Downloaded from http://www.everyspec.com

INCH-POUND

MIL-PRF-32239A
1 OCT 2014

SUPERSEDING
MIL-PRF-32239
3 MAY 2007

PERFORMANCE SPECIFICATION

COATING SYSTEM, ADVANCED PERFORMANCE, FOR AEROSPACE APPLICATIONS

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

1. SCOPE

1.1 Scope.

This specification establishes the requirements for coating systems having high durability for use as aircraft exterior surface finishes. These coating systems normally are comprised of a surface treatment, a primer, and a topcoat and include a chemical stripper and a cleaning compound for topcoat washing.

1.2 Application.

Coating systems are qualified for use on external surfaces of military aircraft but are not limited to such application. If the coating systems qualified to this specification are to be used on other than external surfaces, further testing will be required for the specific application.

Comments, suggestions, or questions on this document should be addressed to AFLCMC/ENRS, 2145 Monahan Way, Bldg. 28, and Wright-Patterson AFB, OH, 45433-7017 or emailed to Engineering.Standards@us.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil/.

AMSC N/A FSC 8010

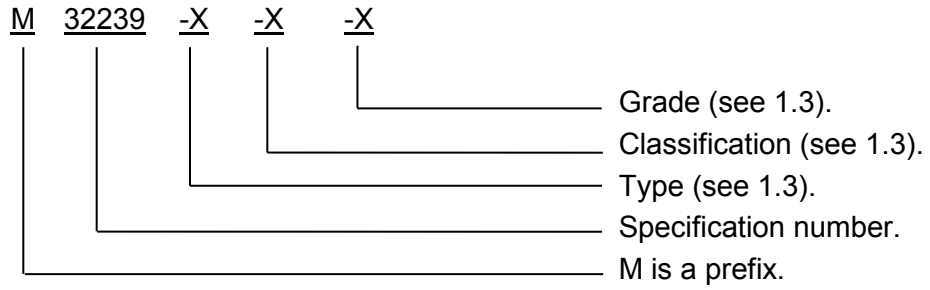
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

Downloaded from http://www.everyspec.com

1.3 Classification.
The coating systems under this specification consist of the following types, classes, and grades.

Type 1	Coating system containing chromium compounds with Skydrol LD-4 resistance.
Type 2	Coating system, chromium free with Skydrol LD-4 resistance.
Type 3	Coating system containing chromium compounds.
Type 4	Coating system, chromium free.
Class 1	Standard flexibility coating system.
Class 2	High flexibility coating system.
Grade 1	Standard pigmented coating system.
Grade 2	Low-infrared (IR) pigmented coating system.

1.3.1 Part or Identifying Number (PIN).
PINs to be used for the coating system acquired to this specification are created as follows:



1.4 Colors.
Coating systems should be furnished in all colors and gloss ranges and should conform to FED-STD-595. Colors not in conformance with FED-STD-595 should be furnished as specified by the procuring activity.

1.5 Safety-hazardous materials.
While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe, proper use, and disposal of any hazardous materials and to take precautionary measures necessary to protect the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

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

Downloaded from http://www.everyspec.com

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 cited in the solicitation or contract.

FEDERAL STANDARDS

FED-STD-595	Colors Used in Government Procurement
FED-STD-595/11136	Red, Gloss
FED-STD-595/12197	Orange, Gloss
FED-STD-595/13538	Yellow, Gloss
FED-STD-595/36118	Gray, Lusterless

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-8507	Coating, Wash Primer (Pretreatment) for Metals, Applications of (for Aeronautical Use)
MIL-C-8514	Coating Compound, Metal Pretreatment, Resin-Acid
MIL-PRF-23377	Primer Coatings: Epoxy, High-Solids
MIL-PRF-23699	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base, NATO Number O-156.
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537
MIL-PRF-85285	Coating: Polyurethane, Aircraft and Support Equipment
MIL-PRF-85570	Cleaning Compounds, Aircraft, Exterior
MIL-PRF-87937	Cleaning Compounds, Aerospace Equipment

DEPARTMENT OF DEFENSE HANDBOOK

MIL-HDBK-831	Preparation of Test Reports

(Copies of these documents are available online at http://quicksearch.dla.mil. For information relating to FED-STD-595, email fedstd595@gsa.gov.)

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 of these documents are those cited in the solicitation or contract.

AIR FORCE TECHNICAL ORDER (AFTO)

TO 1-1-8	Application and Removal of Organic Coatings, Aerospace and Non-Aerospace Equipment

(Copies of this document are available from AFRL/RXSSO (CTIO), Building 652 Room 122, 2179 12th Street, WPAFB, OH 45433-7718.)

Downloaded from http://www.everyspec.com

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.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

NASM24693	Screw, Machine, Flat Countersunk Head, 100°, Cross Recessed, UNC-2A and UNF-2A

(Copies of this document are available online at http://www.aia-aerospace.org.)

ASTM INTERNATIONAL

ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus (DoD adopted)
ASTM G154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials (DoD adopted)
ASTM D522	Standard Test Method for Mandrel Bend Test of Attached Organic Coatings
ASTM D523	Standard Test Method for Specular Gloss (DoD adopted)
ASTM D1193	Standard Specification for Reagent Water
ASTM D1200	Standard Test Method for Viscosity by Ford Viscosity Cup (DoD adopted)
ASTM D2243	Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings (DoD adopted)
ASTM D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates (DoD adopted)
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity. (DoD adopted)
ASTM D2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) (DoD adopted)
ASTM D2805	Standard Test Method for Hiding Power of Paints by Reflectometry (DoD adopted)
ASTM D3335	Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy (DoD adopted)
ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D3363	Standard Test Method for Film Hardness by Pencil Test (DoD adopted)
ASTM D3718	Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy (DoD adopted)
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings (DoD adopted)

(Copies of these documents are available online at http://www.astm.org.)

Downloaded from http://www.everyspec.com

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1513	Paints and Varnishes - Examination and Preparation of Samples for Testing
ISO 15528	Paints, Varnishes and Raw Materials for Paints and Varnishes – Sampling

(Copies of these documents are available online at http://webstore.ansi.org.)

SAE INTERNATIONAL

AMS QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet – UNS A92024 (DoD adopted)
AMS QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet – UNS A82024 (DoD adopted)
AMS QQ-A-250/12	Aluminum Alloy 7075, Plate and Sheet – A97075 (DoD adopted)
AMS 3819	Cloths, Cleaning, for Aircraft Primary and Secondary Structural Surfaces (DoD adopted)
AMS 4911	Titanium Alloy, Sheet, Strip and Plate 6AL-4V, Annealed (DoD adopted)
AS 9100	Quality Management Systems – Aerospace – Requirements (DoD adopted)

(Copies of these documents are available online at http://www.sae.org/.)

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. REQUIREMENTS

3.1 Qualification.
The coating system furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Materials.
The coating system shall consist of a surface treatment, a primer, and a topcoat. The coating system shall also include, in the form of commercial-off-the-shelf products, a chemical stripper and a cleaning compound for topcoat washing. The aforementioned products are the minimum products necessary to achieve the performance requirements detailed herein. Unicoat systems are acceptable. Composition of the coating system components are not specified (see 3.2.1).

