sheet. If water breaks occur, repeat, above treatment. Dry the rinsed parts or specimens for 30 minutes, or until thoroughly dry, at a temperature no greater than 150°F (65.6°C), and repeat the water-break test or subject to instrumentation test as specified in 5.

2. Stainless steel (except sandwich cores). Degrease and proceed as specified in 1, except that immersion will be for 15 minutes at 150F to 160°F (65.6 to 71.1°C) in a strong acid-dichromate solution of the following composition:
   96.6 percent by volume concentrated sulfuric acid (1.84 sp gr)
   3.4 percent by volume saturated water solution of $Na_2Cr_2O_7 – 2H_2O$.

3. Sandwich cores (aluminum alloys). Degrease and proceed as specified in 1 except that immersion will be for 15 minutes at 150° to 160°F (65.6° to 71.1°C) in a mild acid –detergent solution of the following composition by weight:
   92.9 percent clean, demineralized, oil free water
   1.0 percent concentrated sulfuric acid (1.84 sp gr)
   6.0 percent sodium dichromate ($Na_2Cr_2O_7 – 2H_2O$ – technical grade)
   0.1 percent surface-active detergent

4. Sandwich cores (titanium and 302 type stainless steel). Degrease and proceed as specified in 1, except that immersion will be for 15 minutes at 150° to 160°F (65.6° to 71.1°C) in a detergent solution of the following composition by weight:

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94.4 percent clean, demineralized, oil free water
2.0 percent sodium metasilicate (Na_2SiO_2)
3.6 percent surface-active detergent

5. Water contact angle test. A drop of distilled or demineralized water placed on a flat, dry, thoroughly prepared metal surface will spread rapidly and uniformly over the surface. If the water drop does not so disperse itself, the metal surface is not properly prepared for subsequent adhesive bonding and must be reprocessed. With proper instrumentation, the angle of contact of a drop of water with a base surface can be measured. A low contact angle (10 degrees or less) indicates a surface satisfactorily prepared for adhesive bonding. A satisfactory contact angle measuring apparatus consists principally of a telemicroscope with a crosshair in a rotating eyepiece and with a prism on the objective end. The process specification will include an effective quality control provision based on contact angle measurements and instrumentation described herein.

6. Treatment of titanium prior to adhesive bonding. The following treatment is suggested:
   (a) Acetone wipe.
   (b) Vapor degreasing
   (c) Pickle in the following water solution at room temperature for 30 seconds:
   Nitric acid – 15 percent by volume of 70 percent nitric acid solution.
   Hydrofluoric acid – 3 percent by volume of 50 percent hydrofluoric acid solution.
   (d) Rinse in tap water at room temperature for 2 minutes.
   (e) Immerse in the following water solution at room temperature for 2 minutes:
   Trisodium phosphate – 6.68 ounces per gallon of solution.
   Potassium fluoride – 2.7 ounces per gallon of solution.
   Or
   Sodium fluoride – 1.2 ounces per gallon of solution.
   Hydrofluoric acid (50 percent solution) 2.6 percent by volume of solution.
   (f) Rinse in tap water at room temperature.
   (g) Soak in 150°F tap water for 1.5 minutes.
   (h) Spray with distilled water and air-dry.

   Note: If heavy heat-treat scale present, molten salt descale prior to above procedure.

7. Treatment of magnesium alloy, AZ-31-H24 prior to adhesive bonding. The following treatment is suggested:

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(a) Degrease panels for 10 minutes at room temperature in an appropriate solvent. Then treat for 10 minutes at 160° to 190°F in the following solution:
95.3 percent by weight water
2.2 percent by weight Na_2SiO_2 (metal)
1.1 percent by weight $Na_4P_2O_7$ (pyrophosphate)
1.1 percent by weight NaOH
0.3 percent by weight Nacconol NR.

(b) Rinse panels with cold distilled H_2O and then treat for 10 minutes at 155° +/- 5°F in a solution of 20 percent CrO_3.

(c) Panels are then given a final rinse in warm distilled H_2O and air-dried. Prepared surfaces should be primed with adhesive or bonded as soon as possible; elapse time not to exceed 8 hours.

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