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DEPARTMENT OF DEFENSE STANDARD PRACTICE

FINISHES, COATINGS, AND SEALANTS, FOR THE PROTECTION OF AEROSPACE WEAPONS SYSTEMS



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FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense (DoD).
2. This standard covers minimum requirements for methods and materials to be used for protective surface treatments of aerospace weapons systems (see 3.4 and 6.1).
3. This standard identifies material specifications that are required for use as finishes, protective coatings, and sealants in aerospace weapons systems. When an alternate material or process is desired, approval of the procuring activity is required.
4. Comments, suggestions, or questions should be addressed to: Commanding Officer, Naval Air Warfare Center Aircraft Division, Code 4L8000B120-3, Highway 547, Lakehurst, NJ 08733-5100, or email to michael.sikora@navy.mil. Since contact information can change, it may be necessary to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

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1. SCOPE

1.1 Scope. This standard establishes minimum requirements to be considered for finishes, protective coatings, and sealants used in the protection of aerospace weapons systems (see 3.4 and 6.1).

2. APPLICABLE DOCUMENTS

2.1 General. Documents listed in this section are specified in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure completeness of this list, document users are cautioned that they must meet all specified documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL SPECIFICATIONS

TT-P-2760 - Primer Coating: Polyurethane, Elastomeric, High Solids

FEDERAL STANDARDS

FED-STD-595 - Colors Used in Government Procurement

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-3043	- Resin-Coating, Permanent, For Engine Components and Metal Parts
MIL-S-5002	- Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-C-5056	- Coating, Permanent Resin; Process For Application of, to Aircraft Parts
MIL-DTL-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	- Anodic Coatings, For Aluminum and Aluminum Alloys
MIL-C-8779	- Colors, Interior, Aircraft, Requirements for
MIL-C-11796	- Corrosion Preventive Compound, Petrolatum, Hot Application
MIL-PRF-16173	- Corrosion Preventive Compound, Solvent Cutback, Cold-Application
MIL-F-18264	- Finishes, Organic, Weapons Systems, Application and Control of
MIL-PRF-22750	- Coating, Epoxy, High Solids
MIL-PRF-23377	- Primer Coatings: Epoxy, High Solids

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- MIL-L-23398 - Lubricant, Solid Film, Air-Cured, Corrosion Inhibiting, NATO Code Number S-749
- MIL-PRF-32033 - Lubricating Oil, General Purpose, Preservative (Water-Displacing, Low Temperature)
- MIL-PRF-46010 - Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
- MIL-DTL-53039 - Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
- MIL-DTL-53072 - Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection
- MIL-DTL-64159 - Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant
- MIL-PRF-81309 - Corrosion Preventive Compounds, Water Displacing, Ultra-Thin Film
- MIL-PRF-81733 - Sealing and Coating Compound, Corrosion Inhibitive
- MIL-DTL-81706 - Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
- MIL-PRF-83483 - Thread Compound, Antiseize, Molybdenum Disulfide-Petrolatum
- MIL-DTL-85054 - Corrosion Preventive Compound, Water Displacing, Clear (Amlguard)
- MIL-PRF-85285 - Coating: Polyurethane, Aircraft and Support Equipment
- MIL-C-85322 - Coating, Elastomeric, Polyurethane, Rain-Erosion
- MIL-PRF-85582 - Primer Coatings: Epoxy, Waterborne

DEPARTMENT OF DEFENSE HANDBOOKS

- MIL-HDBK-83377 - Adhesive Bonding (structural) for Aerospace and Other Systems, Requirements for

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-464 - Electromagnetic Environmental Effects, Requirements for Systems
- MIL-STD-889 - Dissimilar Metals
- MIL-STD-2161 - Paint Schemes and Exterior Markings for U.S. Navy and Marine Corps Aircraft

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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SAE INTERNATIONAL

- SAE-AMS3265 - Sealing Compound, Polysulfide Rubber, Fuel Resistant, Nonchromated Corrosion Inhibiting for Intermittent Use to 360°F (182°C)
- SAE-AMS3276 - Sealing Compound, Integral Fuel Tanks And General Purpose, Intermittent Use To 360°F (182°C) DoD Adopted.
- SAE-AMS3277 - Sealing Compound, Polythioether Rubber Fast Curing for Integral Fuel Tanks and General Purpose, Intermittent Use to 400 Degrees F (204 Degrees C) DoD Adopted.
- SAE-AMS3281 - Sealing Compound, Polysulfide Synthetic Rubber for Integral Fuel Tank and Fuel Cell Cavities, Low Density for Intermittent Use to 360°F (182°C) DoD Adopted.
- SAE-AMS3138 - Materials, Coating, Fluorocarbon(FKM),Elastomeric DoD Adopted.
- SAE-AMS-M-3171 - Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on DoD Adopted.
- SAE-AMS-S-4383 - Sealing Compound, Topcoat, Fuel Tank, Buna-N Type DoD Adopted.
- SAE-AMS-S-8802 - Sealing compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion DoD Adopted.
- SAE-AMS-C-27725 - Coatings, Corrosion Preventive, For Aircraft Integral Fuel Tanks DoD Adopted.
- SAE-AMS-C-83231 - Coatings, Polyurethane, Rain Erosion Resistant For Exterior Aircraft And Missile Plastic Parts DoD Adopted.
- SAE-AMS-C-83445 - Coating System, Polyurethane, Non-Yellowing, White, Rain Erosion Resistant, Thermally Reflective DoD Adopted.

(Copies of these documents are available online at <http://SAE.org> or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Exterior surfaces. All surfaces of a weapons system normally exposed to an external environment during flight or on the ground, and all interior surfaces that may become regularly wetted with water or other corrosive fluid are considered exterior surfaces. These surfaces include, but are not limited to, wheels and landing gear, wheel wells and their fairings, dive brakes, wing flaps, wing-fold areas, battery compartments, and bilge areas on aircraft with latrines.