3.2.1 Non-qualification of system components.
This specification does not qualify cleaners or chemical strippers. Qualified products for cleaners shall be selected from the qualified products list (QPL) of MIL-PRF-87937, Type IV, or MIL-PRF-85570, Type II. Qualified products for applicable chemical strippers shall be selected from TO 1-1-8.

Downloaded from http://www.everyspec.com

3.3 Coating system components.
The coating system normally comprised of a surface treatment, a primer, and a topcoat, as well as a chemical stripper and a cleaning compound for topcoat washing, shall consist of the minimum number of products necessary to achieve the performance requirements detailed herein. Unicoat systems are acceptable. Composition of the coating system components are not specified (see 3.3.1).

3.3.1 Restrictions in chemical composition.
When tested in accordance with ASTM D3335, no component of any system element shall contain cadmium or cadmium compounds, or more than 0.05 percent lead or lead compounds. When tested in accordance with ASTM D3718, Types 2 and 4 system components shall not contain chromium or chromium compounds.

3.3.2 Toxicity.
Manufacturers of system components shall certify that any materials supplied under this specification shall have no adverse effect on the health of personnel when used for its intended purpose and with the precautions identified on shipping containers and on the material safety data sheet (see 6.3.4).

3.4 System component physical requirements.
Coating system physical requirements are summarized in Table I.

TABLE I. Physical requirements.

Property	Requirement	Conditioning	Test Method
Quality	3.4.1	As received in original container	ISO 1513
Storage Stability	3.4.2	As received in original container	4.6.1
Accelerated Storage Stability	3.4.3	As received in original container	4.6.2
Freeze/Thaw Stability	3.4.4	As received in original container	4.6.3
VOC content	3.5.1 Primer - 340 g/l Topcoat - 420 g/l	Mixed, prepared for application	4.6.4
Odor	3.5.2	Mixed, prepared for application	4.6.5
Viscosity/Pot Life	3.5.3	Mixed, prepared for application	4.6.6
Drying Time	3.5.4	Applied on test panels	4.6.7
Wet-Edge	3.5.5	Applied on test panels	4.6.8

3.4.1 Quality.
Coating system components taken from original containers as received shall be free from extraneous matter and show no skinning, gelling, hard settlement, or other objectionable properties which will prevent satisfactory application to produce a defect-free film.

a. All Materials or Components — Materials or components shall be capable of being reincorporated into a smooth, homogenous, and pourable mixture. It shall be free of grit, skin, seeds, lumps, foreign contaminants, and thickening or livering.

Downloaded from http://www.everyspec.com

b. Pretreatment Powders — System components supplied in powder form shall be uniform in composition and quality, and be free from impurities and other defects that impair usability and adversely affect performance when the powder is mixed with water or other materials as specified by the manufacturer under normal agitation in preparation for use.

c. Mixing — All components shall be readily miscible when mixed according to manufacturer's instructions.

3.4.2 Storage stability.

a. The contents of each component of the coating system or premixed liquid surface pretreatment, as packaged by the manufacturer, shall meet all requirements of this specification when tested in accordance with 4.6.1. A subset of testing shall be performed using coating system components that have been subjected to the requirements of this paragraph. The subset of requirements and corresponding tests shall be 3.5.3, 3.6.1, 3.6.4, 3.6.6.1, 3.6.7.1, and for 3.6.8, use MIL-PRF-83282 only.

b. For touch-up and repair kits, contents of the coating system material or premixed liquid surface pretreatment repackaged by manufacturers' approved packaging companies shall meet all the requirements of this specification after one year minimum indoor storage from date of repackaging, where the daily temperature of the ambient air is maintained between 35 to 95 °F (1.7 to 35 °C).

3.4.3 Accelerated storage stability.

Each component of the coating system excluding the system pretreatment, cleaner and chemical stripper shall meet all the requirements of this specification when tested in accordance with 4.6.2. The accelerated storage conditions shall be seven days at 140 ±5 °F (60 ±3 °C). A subset of testing shall be performed on the coating samples that have been subjected to the requirements of this paragraph. The subset of requirements and corresponding tests shall be 3.5.3, 3.6.1, 3.6.4, 3.6.6.1, 3.6.7.1, and for 3.6.8, use MIL-PRF-83282 only.

3.4.4 Freeze/thaw stability.

Water based components, excluding the system pretreatment, cleaner, and chemical stripper, as packaged by the manufacturer, shall meet all the requirements specified herein after being subjected to five cycles of freezing and thawing when tested in accordance with 4.6.3. A subset of testing shall be performed on the coating samples that have been subjected to the requirements of this paragraph. The subset of requirements and corresponding tests shall be 3.5.3, 3.6.1, 3.6.4, 3.6.6.1, 3.6.7.1, and for 3.6.8, use MIL-PRF-83282 only.

3.5 Admixed product properties.

3.5.1 VOC content.

The maximum VOC content at application of system coatings classified as primers shall be no greater than 340 g/l (2.8 lbs./gal). The maximum VOC content at application of system coatings, classified as topcoats, shall be no greater than 420 g/l (3.5 lbs./gal). Testing shall be in accordance with 4.6.4.

3.5.2 Odor.

The air-dried coating system shall retain no residual odor 48 hours after application, when tested in accordance with 4.6.5.

3.5.3 Viscosity and pot-life.

a. The viscosity/consistency of surface pretreatment materials shall be suitable for

Downloaded from http://www.everyspec.com

application to aircraft surfaces by spray or brush. The viscosity/consistency of primers and topcoats shall be suitable for application by conventional, high volume, low pressure (HVLP), airless, and electrostatic spray (suitably equipped in the event of water based materials). Coating manufacturers shall define the recommended application viscosity range when tested in accordance with 4.6.6.

b. The pot-life requirement is as follows: four hours after initial mixing, primers and topcoats shall meet the performance and application requirements of this specification. A subset of testing shall be performed on the coating samples that have been subjected to the requirements of this paragraph. The subset of requirements and corresponding tests shall be 3.6.1, 3.6.4, 3.6.6.1, 3.6.7.1, and for 3.6.8, use MIL-PRF-83282 only. Test panels for this requirement shall be created by applying the primer four hours after mixing the primer, then applying the topcoat four hours after mixing the topcoat.

3.5.4 Drying time.

Coating system components designated as surface pretreatments shall be dry to prime within four hours. Coating system components designated as primers shall be dry to topcoat within five hours. Coating system components designated as topcoats shall be dry to tape with no adhesion loss or permanent marring in eight hours or less when tested in accordance with 4.6.7. As an alternative, the total time to apply pretreatment, primer, and topcoat to a dry-to-tape condition shall be 17 hours or less.

3.5.5 Wet-edge.

There shall be no streaks, tiger stripes, or other visual irregularities on the test panels when tested in accordance with 4.6.8.

3.6 Applied coating system requirements.

Table II lists the applied coating system requirements.

TABLE II. Cured coating system requirements.

Property	Requirement	Conditioning	Test Method
Surface Appearance	3.6.1	Air dry 24 hours minimum.	Visual Observation
Color	3.6.2 – $\Delta E \leq 1.0$		4.6.9
IR Reflectance	3.6.3 – 8 percent max.		4.6.10
Gloss	3.6.4 – Camouflage: 9 max. – 85° 5 max. – 60° Gunship: 3 max – 85° 3 max – 60° Semigloss: 15 to 45 max. – 60° Gloss: 90 min. – 60°		4.6.11
Opacity	3.6.5 – All Colors: Contrast Ratio ≥ 0.95 Red 11136, Orange 12197, Yellow 13538: Contrast Ratio ≥ 0.90		4.6.12
Adhesion			
Wet Tape	3.6.6.1 – No delamination or peel and a classification of no less than 4A.		4.6.13
Cross-Hatch	3.6.6.2 – No delamination or peel and a classification of no less than 4B.		4.6.14

Downloaded from http://www.everyspec.com

TABLE II. Cured coating system requirements - Continued.

Property	Requirement	Conditioning	Test Method
Flexibility			4.6.15
Ambient Temperature	3.6.7.1 – Class 1 Coating System ≥ 10 percent gloss and, camo before and after; weathering Class 2 Coating System ≥ 60 percent gloss and camo before and after weathering	Standard Cure 3.6.9 Xenon Arc	4.6.15.1
Low Temperature	3.6.7.2 – Class 1 Coating System 1 inch gloss, 2 inch camo; Class 2 Coating System 1 inch for gloss and camo, No Cracking	Standard Cure 3.6.9 Xenon Arc	4.6.15.2
Fluid Resistance (all Types)	3.6.8 – Class1 and Class 2: coating system shall show no blistering, coating delamination, or adhesion loss, no more than a 2-pencil hardness change, ΔE ≤ 3.		4.6.16
MIL-PRF-23699		24 hrs. – 250 °F	
MIL-PRF-83282		7 days – 150 °F	
JP-8		30 days – 77 °F	
Deionized (DI) Water		30 days – 120 °F	
Skydrol LD-4 (applicable for Types 1 and 2 only).		30 days – 77 °F	
Weathering Resistance	3.6.9 – ΔE ≤ 1 Camouflage colors: 60° 5 max. (Gunship): 60° 3 max. Semigloss colors: 60° 15 min. 45 max. Gloss colors: 60° 90 min.	3,000 hours in Xenon Arc	4.6.17
Humidity Resistance	3.6.10 – Coating system: no blistering, no softening, no loss of adhesion, nor other film defects	30 days – 120 °F	4.6.18
Outdoor Exposure	3.6.11 – Equal to or better than chromium control.	Less than 12 months at Daytona Beach site.	4.6.19
Heat Resistance	3.6.12 – no cracking, flaking or adhesion loss. ΔE ≤ 1	1 hour – 250 °F	4.6.20
Solvent Resistance (cure)	3.6.13 – Rubbing through to primer indicates a failure.		4.6.21
Cleanability	3.6.14 – cleaning efficiency of not less than 75 percent		4.6.22
Strippability	3.6.15 – 90 percent stripped		4.6.23

3.6.1 Surface appearance.

The coating system finish shall exhibit a uniform, smooth surface, and free from runs, sags, bubbles, streaks, and hazing, seeding, dusting, floating, mottling, or other defects.

3.6.2 Color.

The coating system, when tested in accordance with 4.6.9, shall match the applicable color standard in FED-STD-595 with a color difference (ΔE) less than or equal to 1.0.

Downloaded from http://www.everyspec.com

3.6.3 Infrared (IR) reflectance (FED-STD-595, color chip number 36118 only).
The total IR reflectance (specular and diffuse) of the coating system, when tested in accordance with 4.6.10, shall be a maximum of eight percent relative to National Institute of Standards and Technology (NIST) traceable Spectralon white calibration standard.

3.6.4 Gloss.
The specular gloss of the system, when tested in accordance with 4.6.11, shall be as follows:

Camouflage colors	85 degree angle of incidence		9 max.
	60 degree angle of incidence		5 max.
(Gunship)	85 degree angle of incidence		3 max.
	60 degree angle of incidence		3 max.
Semigloss colors	60 degree angle of incidence	15 min.	45 max.
Gloss colors	60 degree angle of incidence	90 min.	

3.6.5 Opacity (hiding power).
The system topcoat, when tested in accordance with 4.6.12, shall have a contrast ratio of no less than 0.95 for all colors except yellow gloss, color chip number 13538; yellow orange color chip number 12197, and red color chip number 11136 of FED-STD-595, which shall have a contrast ratio no less than 0.90.

3.6.6 Adhesion.

3.6.6.1 Wet tape.
The coating system, when tested in accordance with 4.6.13, shall have no less than a 4A rating and no component of the coating system shall peel or delaminate from the substrate or any other component of the system.

3.6.6.2 Cross-hatch.
The coating system, when tested in accordance with 4.6.14, shall have no less than a 4B rating, and no component of the coating system shall peel or delaminate from the substrate or any other component of the system.

3.6.7 Flexibility.

3.6.7.1 Ambient temperature impact flexibility.

Class 1 coating systems: When tested in accordance with 4.6.15.1, the coating system shall exhibit a minimum impact elongation of 10 percent for gloss and camouflage coating systems. This requirement remains the same after weathering per 4.6.17. Flexibility testing after weathering shall not be part of the subset of tests listed in 3.4.2, 3.4.3, 3.4.4, and 3.5.3.

Class 2 coating systems: When tested in accordance with 4.6.15.1, the coating system shall exhibit a minimum impact elongation of 60 percent for gloss and camouflage coating systems. This requirement remains the same after weathering per 4.6.17. Flexibility testing after weathering shall not be part of the subset of tests listed in 3.4.2, 3.4.3, 3.4.4, and 3.5.3.

Downloaded from http://www.everyspec.com

3.6.7.2 Low temperature flexibility.

Class 1 coating systems: The coating system shall exhibit no cracking when tested in accordance with 4.6.15.2.

Class 2 coating systems: The coating system shall exhibit no cracking when tested in accordance with 4.6.15.2.

3.6.8 Fluid resistance.

The coating systems, when tested in accordance with 4.6.16 shall meet the following:

Class 1 and Class 2 coating systems: The coating system shall show no blistering or coating delamination or adhesion loss when tested in accordance with 4.6.14 and shall not exhibit more than a 2-pencil hardness change from the original hardness when tested in accordance with 4.6.24.

For all coating systems, color change (ΔE) less than or equal to 3.0 when tested in accordance with 4.6.9, is acceptable.

3.6.9 Weathering resistance.

The coating system, when tested in accordance with 4.6.17:

a. Shall have a color change (ΔE) less than or equal to 1.0 when tested in accordance with 4.6.9.

b. The 60 degree specular gloss of the coating system when tested in accordance with 4.6.11 shall be:

Camouflage colors	60 degree angle of incidence		5 max.
Gunship colors	60 degree angle of incidence		3 max.
Semigloss colors	60 degree angle of incidence	15 min.	45 max.
Gloss colors	60 degree angle of incidence	90 min.	

c. Shall meet the requirements of 3.6.7.1 and 3.6.7.2.