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3.2 Extreme conditions. Extreme conditions include, but are not limited to, exhaust trails, gun-blast surfaces, rocket-blast areas, leading edges, areas that may trap or be exposed to fumes from exhaust, guns or rockets, or surfaces subjected to temperatures above 250 °F (121 °C) as the result of thermal radiation, aerodynamic heating, or other sources of heat.

3.3 Fayed surface. The term "fayed surface" means two or more surfaces are joined or fitted closely or tightly together.

3.4 Weapons system. All types of aircraft, manned and unmanned, and missiles are considered weapons systems.

3.5 Frequent Removal or Disassembly. With regard to fasteners, frequent removal is defined as either removal or disassembly which occurs, or is anticipated to occur, within a maximum of six (6) months.

4. GENERAL REQUIREMENTS

4.1 General. This section establishes the methods of corrosion prevention required to ensure that aerospace weapons systems (see 3.4), including those exposed to extreme conditions (see 3.2), are protected by coatings and finishes proven suitable for the intended environment.

4.2 Exceptions. Unless specifically prescribed by a particular item and/or accessory specification or drawing, this standard is not applicable to propellers, power plants, instruments, electronic enclosures or chassis, or contractor purchased accessories, such as electric motors, generators, switches, hydraulic valves, and similar parts. Contractors are not normally required to refinish such equipment or accessories, provided the color and finish systems are acceptable to the procuring activity or its agent.

4.3 Contractor-prepared finish specification. A finish specification defining the protective finish system, including cleaning and surface treatments of the item being purchased shall be developed. The finish specification is required in accordance with the DoD Corrosion Prevention and Control Policy of 12 November 2003. Specific guidance may be found in the DoD Corrosion Prevention and Control Planning Guidebook, Spiral 3, of September 2007. Any deviations from the requirements specified herein shall be identified and supported with technical data and information. In areas where the coating thickness requirement cannot be met (see 5.1.5), the finish specification shall indicate the specific areas of variation.

4.3.1 Special Treatments. A detailed parts list of the weapons system is not required in the finish specification; however, sufficient examples shall be included so that any part of the weapon system may be properly classified as to its detailed protective treatment. All parts for which the exact treatment may be in doubt, all of the areas identified in 4.1 requiring special treatment, and all parts or assemblies with design features noted in their specifications to require maximum corrosion preventive treatment shall be included in the finish specification.

4.3.2 Cross references. When the contractor-prepared finish specification references manufacturer's material, and or other finish process specifications, or other documents, a cross

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reference shall be prepared as part of the specification indicating their equivalence to existing Government and non-Government specifications and standards. Copies of any originated referenced documents shall be required with the proposed finish specification.

4.3.3 Alternate materials. Where there is a choice of coatings and/or finish materials or processes herein, the finish specification shall be tailored to identify only those intended to be used. Alternate materials shall not be used without the written approval of the procuring activity.

4.3.4 Non-standard coatings and finishes. The contractor prepared finish specification (see 4.3) shall identify any proposed deviations from, or additions to the requirements specified herein by marking with an asterisk. These shall be considered non-standard. The affected materials or processes shall be replaced with coating or finishing systems that have been proven suitable for the intended environment. Environmentally driven usage of organic primers containing non-chromate corrosion inhibitors is one example where the product must have been proven to have acceptable performance to the procuring activity.

4.4 General precautions.

4.4.1 Metal particles. Fabrication and assembly procedures shall be established such that the retention of metal particles or pieces, such as chips, slivers, and filings, or other foreign objects, in structure(s) is precluded. A vacuum cleaner with strong suction may be used for frequent cleaning operations in inaccessible areas. Metal cutting or filing is not permitted on an assembly after it has been accepted, except upon specific approval by the local government representative. When such action has been approved, those areas shall be retouched in accordance with the detailed paint schedule for the part.

4.4.2 Use of abrasive materials. The selection of the correct abrasive material and size is dependent upon the material/surface to be treated and the purpose for which the abrasive material is to be used. In areas where control or removal of generated debris can cause failure of the weapons system, the abrasive shall not be used. Applicable technical orders, bulletins, and manuals shall be consulted prior to selection of any abrasive material. Any abrasive material that may produce a surface finish that would degrade the fatigue life of the part shall not be used. Abrasives used on one metal or alloy shall not be used on different metals or alloys unless it can be proven to the procuring activity that the media recycling process eliminates damaging contaminants.

4.4.3 Welding, brazing, and soldering. When welding, brazing, or soldering is permitted on an assembly after it has been finished, inspected, and accepted, the surface shall be refinished. Any pre- or post-cleaning processes associated with welding, brazing, or soldering operations shall be compatible with subsequent finish processes and shall be compatible with the joining materials (filler materials, solder, fluxes, or brazing alloys). Any surface refinishing shall cover a large enough area to ensure correction of any damage resulting from the joining operation. The finish requirements in the joined area shall be equivalent to the basic part finish requirements.

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5. DETAILED REQUIREMENTS

5.1 Protective finish system requirements.

5.1.1 Surface treatment. All metal surfaces, regardless of whether they are to be painted or are specifically excluded from painting, shall be surface treated in accordance with MIL-S-5002, except as modified by 5.2.1.1c.

5.1.2 Application of organic finishes. The application of organic coatings and finish systems prescribed herein shall be in accordance with MIL-F-18264 or MIL-DTL-53072, as applicable.