3.6.10 Humidity resistance.

The coating system, when tested in accordance with 4.6.18, shall not blister, nor shall it exhibit any loss of adhesion when tested in accordance with 4.6.14, nor exhibit a change in pencil hardness from the original hardness when tested in accordance with 4.6.24, nor exhibit other film defects.

3.6.11 Outdoor exposure.

The test coating system shall perform equal to or better than the chromium control coating system when tested in accordance with 4.6.19.

3.6.12 Heat resistance.

The coating system shall have no cracking, flaking, or adhesion loss when tested in accordance with 4.6.20 and a color change (ΔE) less than or equal to 1.0, when tested in accordance with 4.6.9.

3.6.13 Solvent resistance (cure).

The coating system, when tested in accordance with 4.6.21, shall withstand 25 methyl ethyl ketone (MEK) double-rubs (50 passes over the surface). Rubbing through to the primer indicates a failure.

Downloaded from http://www.everyspec.com

3.6.14 Cleanability.
The coating system shall maintain a minimum cleaning efficiency of not less than 75 percent when cleaned with system cleaner qualified to MIL-PRF-87937, Type IV, or MIL-PRF-85570, Type II, in accordance with 4.6.22.

3.6.15 Strippability.
A minimum of 90 percent of the coating system shall be stripped from the test panel within 24 hours and not more than four applications of chemical stripper or strippers when tested in accordance with 4.6.23. A chemical stripper may be specified to strip the topcoat and a different chemical stripper may be specified to strip the primer. However, no more than the aggregate four applications shall be applied to meet the above requirement.

4. VERIFICATION

4.1 Classification of inspections.
The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspection.
All products sold to this specification shall be listed, or approved for listing, on the associated Qualified Products List (QPL)-32239. To qualify, the product shall meet all requirements of the tests in this specification. A subset of testing shall be performed on the coating samples that have been subjected to the requirements of 3.4.2, 3.4.3, 3.4.4, and 3.5.3. The subset of tests shall be viscosity, surface appearance, gloss, wet tape, ambient temperature impact flexibility (see 4.6.15.1), and MIL-PRF-83282 fluid resistance. All qualification testing is to be carried out by AFRL/RXSSO through the Cooperative Research and Development Agreement (CRADA) with the University of Dayton Research Institute (UDRI). Suppliers shall provide their manufacturing/quality control specifications and test procedures for each system component at the time of qualification. All systems submitted for qualification or purchased as qualified products under this specification shall meet all manufacturer production and quality assurance specifications.

4.2.1 Certification.
Qualified products shall be recertified every two years to verify there have been no changes to the material ingredients, manufacturing processes, or site of production since original qualification and that the product continues to meet all of the requirements in this specification (see 6.3.3).

4.2.1.1 Approval of minor changes.
The manufacturer shall use ingredients, manufacturing procedures, processes, location, and methods of inspection on production products which are the same as those used on the approval sample. If it is necessary to change ingredients, type of equipment for processing, or manufacturing procedures or location, the qualifying activity will request that the manufacturer submit for approval a statement of the proposed changes in ingredients and/or processing and, at the option of the qualifying activity, a sample product. The qualifying activity, at its discretion, may accomplish partial or full requalification testing. Products manufactured by the revised procedure shall not be shipped as a qualified MIL-PRF-32239 product prior to approval.

Downloaded from http://www.everyspec.com

4.3 Conformance inspection.

In order to ensure conformity to the composition and performance established during qualification, the manufacturer shall test a representative sample, taken in accordance with ISO 15528, of each batch of the material before shipment. As a minimum, conformance tests shall consist of the following:

a. VOC content

b. Viscosity and pot-life

c. Drying time

d. Color

e. Gloss

NOTE: The quality assurance authority may take samples of the material and its ingredients at any stage of manufacture or from any portion of the consignment for inspection.

4.4 Standard conditions.

4.4.1 Test conditions.

Standard laboratory conditions shall be 77 ±5 °F (25 ±3 °C) and 50 ±10 percent relative humidity. Except as otherwise specified herein, all test specimens shall be cured under these conditions.

4.4.2 Standard tolerances.

Unless otherwise specified herein, Table III shows standard tolerances applied throughout test methods.

TABLE III. Standard tolerances.

Measurement Units	Tolerances
Temperature	±2 °F (±1 °C)
Days	±2 hours
Hours	±5 minutes
Minutes	±10 seconds
Inches (mm)	±0.010 inch (±0.25 mm)

4.5 Preparation of test panels.

a. Description of test panels.

Except as specified in the test procedures (see 4.6) and as specified in Table IV, all test panels shall be 0.032 × 3 × 6 inches (0.81 × 76.2 × 152.4 mm) bare aluminum alloy conforming to AMS-QQ-A-250/4. Test procedures 4.6.13 and 4.6.14 shall use an additional substrate conforming to AMS 4911. Test procedure 4.6.19 shall use test panels manufactured as shown on Figure 1 using 0.125 inch bare aluminum alloy conforming to AMS-QQ-A-250/4. Three holes shall be drilled and countersunk as shown to accommodate the dry installation of either a titanium fastener or cadmium plated steel fastener. The titanium fasteners shall be 10-24 × 5/8, Grade 2 with a 10-24 Grade 2 titanium nut. The cadmium plated steel fasteners shall be a NASM24693 screw with a 10-24 cadmium plated nut.

Downloaded from http://www.everyspec.com

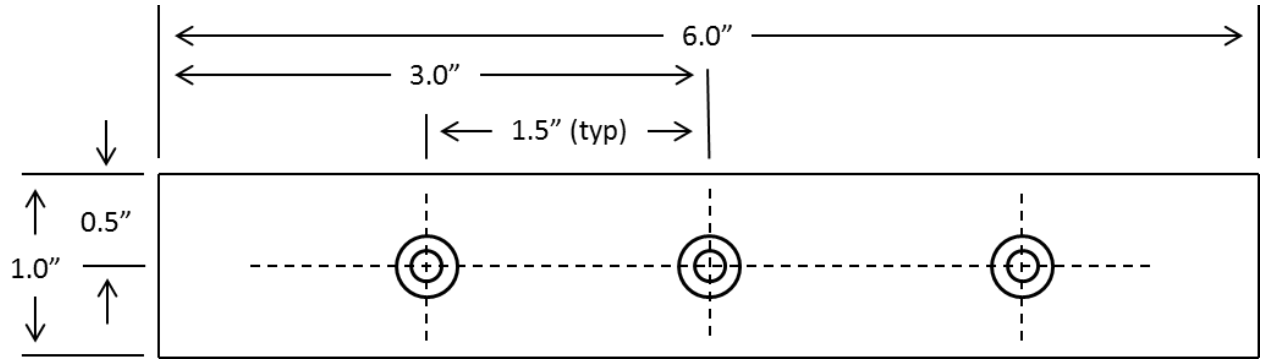


FIGURE 1. Diagram of outdoor exposure test panel.

b. Test panel preparation.

Standard panel preparation. The standard panel preparation procedures in 4.5.1, 4.5.2, and 4.5.3 are based upon practices long accepted by the aerospace community involving epoxy or polyurethane primers and topcoats.

c. Deviations from standard panel preparation.