5.1.3 Interior surfaces. Primer coating and topcoat, where applicable, as specified in tables I and II, shall be applied to the interior surfaces of items in accordance with MIL-F-18264 or MIL-DTL-53072, as applicable. The primer coating shall be applied such that the dry-film thickness is in accordance with 5.1.5, with the exception that the topcoat may be applied after final assembly, subject to the requirements of 5.2.1. When a topcoat is required for interior surfaces, such as to prevent fluid intrusion or to enhance visibility, and those surfaces are primed and topcoated prior to assembly, a finish coat shall be applied after final assembly. The interior color of the aerospace weapons system shall be in accordance with MIL-C-8779. FED-STD-595, which defines colors used in government procurement, shall be a basis for all color requirements.

TABLE I. PRIMER-TOPCOAT SYSTEM COMPATIBILITY

SPECIFICATION	MIL-PRF-22750 Epoxy Topcoat <u>1/</u>	MIL-DTL-53039 Polyurethane Topcoat <u>2/ 3/</u>	MIL-DTL-64159 Polyurethane Topcoat <u>2/ 3/</u>	MIL-PRF-85285 Polyurethane Topcoat <u>1/ 3/</u>
MIL-PRF-23377 Epoxy Primer <u>1/ 4/ 7/</u>	X	X	X	X
MIL-PRF-85582 Epoxy Primer <u>1/ 4/ 5/ 7/</u>	X	X	X	X
TT-P-2760 Polyurethane Primer <u>1/ 4/ 6/</u>	-	-	-	X

1/ Contains at least one type or class with a VOC of less than or equal to 340 grams/liter (2.8 pounds/gallon). Note: MIL-PRF-85285 is the preferred topcoat for exterior applications, due to the reduced weathering performance of MIL-PRF-22750.

2/ MIL-DTL-53039 and MIL-DTL-64159 are not approved for use on U.S. Air Force airborne weapons systems.

3/ Contains at least one type or class with a VOC of less than or equal to 420 grams/liter (3.5 pounds/gallon).

4/ These coatings are best suited for aluminum and polymer matrix composite substrates.

5/ This material may cause flash rusting on bare steel. Do not use on bare steel unless proven satisfactory for the intended purpose. This material shall not be used for wet-installation purposes (see 5.2.3, 5.2.4, and 5.2.12).

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- 6/ TT-P-2760 is primarily intended for use on aircraft in areas where there is a high degree of structural flexing. TT-P-2760 is to be applied to a dry film thickness of 1.5 to 2.0 mils (38 to 51 μm).
- 7/ Materials conforming to MIL-PRF-23377, class N, or MIL-PRF-85582, class N, shall not be used unless prior authorization is given by the procuring activity.

5.1.4 Exterior surfaces. Primer coatings and topcoats shall be applied to the exterior surfaces of items as specified in 5.1.5 and in accordance with MIL-F-18264 or MIL-DTL-53072 as applicable. The exterior color of the aerospace weapons system shall be as specified by the procuring activity. The exterior color scheme of Department of the Navy and Marine Corps aircraft shall be in accordance with MIL-STD-2161. FED-STD-595, which defines colors used in government procurement, shall be a basis for all color requirements.

5.1.5 Coating thickness. The maximum applied dry-film thickness of the coatings in table I shall be as specified in table III. The minimum applied dry-film thickness of the coatings in table I shall be as specified in table II. On interior surfaces of all materials and on the exterior surfaces of magnesium, the applied dry-film thickness of the coatings shall be not greater than 150 percent of that specified in table III.

5.2 Specific parts requirements. In applying the requirements of this section, the groupings of the more commonly used aircraft metals shall be selected in accordance with MIL-STD-889 and DoD Corrosion Prevention and Control Planning Guidebook, with the exception that the protection requirements specified for attaching parts and fasteners (see 5.2.12) shall take precedence, where applicable. Magnesium surfaces shall be treated in accordance with SAE-AMS-M-3171. A resin coating, in accordance with MIL-PRF-3043 or approved alternative shall be applied, followed by a dry film thickness of primer and topcoat in accordance with 5.1.5 and tables II & III, except for surfaces in oil, lubricating oil, hydraulic fluid and fuel, such as interior surfaces of gearboxes. During manufacture, breaches to this protection scheme shall be repaired using SAE-AMS-M-3171, type VI, followed by resin and/or then primer and topcoat. All faying surfaces containing magnesium shall be sealed and all the edges shall be fillet seal with sealant conforming to MIL-PRF-81733. All fasteners in magnesium substrates shall be wet installed and overcoated with sealant conforming to MIL-PRF-81733.

TABLE II. PROTECTIVE FINISH SYSTEM REQUIREMENTS

Item	Material	Minimum applied dry film thickness, mil (μm)			
		Primer		Topcoat	
		Exterior	Interior	Exterior	Interior
1	All aluminum alloys (except bottoms and interior trailing edge control surfaces, for which item 7 applies).	0.6 (15)	1.2 (30)	1.7 (43)	-
2	Sacrificial metal coatings and non-sacrificial coatings applied to non-corrosion-resistant metals	0.6 (15)	1.2 (30)	1.7 (43)	-
3	Titanium alloys <u>1/</u>	-	-	-	-
4	Magnesium alloys	1.2 (30)	1.2 (30)	1.7 (43)	1.7 (43)
5	Armor plate – ferrous	0.6 (15)	1.2 (30)	1.7 (43)	-
6	Corrosion resistant alloys	0.6 (15)	0.6 (15)	1.7 (43)	-
7	All metals not covered above	0.9 (23)	1.5 (38)	1.7 (43)	-
8	Polymer matrix composites	0.6 (15)	1.2 (30) <u>2/</u>	1.7 (43)	-

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- 1/ These metals do not require primer coating or topcoats for corrosion protection except for faying surfaces as noted in 5.2.1. Primer coatings and topcoats may be applied to blend with adjacent areas (use item 2 requirements).
- 2/ Application of primer on interior surfaces is only required at dissimilar metal interfaces (see 5.2.1.2b).