In order to encourage innovation and creativity, manufacturers may deviate from the standard panel preparation procedures (see 4.5.2). Manufacturers may utilize conditions, procedures, or techniques specific and unique to their materials and processes when attempting to qualify advanced concepts in aerospace finishing systems (see 6.7).

TABLE IV. Test panel plan.

Requirement Paragraph	Property	Alloy and Heat Treatment	Quantity of Panels Required
3.4.2	Viscosity and Pot Life	N/A	N/A
	Surface Appearance	Bare 2024-T3	3
	Gloss	Bare 2024-T3	3
	Wet Tape	Bare 2024-T3	3
	Impact Flexibility Ambient	Bare 2024-O	3
	Fluid Resistance MIL-PRF-83282	Bare 2024-T3	3
3.4.3	Viscosity and Pot Life	N/A	N/A
	Surface Appearance	Bare 2024-T3	3
	Gloss	Bare 2024-T3	3
	Wet Tape	Bare 2024-T3	3
	Impact Flexibility Ambient	Bare 2024-O	3
	Fluid Resistance MIL-PRF-83282	Bare 2024-T3	3
3.4.4	Viscosity and Pot Life	N/A	N/A
	Surface Appearance	Bare 2024-T3	3
	Gloss	Bare 2024-T3	3
	Wet Tape	Bare 2024-T3	3
3.4.4	Impact Flexibility Ambient	Bare 2024-O	3

Downloaded from http://www.everyspec.com

TABLE IV. Test panel plan - Continued.

Requirement Paragraph	Property	Alloy and Heat Treatment	Quantity of Panels Required
	Fluid Resistance MIL-PRF-83282	Bare 2024-T3	3
3.5.2	Residual Odor of Dry Coating after 48 hrs	Bare 2024-T3	Use panels from 3.6.1
3.5.3	Surface Appearance	Bare 2024-T3	3
	Gloss	Bare 2024-T3	3
	Wet Tape	Bare 2024-T3	3
	Impact Flexibility Ambient	Bare 2024-O	3
	Fluid Resistance MIL-PRF-83282	Bare 2024-T3	3
3.5.4	Dry-to-Tape	Bare 2024-T3 0.032 × 12 × 12 inches (0.813 × 304.8 × 304.8 mm)	1
3.5.5	Wet Edge	Bare 2024-T3 0.032 × 12 × 12 inches (0.813 × 304.8 × 304.8 mm)	1
3.6.1	Surface Appearance	Bare 2024-T3	Use panels from 3.6.2
3.6.2	Color	Bare 2024-T3	3
3.6.3	Visible Light, Ultraviolet, and Near Infrared Reflectance	Bare 2024-T3	3
3.6.4	Gloss	Bare 2024-T3	Use panels from 3.6.2
3.6.5	Hiding Power	LENETA form 3B opacity card	
3.6.6.1	Adhesion (Wet Tape)	Bare 2024-T3	3
		Ti 6Al-4V	3
3.6.6.2	Adhesion (Cross Hatch)	Bare 2024-T3	3
		Ti 6Al-4V	3
3.6.7.1	GE Impact Elongation (Ambient Temp)	Bare 2024-O 0.020 inch (0.51 mm) thick	3
3.6.7.2	Mandrel Bend Flexibility (Low Temp)	Bare 2024-O 0.020 inch (0.51 mm) thick	3
3.6.8	MIL-PRF-23699	Bare 2024-T3	3
	MIL-PRF-83282	Bare 2024-T3	3
	Skydrol LD-4	Bare 2024-T3	6
	JP-8	Bare 2024-T3	3
	DI Water	Bare 2024-T3	3
3.6.9	Color	Bare 2024-T3	3
	Gloss	Bare 2024-T3	Use panels from color
	GE Impact Elongation (Ambient Temp)	Bare 2024-O 0.020 inch (0.51 mm) thick	3

Downloaded from http://www.everyspec.com

TABLE IV. Test panel plan - Continued.

Requirement Paragraph	Property	Alloy and Heat Treatment	Quantity of Panels Required
3.6.9	Mandrel Bend Flexibility (Low Temp)	Bare 2024-O 0.020 inch (0.51 mm) thick	3
3.6.10	Blistering/Film Defects	Bare 2024-T3	3
	Cross Hatch Adhesion	Bare 2024-T3	Use panels from blistering
	Pencil Hardness	Bare 2024-T3	Use panels from blistering
3.6.11	Corrosion Evaluation	Bare 2024-T3, 0.125 × 1 × 6 inches (3.2 × 25.4 × 152.4 mm) Ti fasteners	3 Scribed 3 Unscribed
		Bare 2024-T3, 0.125 × 1 × 6 inches (3.2 × 25.4 × 152.4 mm) Cad-Stl fasteners	3 Scribed 3 Unscribed
3.6.13	Color	Bare 2024-T3	3
	Cross Hatch Adhesion	Bare 2024-T3	Use panels from color
	Mandrel Bend Flexibility	Bare 2024-O	3
3.6.14	MEK Rubs	Bare 2024-T3	3
3.6.15	Cleanability	Bare 2024-T3 0.063 × 3 × 6 inches (1.6 × 76.2 × 152.4 mm)	3
3.6.16	Strippability	Bare 2024-T3	3

4.5.1 Outdoor exposure control panel preparation.

Prepare the control panels for outdoor exposure test panels according to the following procedure:

a. Wipe panels with MEK solvent.

b. Apply PreKote manufactured by Pantheon Chemical per Air Force T.O. 1-1-8

c. Apply an epoxy primer coating conforming to MIL-PRF-23377, Type I, Class C2. Dry film thickness of the primer shall be 0.75 ±0.2 mil.

d. Apply color chip number 36173 camo gray, of FED-STD-595, topcoat conforming to MIL-PRF-85285, Type IV. Dry film thickness of the topcoat shall be 2.2 ±0.2 mils.

e. Control panels shall be cured 14 days at standard conditions (see 4.4.1).

4.5.2 Test panel preparation.

Alternate procedures for application of coating system components may be followed as specified by the manufacturer. Immersion applications shall not be used for the qualification of coating systems. In the absence of specific instructions to the contrary, prepare test panels according to the following procedure:

NOTE: If a non-chrome primer with a topcoat is submitted for qualification without a specified non-chrome pretreatment, they will be tested with an Alodine 1200S or equivalent pretreatment and shall be listed as Type 1 or Type 3, (coating system containing chromium compounds with Skydrol LD-4 resistance or coating system containing chromium compounds) if the coating system passes all the requirements of this specification.

a. Wipe panels with MEK solvent to remove ink stampings completely.

Downloaded from http://www.everyspec.com

b. Test panels shall be hand-scrubbed with an abrasive pad (Scotchbrite 7447B or equivalent pad) and a 10 percent by volume Brulin 815GD or equivalent and 90 percent by volume DI water cleaning solution to remove surface contaminants and to abrade the surface lightly. Rinse the test panels in tap water.

c. Using a deoxidizing solution consisting of the following:

(1) 35 percent by volume n-butyl alcohol.

(2) 25 percent by volume isopropyl alcohol.