TABLE III. MAXIMUM APPLIED DRY FILM THICKNESS

Coating	Maximum applied dry film thickness mil (μm)
MIL-PRF-23377	0.9 (23)
MIL-PRF-85582	0.9 (23)
TT-P-2760	2.0 (51)
MIL-PRF-22750	2.3 (58)
MIL-DTL-53039	<u>1/</u>
MIL-DTL-64159	<u>1/</u>
MIL-PRF-85285	2.3 (58)

1/ Refer to MIL-DTL-53072

5.2.1 Fayed surfaces, joints, and seams.

5.2.1.1 Surfaces of similar metals. Seams and joints that possess fayed surfaces (see 3.3) of similar metals, as defined by MIL-STD-889 and DoD Corrosion Prevention and Control Planning Guidebook, shall be protected, at a minimum, by the application of primer coating to each surface, in accordance with 5.2.1 and tables I and II. The dry film thickness of the primer coating shall be as prescribed for interior surfaces (see 5.1.3, 5.1.5 and table II). Exceptions to the above are as follows:

- a. Where 5.1.5 and table II specify application of a specific thickness of primer coating to fayed surfaces, one-half of the required thickness of primer coating may be applied to each surface being joined.
- b. Primer coating shall not be applied to resistance-welded fayed surfaces. Only weld-through sealants approved by the procuring activity shall be used prior to assembly. Primer coating shall be applied to fayed surfaces after spot-welding. All exterior edges shall be sealed.
- c. Fayed surfaces that are to be adhesively bonded shall be surface cleaned, treated, and processed as specified in the procuring activity approved bonding procedures document(s) for the assemblies concerned. Specific guidance is provided in MIL-HDBK-83377. The process specification shall specify the procedure for treatment of faying surfaces of parts to be bonded, and precautions to be taken to eliminate contamination of treated surfaces awaiting application of adhesive or primer.
- d. Titanium to titanium and corrosion resistant steel to corrosion resistant steel constructions shall be protected by application of primer coating (see 5.1.5 and tables I and II) or sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281, to the fayed surfaces. Where protection against fretting is required for these constructions, a method of protection shall be proposed for approval by the procuring activity.
- e. In addition to any required primer coating, all exterior fayed surfaces, seams, and edges shall be sealed with a sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-

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AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281. A minimum gap of 0.02 in. (0.5 mm) is required at exterior surface (see 3.1) butt joints to allow for effective sealing.

5.2.1.1.1 Defect filling. The use of filling material for the purpose of sealing and concealing nicks, dents, gouges, and poor joints is prohibited.

5.2.1.1.2 Surfaces of dissimilar metals. Surfaces of dissimilar metals, as defined in MIL-STD-889 and DoD Corrosion Prevention and Control Planning Guidebook, Spiral 3, of September 2007, shall each receive a minimum of 0.0006 inch (15 μ m) of primer coating in accordance with table I, except as specified in 5.2.1.1c. When fayed surfaces are of dissimilar metals, they shall be sealed with sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281 unless prior authorization for alternative sealants is provided. The thickness of the primer coating applied to each surface shall be in accordance with 5.1.5 and table II. In addition, the following precautions shall be taken:

- a. Where magnesium is part of a dissimilar metal fayed surface, sealant conforming to MIL-PRF-81733 shall be applied between the surfaces and squeezed out of all boundaries. The excess shall be removed in a manner that ensures a fillet on all edges. Except for bushing installations, the fillet width shall be a minimum of 0.25 in. (6.4 mm). For bushings, the fillet shall be the largest practicable. Joint areas that may retain water shall be filled with sealing compound. Exceptions to these materials and requirements shall be authorized by the procuring activity.
- b. In joints constructed of reinforced composite containing electrically conductive phase and aluminum, or other dissimilar metal as defined in MIL-STD-889 and DoD Corrosion Prevention and Control Planning Guidebook, there shall be a glass barrier ply at a minimum thickness of 0.002 inches. The glass barrier ply shall extend a minimum of 1 in. (25.4 mm) beyond the metal member. For condensation polyimide based laminates (e.g., bismaleimide and cyanate ester), the glass barrier ply shall fully cover the laminate surfaces in contact. Primer coating shall be applied to each of the interface surfaces at a dry-film thickness of 1.2 to 1.8 mil (30 to 46 μ m). The surfaces of permanent joints shall be fayed and sealed with sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281. Joints that require separation as part of normal maintenance may have formed-in-place seals substituted for fayed surface sealing.

5.2.2 Sealing. For exterior locations (see 3.1), openings (with the exception of drain holes at low points) which are not required for aircraft operations, shall be sealed to prevent fluid intrusion from external sources. Sealing around access plates shall be accomplished by the application of formed-in-place sealant, seals, or gaskets to the structure in a manner such that the access plates can be removed without damaging the surrounding metal.

5.2.3 Slip fits. The sealing of slip fits shall be accomplished with wet primer coating conforming to MIL-PRF-23377, class C1 or C2, or wet sealant conforming to MIL-PRF-81733 or SAE-AMS3265. If design requires disassembly, primer coating conforming to MIL-PRF-23377, class C1 or C2, shall be applied and permitted to dry thoroughly prior to assembly. In

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instances where the above materials are incompatible with the function of the part or assembly, corrosion preventive compound conforming to MIL-PRF-16173, grade 3 or 4, shall be used.

5.2.4 Press fits. The sealing of press fit component assemblies, with the exception of assemblies permanently housed in grease or oil, shall be accomplished with either wet primer coating conforming to MIL-PRF-23377, Class C1 or C2, or wet sealant conforming to MIL-PRF-81733 or SAE-AMS3265. Exterior edges of the press fit component shall be sealed with sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281, with the exception that sealing with primer coatings (see 5.1.5 and table I) may be used for bushings with walls of 0.094 in. (2.4 mm) or less. The completed assembly shall then be finished as specified in 5.1.5 and tables I and II. Parts permanently housed in grease or oil shall be assembled with the grease or oil to be used in the housing.

5.2.5 Cut edges. The edges of all metals shall be chamfered or rounded to permit adhesion of an adequate thickness of applied paint coatings or sealants. After rounding of the edges and prior to the application of paint or sealant, chemical surface treatments shall be applied in accordance with MIL-S-5002.

5.2.6 Functional surfaces. Paint-type coatings shall not be applied to functional, working, or wearing surfaces; to lubricated surfaces; to adjustable screw threads; to lubrication holes; to bearing or sliding surfaces; to areas where they could be rubbed or scraped onto surfaces that must be clean and bare to function properly; or to any other surface where the application of the coating may cause malfunction of the part or system. The interior walls of drain holes shall be coated with paint-type coatings for corrosion protection.

5.2.7 Control cables and control chains. Control cables and control chains shall not be painted. However, prior to installation, control cables shall be protected with a dip-coating of corrosion preventive material conforming to MIL-PRF-16173, grade 4, with the exception of those surfaces requiring lubrication for functional purposes. Those surfaces requiring lubrication shall be cleaned and coated with the required lubricant in lieu of corrosion preventive material. After installation, the control cables and control chains shall be inspected. If touch-up of the corrosion preventive compound is necessary, touch up shall be accomplished with the same material used prior to installation. Nylon jacketed cables do not require treatment, with the exception of exposed end fittings.

5.2.8 Closely coiled springs. Springs that are closely coiled, preventing the application of plating to internal surfaces, or springs not plated for other reasons, shall receive a minimum of 0.0012 inch (31 μ m) of primer coating conforming to MIL-PRF-23377 type I or II, class C1 or C2, or shall be coated with corrosion preventive compound conforming to MIL-PRF-16173, grade 4, or MIL-C-11796, class 2.

5.2.9 Parts in oil or grease. Parts that are housed in lubricating oil, hydraulic oil, or grease shall be finished with a baked resin coating conforming to MIL-PRF-3043, applied in accordance with MIL-C-5056. Parts constructed of corrosion-resistant metals need not be coated, unless they contact dissimilar metals. Functional surfaces, such as bearing surfaces, shall not be coated.

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5.2.10 Metal tanks.

5.2.10.1 Temporary and auxiliary fuel tanks. The interior surfaces of aluminum alloy tanks shall be surface treated in accordance with MIL-DTL-5541, class 1A, using materials qualified to MIL-DTL-81706, or anodized in accordance with MIL-A-8625, type II. The interior surfaces of aluminum alloy tanks shall be finished with coating conforming to SAE-AMS-C-27725, unless otherwise specified by the specific engineering directive. The interior of steel tanks shall be finished with baked resin coating conforming to MIL-PRF-3043 or approved alternative, applied in accordance with MIL-C-5056. Sealants conforming to SAE-AMS-S-8802, SAE-AMS3276, SAE-AMS3277, SAE-AMS3281, or SAE-AMS-S-4383 or coating conforming to SAE-AMS-C-27725 may be used in lieu of MIL-PRF-3043 when authorized by the procuring activity. Where coating conforming to SAE-AMS-C-27725 is specified, type III shall not be used unless prior authorization is given by the procuring activity.

5.2.10.2 Welded fuel tanks (including welded external auxiliary fuel tanks). The interior surfaces of aluminum tanks shall be thoroughly cleaned and surface treated in accordance with MIL-DTL-5541, class 1A, using materials qualified to MIL-DTL-81706, and interior surfaces that are fayed, whether sealed or not, shall be coated with 0.0009 to 0.0015 in. (23 to 38 μ m) of corrosion preventive coating conforming to SAE-AMS-C-27725. SAE-AMS-C-27725 shall not be applied to exterior surfaces. Droppable steel tanks shall be finished on the interior with a baked resin finish conforming to MIL-PRF-3043, applied in accordance with MIL-C-5056, or coated with sealants conforming to SAE-AMS-S-8802, SAE-AMS3276, SAE-AMS3277, SAE-AMS3281, or SAE-AMS-S-4383. Coating conforming to SAE-AMS-C-27725 may be used in lieu of the finishes specified above when authorized by the procuring activity. Where coating conforming to SAE-AMS-C-27725 is specified, type III shall not be used unless prior authorization is given by the procuring activity.

5.2.10.3 Integral and riveted fuel tanks. The inside surface of integral or permanently fastened, such as riveted, fuel tanks shall be finished and sealed with sealant conforming to SAE-AMS-S-8802, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281 to prevent corrosion and leakage of fuel. Interior surfaces that are fayed, whether sealed or not, shall be coated with 0.0009 to 0.0015 inch (23 to 38 μ m) of corrosion preventive coating conforming to SAE AMS-C-27725. Where coating conforming to SAE-AMS-C-27725 is specified, type III shall not be used unless prior authorization is given by the procuring activity. SAE AMS-C-27725 shall not be applied to exterior surfaces.

5.2.10.4 Lubricating oil and hydraulic fluid tanks. The inside surfaces of lubricating oil tanks constructed of corrosion-resistant materials shall not be painted. Tanks of other materials shall be finished with a baked resin coating conforming to MIL-PRF-3043, applied in accordance with MIL-C-5056.

5.2.10.5 Miscellaneous aluminum alloy tanks. Interior surfaces of miscellaneous aluminum alloy tanks, with the exception of potable water tanks, shall be surface treated in accordance with MIL-A-8625, type II, or MIL-DTL-5541, class 1A, using materials qualified to MIL-DTL-81706. The interior surfaces of potable water tanks shall not be painted or conversion coated.