(3) 22 percent by volume DI water.

(4) 18 percent by volume ortho-phosphoric acid (85 percent).

Immerse panel for two minutes, rinse with tap water and then with DI or distilled water. Test for a water break free surface using DI or distilled water. If the panel fails the water break test, repeat steps 2 and 3. Do not allow panel surfaces to dry between steps 3 and 4.

d. Spray or brush the wet panel with Alodine 1200S or equivalent according to manufacturer's instructions. For test procedure described in 4.6.15.2, this step shall be omitted.

e. Apply primer(s) and topcoat(s) according to manufacturers' instructions. The thickness of each system component shall be maintained within the range specified by the manufacturer. Total dry film thickness of the complete coating system shall be less than 3.2 mils unless previously approved by AFRL/RXSSO.

f. All test panels shall be cured 14 days at standard conditions (see 4.4.1).

4.5.3 Test panel scribe (outdoor exposure testing).
Test panels that require a scribe shall be scribed with one, 0.75 ±0.03 inch line parallel to the 1.0 inch dimension of the test panel and through the center of each fastener utilizing a New Hermes engraving machine and rotating carbide cutter as shown on Figure 2 (see 4.6.19).

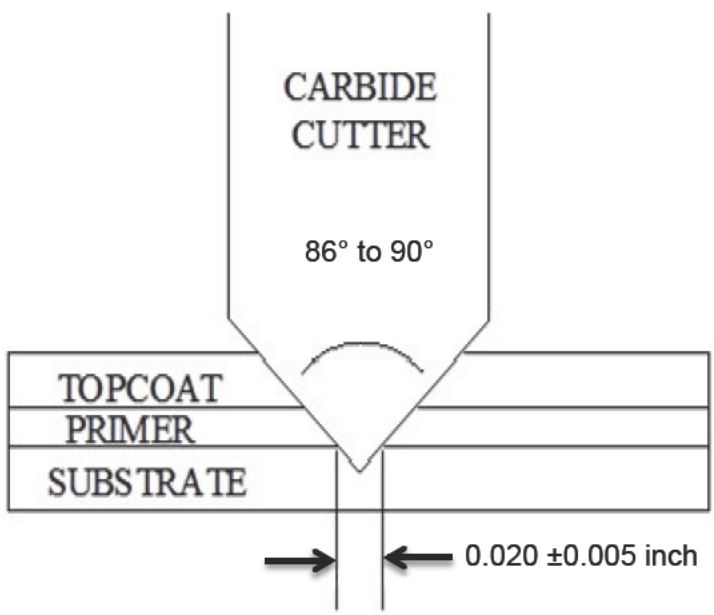


FIGURE 2. Dimensions for scribing test panels.

Downloaded from http://www.everyspec.com

4.6 Test procedures.

4.6.1 Storage stability.

Original, unopened containers of primer, topcoat, or unicoat shall be stored indoors for one year from date of manufacture where the daily temperature of the ambient air is maintained between 35 to 115 °F (1.7 to 46 °C). All surface pretreatment concentrated liquids and powders shall be stored under the same conditions for six months. Test panels for properties testing under this paragraph shall be made from aged system components. Test panels shall be created after the four hour pot-life has elapsed for the primer and topcoat.

4.6.2 Accelerated storage stability.

Each coating component, as packaged by the manufacturer shall be stored at 140 ±5 °F (60 ±3 °C) for seven days, cool to room temperature and examine for conformance with 3.4.3. Test panels for properties testing under this paragraph shall be made from accelerated aged topcoat applied over the accelerated aged primer. Test panels shall be created after the four hour pot-life has elapsed for the primer and topcoat.

4.6.3 Freeze/thaw stability.

The test shall be five cycles of freezing and thawing when tested in accordance with ASTM D2243. One freeze/thaw cycle shall be 16 hours at 16 ±5 °F (-9 ±3 °C) followed by eight hours at room temperature; 64 to 84 °F (18 to 29 °C). Test panels shall be created after the four hour pot-life has elapsed for the primer and topcoat.

4.6.4 Volatile organic compound (V.O.C.) content.

The test shall be conducted in accordance with ASTM D3960.

4.6.5 Odor.

After drying for 48 hours at laboratory conditions, place one panel into a 1000 ml tall form, clean-dry glass beaker cover with a watch glass and allow to equilibrate for 20 minutes at laboratory conditions, then remove watch glass, raise the beaker to the nose and examine for the presence of an odor. Before placing the panel into the beaker, verify that there are no residual odors from the cleaning materials used to clean the beaker.

4.6.6 Viscosity/pot-life.

Where applicable, the test shall be conducted in accordance with ASTM D1200 using a #4 Ford viscosity cup. For pot-life, the admixed coating system components shall remain in a closed container and tested for viscosity in accordance with ASTM D1200 using a #4 Ford viscosity cup four hours after mixing. Test panels for properties testing under this paragraph shall be made from four hour aged topcoat applied over the four hour aged primer.

4.6.7 Dry to tape.

After a double lap of tape is removed from the roll, a five inch strip of masking tape (3M #250) or equivalent, one inch (25.4 mm) wide, shall be applied to each test panel and pressed down with four double passes of a roller weighing no less than 4.5 lbs. (2.04 kg). The tape shall remain in contact with the test panel for no less than one hour. The tape shall then be removed by seizing the free end and with a steady, moderate motion, pull back on itself as close to 180 degrees as possible.

4.6.8 Wet-edge.

The following test shall be conducted in a spray booth with an air flow of 75 to 125 linear feet per minute (0.381 to 0.635 meters per second). Use a 12 × 12 inch (304.8 × 304.8 mm) panel. Spray a coating layer of the mixed topcoat to half of the panel. After 15 minutes in the spray booth, spray a coating layer of the mixed topcoat over the second half of the panel overlapping

Downloaded from http://www.everyspec.com

the first application by one inch. After the second application, the panel may be removed from spray booth for final cure. Evaluation of test panel shall be after a minimum of 24 hour cure.

4.6.9 Color.
The test shall be conducted in accordance with ASTM D2244 using CIE 1976 L* a* b*. Ensure that the spectrometer is set to the following parameters:

a. CIE Lab color system
b. 10 degree observer
c. D65 illuminant
d. Specular reflectance included

4.6.10 IR reflectance.
The total IR reflectance (specular and diffuse) of the coating shall be measured using NIST traceable Spectralon white calibration standard over the wavelength range of 700 to 2600 nanometers (nm) with a PerkinElmer LAMBDA 9 spectrophotometer or equivalent, equipped with a total integrating sphere or equivalent.

4.6.11 Gloss.
The test shall be conducted in accordance with ASTM D523.

4.6.12 Opacity (hiding power).
The system topcoat shall be cast to a dry film thickness of 0.002 to 0.0024 inch (0.051 to 0.061 mm) onto three LENETA Form 3B Opacity cards, or equivalent, and tested in accordance with ASTM D2805. The average opacity will be assessed for compliance.