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5.2.11 Tubing.TABLE IV. TUBING CATEGORIES AND REQUIRED COATINGS.

Category	Category description	Primer coating <u>1/</u>	Final paint system <u>2/</u>
I	Single tubes having separable connections at each end.	Applied after all required forming operations have been completed and prior to fabrication of the assembly.	Topcoat applied after fabrication and prior to installation.
II	Assemblies made up of individual tubes permanently joined by nonseparable type fittings (brazing, welding, swaging) and having separable type connectors at each end.	Primer coating applied, followed by application of sealant (SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281) after all required bending and permanent joining has been completed and prior to final fabrication of the assembly.	Same as for category I
III	Single or multiple tube assemblies having one or more free ends shall be permanently joined by nonseparable type fittings.	Same as for category II. For tube assemblies employing a permanent joining process not compatible with the primer coating during fabrication, the primer coating may be omitted from the affected free ends at a distance acceptable to the procuring activity.	Same as for category I. For assemblies having been only partially primed, additional primer coating shall be applied as required, followed by the coating of all nonseparable joints with sealant (SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281), followed by the required exterior paint system.
IV	Other types of tube assemblies not covered in categories I, II, or III. For this category, a paint protection system shall be established that is acceptable to the procuring activity	Not applicable.	Not applicable.

1/ Apply primer coatings in accordance with tables I, II and III as applicable. Assemblies in categories I, II, and III, in which sleeves or ferrules are used in the separable connection, and the sleeves or ferrules are fixed in position by deformation of one or both members into contact, the primer coating need not extend beyond the initial point of intimate contact. For all tubing categories where flare fittings are used, primer coating shall be applied to the end of the tube.

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- 2/ Any damage occurring to the finish system during installation shall be touched up.
For aluminum plumbing lines, see 5.2.11.1.2

5.2.11.1 Nonstructural tubing. With the exception of tubing constructed of titanium alloy, corrosion-resistant steel alloy, heat-resistant steel alloy, and as otherwise specified herein, all nonstructural tubing and plumbing lines shall receive the complete interior or exterior paint system, as applicable, on the exterior of the lines, and shall be protected in accordance with table IV. In addition, the requirements specified in 5.2.11.1.1 – 5.2.11.1.3 apply:

5.2.11.1.1 Oxygen tubing. Surface finishes (paints, primer coatings, and other organic coatings) and conversion treatments (anodizing or non-electrochemical conversion coatings) are not to be applied to the interior of oxygen tubing. Oxygen tubing is to be thoroughly cleaned of all contaminants prior to and following any mechanical processing being performed.

5.2.11.1.2 Aluminum tubing and plumbing lines. Interior and exterior surfaces of aluminum-alloy tubing and plumbing lines shall be surface-treated in accordance with MIL-DTL-5541, class 1A, or MIL-A-8625, type II. The exterior of aluminum plumbing lines in fuel tanks that are not made from either 5052 or 6061 requires the application of a corrosion preventive coating conforming to AMS-C-27725. Paint coatings shall not be applied to the interior surfaces of airspeed indicator tubing or other sensing lines. Aluminum tubing used in fire-extinguishing systems employing halogenated agents shall be finished internally and externally with a baked resin coating conforming to MIL-PRF-3043, applied in accordance with MIL-C-5056.

5.2.11.1.3 Protection of tubing joints after installation. After installation of the tube assemblies, all remaining non-sealed joints that will not be disconnected during normal servicing, shall receive a coating of sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281, followed by the appropriate top coating. All remaining nonsealed joints that must be disconnected during normal servicing operations shall be coated with corrosion preventive compound conforming to MIL-PRF-16173, grade 4, or MIL-DTL-85054, which shall seal all exposed spaces between the parts. A second coat of the same material shall be applied to the same areas after a period of 60 minutes. Contractor-prepared maintenance instructions shall require periodic reapplication of this material in-service.

5.2.11.2 Structural tubing.

5.2.11.2.1 Structural carbon steel tubing. All exterior surfaces and all interior surfaces without completely welded or crimped ends of structural carbon steel tubular assemblies shall be finished in accordance with 5.2.5, tables I and II, and as specified in 5.2.11.2.1 a – c, where applicable:

- a. Assemblies completely closed by welding or to which the application of primer coating is impractical or ineffective, such as crimped-end tubing not closed by welding or tubing heat treated after assembly, shall be treated after assembly with corrosion preventive compound conforming to MIL-C-11796, classes 1 or 1A, or MIL-PRF-16173, grades 2 or 4. The corrosion preventive compound shall be applied under pressure into the hollow member through holes drilled in the tubing, or by immersion of the tubing in a bath of the preservative.

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- b. For large tubing structures, interconnecting holes may be drilled between members to promote circulation of the corrosion preventive compound, described in 5.2.11.2.1a.
- c. Parts subjected to immersion in corrosion preventive oil shall be manipulated in such a manner as to ensure the absence of air pockets and shall remain in the bath until all bubbling has ceased. The members shall be thoroughly drained after treatment and all access holes drilled in the members shall be closed with cadmium plated, self-tapping screws, or blind rivets. Where cadmium alternative coatings are proposed, they are subject to approval of the procuring activity. The screws or rivets shall be wet installed with sealant conforming to MIL-PRF-81733 or SAE-AMS3265, and overcoated with the same after installation. The exterior surface of the tubing assemblies shall be free of oil, grease, and dirt prior to application of the prescribed finish system.

5.2.11.2.2 Structural aluminum-alloy tubing. Interior surfaces of structural aluminum-alloy tubing shall be protected in accordance with 5.1.5 and tables I and II. The interior surfaces of structural aluminum-alloy tubing closed by welding shall be coated with primer coating conforming to MIL-PRF-23377, Types I or II, classes C1 or C2, or corrosion preventive compound conforming to MIL-PRF-16173, grade 2 or 4, applied through appropriately drilled holes.