4.6.13 Wet tape test.
Loss of adhesion as a result of exposure tests shall be determined in accordance with ASTM D3359 with the following exceptions:

a. The test panels shall be thoroughly dried by wiping with clean dry cloth conforming to AMS 3819, Grade A.
b. The test shall be conducted after no more than ten minutes after wiping and standing at 77 ±5 °F (25 ±3 °C).
c. With a razor blade or scalpel, cut two parallel lines 1.0 inch (25.4 mm) apart and an “X” in between and overlapping the parallel lines. The “X” shall be 0.5 inch (12.7 mm) wide as shown on Figure 3.

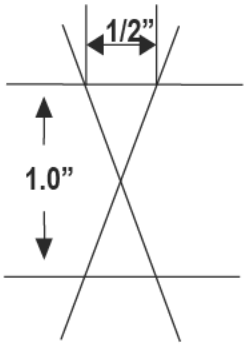


FIGURE 3. Wet tape test.

Downloaded from http://www.everyspec.com

Parallel lines and an "X" shall be cut through the coating to bare metal to the dimensions shown using a razor blade or scalpel.

d. Press a piece of 1.0 inch (25.4 mm) wide masking tape (3M #250 tape) or equivalent, perpendicular across the parallel cuts covering the "X". The tape shall be pressed down by using eight passes of a 4.5 to 5 pound (2.04 to 2.27 kg) rubber covered roller with a durometer hardness of Shore D 70-80, that is approximately 3.5 inches (88.9 mm) in diameter by 1.75 inches (44.45 mm) long.

e. Within 90 ±30 seconds of rolling the tape, the tape shall be removed in one rapid motion, pulling at an angle of 180 degrees to the plane of the panel.

f. The adhesion is determined by a visual examination of the paint remaining/removed from the scribed area, using the rating scale in ASTM D3359, Method A.

4.6.14 Cross hatch.

The test shall be conducted in accordance with ASTM D3359, Method B using a Gardco cutting tool (part number PA-2058) or equivalent. The blade used to make the cross hatch shall make six cuts that are 2 mm apart.

4.6.15 Flexibility.

4.6.15.1 Ambient temperature impact flexibility.

The coating system shall be tested in accordance with ASTM D2794, using the Gardco GE universal impact tester, model 172 or equivalent. Cracking of the coating is defined as cracking to the substrate and will be assessed using an Elcometer, Model D204-01 holiday detector or equivalent.

4.6.15.2 Low temperature flexibility.

Class 1 coating systems:	The coating system shall be tested in accordance with ASTM D522 Method B at -60 ±5 °F (-51 ±3 °C) using a 1.0 inch (25.4 mm) mandrel for gloss and semi-gloss and a 2 inch (50.8 mm) mandrel for camouflage.
Class 2 coating systems:	The coating system shall be tested in accordance with ASTM D522 Method B at -60 ±5 °F (-51 ±3 °C) using a 1.0 inch (25.4 mm) mandrel for gloss, semi-gloss and camouflage topcoat.

4.6.16 Fluid resistance.

Use test panels prepared in accordance with 4.5 through 4.5.2. To establish the initial values for pencil hardness, use 2024-T3 test panels from 3.6.6.2 in accordance with 4.6.24. The initial adhesion values will be taken from these same test panels. Expose a separate set of three test panels to each of the following fluids at the designated conditions:

MIL-PRF-23699	Prior to exposure, measure the color of three panels in accordance with 4.6.9, and then completely immerse them for 24 hrs. at 250 ±5 °F (121 ±3 °C).
MIL-PRF-83282	Prior to exposure, measure the color of three panels in accordance with 4.6.9, and then completely immerse them for 7 days at 150 ±5 °F (65.6 ±3 °C).
Jet Fuel JP-8	Prior to exposure, measure the color of three panels in accordance with 4.6.9, and then completely immerse them for 30 days at 77 ±5 °F (25 ±3 °C).
Water (ASTM D1193 Type IV)	Prior to exposure, measure the color of three panels in accordance with 4.6.9, and then completely immerse them for 30 days at 120 ±5 °F (49 ±3

Downloaded from http://www.everyspec.com

°C).

Skydrol LD-4 Prior to exposure, measure the color of three panels in accordance with 4.6.9, then scribe three additional panels in accordance with 4.5.3, and place the six panels in a horizontal position coating side up in a test area maintained at 77 ±5 °F (25 ±3 °C). Using Skydrol LD-4 at 77 ±5 °F (25 ±3 °C), wet the six panels once each day (no immersion) for 30 days.

After each exposure, remove the panels, and immediately evaluate for blistering and film delamination. After evaluation, gently clean the (MIL-PRF-23699, MIL-PRF-83282, Jet Fuel, and the unscribed Skydrol LD-4) panels with the coating system cleaner, and rinse thoroughly with water. Blot the panels dry and allow to air dry for an additional one hour. Measure the final color in accordance with 4.6.9. After the color measurement has been made, test for final adhesion and hardness in accordance with 4.6.14, and 4.6.24 respectively. Compare the average of the initial values with the average of the final values to assess compliance.

4.6.17 Weathering resistance

Test panels shall be exposed for 3000 hours in a Xenon-arc weather-o-meter (Q-Sun/3000 or Q-Sun/1000) or equivalent that is cycling between 102 minutes of light only and 18 minutes of light and DI water spray. After exposure, examine for conformance to 3.6.9. The following conditions shall apply when tested in accordance with ASTM G155, Type BH:

Black body temperature in cabinet:	145 ±5 °F (63 ±3 °C)
Intensity (spectral irradiance) of Xenon-arc:	0.35 ±0.05 watt/meter^2 at a wavelength of 340 nm

4.6.18 Humidity resistance.

Test panels shall withstand exposure for no less than 30 days in a humidity cabinet maintained at 120 ±3 °F (48.9 ±1.6 °C) and 100 percent relative humidity in accordance with ASTM D2247.

4.6.19 Outdoor exposure.

Test and control panels shall be prepared in accordance with 4.5 through 4.5.2. Half of the test panels and half of the control panels shall be scribed in accordance with 4.5.3. The panels shall be securely fixed to an outdoor rack with non-conductive supports such that no panel is touching another panel and no panel is dripping on another panel. The exposure racks shall be located at the Battelle Daytona Beach site, tilted at 45 degrees from horizontal and exposed 180 degrees from magnetic north.

4.6.20 Heat resistance.

Test panels shall be placed in a convection oven at 250 ±5 °F (121.21 ±3 °C). After one hour, remove the panels from the oven and allow them to cool to standard conditions (see 4.4.1). The –O temper test panels shall be tested for flexibility in accordance with ASTM D522, Method B using a 1 inch (25.4-mm) mandrel for gloss coatings, and a 2 inch (50.8-mm) mandrel for camouflage coatings. The –T3 test panels shall be tested for adhesion in accordance with 4.6.14.

4.6.21 Solvent resistance (cure).

Test panels shall be prepared in accordance with 4.5 through 4.5.2. A cotton, terrycloth rag shall be soaked in MEK solvent and rubbed back and forth 25 times (50 passes) over the coating with firm finger pressure.

4.6.22 Cleaning efficiency.

The cleaning efficiency test shall be performed in accordance with 4.6.22.1 through 4.6.22.7.