5.2.11.2.3 Structural copper alloy, corrosion-resistant alloy, and heat-resistant alloy tubing. Interior and exterior surfaces of structural copper alloy, corrosion-resistant alloy, and heat-resistant alloy tubing need not be painted, except as required for dissimilar metal contact.

5.2.11.3 Mechanical attachment. Tubular parts that have fittings mechanically attached shall have all edges of the attachment sealed with a sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281.

5.2.12 Attaching parts and fasteners.

5.2.12.1 General finish. Attaching parts and fasteners, such as screws, nuts, bolts, bushings, spacers, washers, rivets, high-shear rivets, self-tapping screws, sleeves for "shake-proof" fastener studs, self-locking nuts, "speed nuts," and clamps, need not be painted in detail, except when dissimilar metals are involved in the materials being joined. All attaching parts and fasteners, or the surfaces with which they are in contact, shall be wet installed with primer coating conforming to MIL-PRF-23377, class C1 or C2, or sealant conforming to MIL-PRF-81733 or SAE-AMS3265. Primer coating or sealant shall not be applied to the threaded portions of fasteners for which torque requirements are established without the coating. For new acquisitions, when installed in interior aluminum structures, all non-aluminum fasteners shall be overcoated with sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281. For legacy applications, all non-aluminum fasteners in interior aluminum structures shall also be overcoated with sealant, unless otherwise specified by local engineering directive. Dry-film thickness of sealant shall be a minimum of 0.006 inch (152 μ m). For magnesium dissimilar metal combinations, 5.2.1.2 shall apply. Fasteners expected to be frequently removed (see 3.5) may be installed with corrosion preventive compound if holes are first primed with MIL-PRF-23377, class C1 or C2 and allowed to completely dry prior to installing the fastener.

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5.2.12.2 Close tolerance bolts. Prior to installation, close tolerance bolts shall receive application of primer coating conforming to MIL-PRF-23377, class C1 or C2, or sealant conforming to MIL-PRF-81733 or SAE-AMS3265, except where frequent removal of the bolts is required. For close tolerance bolts requiring frequent removal, use corrosion preventive compound conforming to MIL-C-11796, class 3, or MIL-PRF-16173, grade 4, or corrosion-inhibiting, solid film lubricant conforming to MIL-PRF-46010 or MIL-L-23398. MIL-PRF-46010 requires heat curing and shall not be used on aluminum parts whose temper (strength) would be adversely affected. MIL-L-23398 is air curing and may be used on all types of metallic parts. When a solid film lubricant is used, it shall be applied and completely cured prior to assembly. The bolt shall then be wet installed and fillet sealed (after installation) with sealant conforming to MIL-PRF-81733 or SAE-AMS3265.

5.2.12.3 Adjustable parts. Threads of adjustable parts, such as tie rods and turnbuckles, shall be lubricated and protected, both before and after assembly, with anti-seize compound conforming to MIL-PRF-83483, corrosion preventive compound conforming to MIL-PRF-16173, grade 3, or lubricating oil conforming to MIL-PRF-32033, followed by corrosion preventive compound conforming to MIL-PRF-16173, grade 2.

5.2.12.4 Touch-up. All attaching parts shall receive final coating after installation. Topcoats shall be applied over the primer coating to match the color of adjacent exterior surfaces, when necessary. Nuts and heads of bolts in joints that are subsequently lubricated need not receive final finishing.

5.2.12.5 Washers. Washers constructed of aluminum alloys or high pressure phenolic laminates shall be used under machine screws, countersunk fasteners, bolt heads and nuts that would otherwise contact magnesium and shall be wet installed and fillet sealed after installation with sealant conforming to MIL-PRF-81733 or SAE-AMS3265.

5.2.13 Areas subjected to corrosive fluids. Battery compartments constructed of leakproof and corrosion resistant material require no further finishing. All other battery compartments and adjacent areas subject to vapors and spills shall be coated with a polyurethane casting resin approved by the procuring activity. All bilge areas, all surfaces within 24.0 in. (610 mm) of urinals, and all areas beneath lavatories and galleys shall be finished with a primer coating conforming to MIL-PRF-23377 class C1 or C2 or MIL-PRF-85582 class C1 or C2 applied to a dry film thickness of 0.0009-0.002 inch (23-51 μm) and topcoated with coating conforming to MIL-PRF-85285, in accordance with 5.1.5 and tables I and II for exterior surfaces.

5.2.14 Electrical parts.

5.2.14.1 Connections. The exterior of electrical bonding and ground connections conforming to MIL-STD-464 shall be finished in accordance with 5.2 and table II after installation. All permanent electrical bonds, such as jumpers and ground studs, shall be sealed after installation with sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281. Connectors not permanently sealed shall be internally and externally protected with material conforming to MIL-PRF-81309, type III, unless

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prohibited by the procuring activity. Permanently mated electrical connectors shall be sealed after installation with sealant conforming to SAE-AMS-S-8802, SAE-AMS3277, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276 or approved alternative. Alternative sealing methods that have demonstrated water tightness and corrosion protection may be used if approved by the procuring agency.

5.2.14.2 Conduit and boxes. Electrical conduit and junction or relay boxes shall receive protection in accordance with 5.1.5 and tables I and II. Plastic coated and braided wire shall not be coated.

5.2.14.3 Electrical connector pins and sockets. Electrical connector pins and sockets shall have a thin, continuous coat of MIL-PRF-81309, type III, applied to the pins and pin receptacle end of the connector prior to mating the connector halves. The connector shells shall then be coated with MIL-PRF-81309, type III after mating the connector halves, unless prohibited by the procuring activity.

5.2.14.4 Antennas and Static Dischargers. External antennas and static discharger mounting bases shall be adequately sealed to prevent moisture intrusion into fuselage surface mating area. The preferred method of sealing is through use of conductive gaskets that provide maximum environmental protection from both internal and external moisture sources without introducing incompatible dissimilar metals or compromising electrical bonding requirements. In areas of high fluid exposure, a perimeter seal shall be applied using SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3277, SAE-AMS3276, SAE-AMS3265, or SAE-AMS3281, unless a waiver is approved by the procuring authority.

5.2.15 Surfaces and components exposed to high temperatures. Surfaces and components that are exposed to high temperatures, either on the ground or in flight, shall be finished as follows:

- a. Where primer and/or topcoat is specified in areas subjected to sustained service temperatures up to 350°F (177°C), primers and topcoats specified in section 5.1 and tables I and II may be used.
- b. Where primer and/or topcoat is specified in areas subjected to sustained service temperatures in excess of 350°F (177°C), high-temperature resistant materials shall be used. Any alternative finishes and coatings for high-temperature applications shall be approved by the procuring activity prior to use. The request for approval shall include all necessary technical information concerning the proposed material and application, with data supporting the effectiveness of the coating system.
- c. Where sealants are specified in areas exposed to service temperatures in excess of 300°F (149°C), sealant selection for each application shall be approved by the procuring activity.

5.2.16 Molded plastic and ceramics. Transparent plastic parts shall not be painted. Other plastic parts (except fiberglass laminates, antennae, and radomes (see 5.2.19)) need not be painted, except for color-matching purposes. Plastic or ceramic insulators (used for radio antennae) shall not be painted. Their edges, however, shall be sealed with sealant conforming to SAE-AMS-S-8802, SAE-AMS3276, SAE-AMS3277, or SAE-AMS3281, after installation in exterior locations.

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5.2.17 Finishing of ducts. The interior surfaces of aluminum alloy heating and cooling ducts need not be painted, provided that those surfaces have been anodized in accordance with MIL-A-8625, type II, and sealed. Aluminum alloy duct work treated in accordance with MIL-DTL-5541, class 1A, shall be painted as required for interior surfaces (see table II). Prior to application of insulation material, the exterior surfaces of insulated duct work, regardless of composition, shall be coated with material to withstand the temperatures and environment of the system. Titanium and nickel alloys do not require painting.

5.2.18 Reinforced plastic components. Plastic parts reinforced with fibers shall be finished for protection against erosion and environmental degradation. Leading edges of fiber-reinforced plastic radomes, antennae, and other components exposed to the air stream, shall be finished with a rain-erosion resistant coating conforming to AMS-C-83231, AMS-C-83445, or MIL-C-85322. Other methods of protection, such as a boot or tapes made of erosion and high temperature-resistant material, may be used when approved by the procuring activity. In exterior locations, boot or tape edges shall be sealed with sealant conforming to SAE-AMS-S-8802, MIL-PRF-81733, SAE-AMS3265, SAE-AMS3276, SAE-AMS3277, SAE-AMS3281, or an alternative approved sealing compound. Transparent components, whether glass or plastic, shall not be painted. Plastic parts and surfaces, other than those described above may be painted for color-matching purposes.

5.2.19 Metal leading edges. Exterior surfaces of metallic leading edges exposed to speeds in excess of 500 knots shall be finished with rain erosion-resistant coatings in accordance with MIL-F-18264. Other methods of protection, such as a boots or tapes made of erosion- and high temperature-resistant material, may be used when approved by the procuring activity. Exterior surfaces shall be aerodynamically smooth.

5.2.20 Helicopter rotor-blade leading edges. The finishing system used on the leading edges of helicopter rotor blades shall prevent deterioration of the underlying surfaces and shall be resistant to erosion from rain, sand particles, sea spray, and insects. This type of finishing system is not necessary when the edges are made of corrosion-resistant and erosion-resistant material, such as nickel, or stainless steel, unless specified by the procuring activity.

5.2.21 Rubber (natural and synthetic). Natural and synthetic rubber shall not be painted, greased, or oiled. Exceptions may be made when the part manufacturer or a relevant technical manual require parts to be greased or oiled prior to installation or when placed in long-term storage.

6. NOTES

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

6.1 Intended use. This standard covers the standard methods and materials used for the protective surface treatments and finishes used on aerospace weapons system parts (including spares) and assemblies (such as fuselages, wings, cowlings, empennage, and rotor blades). This

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standard does not intend to address the application of solid film lubricants as a finishing system, nor does it address electroplating or other metallic coatings. This standard does not apply to equipment (such as propellers, electrical and electronic equipment, power plants, and instruments) or to standard contractor purchased accessories, (such as electric motors, generators, switches, hydraulic valves, and similar parts), unless specifically referenced in the item specification or drawing.

6.2 Acquisition requirements. Acquisition documents should specify the title, number, and date of this standard.

6.3 Associated Data Item Descriptions (DIDs). This standard has been assigned an Acquisition Management Systems Control number authorizing it as the source document for the following DIDs. When it is necessary to obtain the data, the applicable DIDs must be listed on the Contract Data Requirements List (DD Form 1423).

<u>DID NUMBER</u>	<u>DID TITLE</u>
DI-MFFP-81402	Finish specification report

The above DID was current as of the date of this standard. The ASSIST database should be researched at <http://assist.daps.dla.mil/quicksearch/> to ensure that only current and approved DIDs are cited on the DD Form 1423.

6.4 Subject term (key word) listing.

Corrosion prevention
Finish specification
Protective coatings
Surface treatments

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

Custodians:
Army – MR
Navy – AS
Air Force - 11

Preparing Activity
Navy - AS
(Project MFFP-2009-005)

Review activities:
Army - AR, AV, MI
Navy - CG, MC
Air Force - 84, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.