Downloaded from http://www.everyspec.com

4.6.22.1 Preparation of artificial soil.
Prepare the artificial soil by mixing 1.76 ±0.018 oz. (50.0 ±0.5 g) of carbon black with 17.64 ±0.035 oz. (500.0 ±1.0 g) of lubricating oil conforming to MIL-PRF-23699. Homogenize the artificial soil using a high shear mixer for 15 ±1 minute. Prior to each application of the artificial soil, stir or shake the mixture by hand.

4.6.22.2 Cleaning compound.
Mix MIL-PRF-87937, Type IV or MIL-PRF-85570, Type II cleaning compounds in accordance with the manufacturer's instructions.

4.6.22.3 Preparation of test panels.
Prepare two test panels in accordance with 4.5 through 4.5.2. Using a clean, hog bristle brush, lightly scrub the coating of each panel with cleaning compound (see 4.6.24.2). Rinse each panel thoroughly three times in reagent water. Dry for 18 hours at 120 ±5 °F (48.9 ±3 °C). Using ASTM D2244, determine the L* value of the coating. This will be value "A".

4.6.22.4 Soiling of test panels.
Using a soft-bristle brush, coat the painted surfaces of the test panels with the artificial soil. Remove excess soil by covering the test panel surface with folded absorbent tissue and exerting pressure by rolling the tissue with a 5 lb. (2.27 kg) rubber roller. Repeat this blotting procedure twice. Brush the soiled surface only in one direction and parallel to the long dimension of the test panel, using 10 strokes of the hog bristle brush. Bake the test panel at 221 ±5 °F (105 ±3 °C) for 60 ±1 minute. Determine the L* value of the coating system in accordance with ASTM D2244. This will be value "B". In order for the test to be valid, value "B" shall be 25 ±5. Test panels outside this range must be discarded and new test panels created.

4.6.22.5 Procedure.
Clean the soiled test panel within four hours of soil application using a Gardner Heavy Duty Wear Tester, Model D10V, or equivalent, with a sponge attached to the wear head.

4.6.22.6 Cleaning.
Using hook-and-loop (Velcro) type strips, attach the nylon web side of a dry sponge, dimensions 3.5 × 2.75 inches (88.9 × 69.85 mm) to the cleaning head of the wear tester, such that the dimension parallel to the cleaning stroke is 3.5 inches (88.9 mm). The combined weight of the sponge and cleaning head shall be 2.98 to 3.09 lbs. (1350 to 1400 grams). Place the test panel holder in the wear tester. Place a soiled test panel in the holder such that the test panel is at +45 degrees to the cleaning stroke. Saturate the sponge and cover the test panel with the cleaning compound (see 4.6.22.2). After 60 ±5 seconds, clean the test panel using five cycles of the wear tester, then immediately turn the test panel 90 degrees in the template and clean for an additional five cycles. Remove the test panel from the holder and rinse the test panel with a flowing stream of water at room temperature. Allow the test panel to dry. Using ASTM D2244, determine the L* value of the coating system. This will be value "C".

4.6.22.7 Calculation.
Cleaning efficiency (percent) = [(C-B)/(A-B)] × 100.

4.6.23 Strippability.
Test panels shall cure under standard conditions (see 4.4) for seven days followed by artificial aging at an elevated temperature of 210 °F (99 °C) for 96 continuous hours. All test panel edges shall be masked with 3M aluminum tape and placed on a rack at a 60 degree angle from horizontal. Enough chemical stripper, selected from TO 1-1-8, shall be poured along the upper edge of each test panel to completely cover the coating surface. After six hours of exposure,

Downloaded from http://www.everyspec.com

the loosened coating system shall be brushed off, and the test panel shall be rinsed while brushing under a stream of cool water. Successive applications of the same chemical stripper or different stripper may be applied in the same manner. No more than four applications of strippers, totaling 24 hours shall be applied. The amount of coating stripped in this test is determined by the percentage of substrate surface area exposed.

4.6.24 Pencil hardness.
Test panels shall be placed in a horizontal position and tested immediately at standard conditions (see 4.4) in accordance with ASTM D3363, with the exception that the desired edge of the pencil lead shall be maintained before each stroke.

4.7 Reports.
The supplier of the product shall furnish with each shipment a certificate of conformity. This certificate shall include the purchase order number, lot number, MIL-PRF-32239, manufacturer's identification, and quantity in accordance with MIL-HDBK-831.

4.7.1 Resampling and retesting.
If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.

5. PACKAGING

5.1 Packaging.
For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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 coating/finish system covered by this specification is intended for use on external moldlines of military aerospace weapon systems. In general, the components comprising the coating system work in concert to provide superior weather and chemical resistance with protection against corrosion and may be used in applications other than aerospace weapon systems. Additional testing would be needed to address the specific requirements of other applications. This specification contains military specific camouflage gloss requirements, gunship gloss requirements, and low IR requirements.

6.2 Acquisition requirements.
Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type, class, grade and color of the coating system desired (see 1.3 and 1.4).
c. Quantity and size of containers for each system component required.

Downloaded from http://www.everyspec.com

d. Minor modifications desired to one or more components in the coating system relative to unique application conditions.

e. Information required on toxicity, material safety data and precautionary measures (see 3.3.2 and 6.3.4).

f. Packaging requirements (see 5.1 and 6.9).

6.3 Qualification.

With respect to products requiring qualification, awards will be made only for products which are, at the time of contract, qualified for inclusion in Qualified Products List QPL No. 32239 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Air Force Research Laboratory (AFRL), Materials and Manufacturing Directorate, Attn: AFRL/RXSSO (CTIO), 2179 12th Street, WPAFB, Ohio, 45433-7718. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil/.

6.3.1 Qualification of gloss or camouflage coating systems.

Gloss and camouflage coating systems will be qualified separately. Manufacturers may qualify to either or all types. Upon qualification, it is accepted that all FED-STD-595 colors in the same gloss category are qualified. If both gloss and camouflage coating systems pass qualification, it is accepted that semi-gloss coatings are also qualified. To qualify a gloss coating system, the manufacturer should submit color chip number 17925 of FED-STD-595. To qualify the camouflage coating system, the manufacturer should submit color chip number 36173 of FED-STD-595. In addition, for the purpose of opacity testing, color chip numbers 13538, 12197, and 11136 of FED-STD-595 should be submitted.

6.3.2 Qualification inspection samples.

The test samples should consist of a minimum of three, one-quart kits and one, one-gallon kit for the primer, and topcoats. For opacity testing, the samples should consist of at minimum one-pint kits. The material should be furnished in the type of containers used in filling contract orders. Samples should be identified (see 6.9.1) and forwarded to the laboratory designated in the letter of authorization.

6.3.3 Certification of qualified products.

A request for recertification consists of a letter or a DD Form 1718, Certification of Qualified Products, certifying that there have been no changes in the material ingredients, manufacturing processes, or site of production since qualification and that the product meets all of the requirements of this specification. In addition, a test report should be provided from a laboratory of the manufacturer's choosing, showing compliance with all of the qualification tests. AFRL/RXSSO may elect to certify without testing based on this report, or may require partial or full requalification testing before the manufacturer may ship a product with the MIL-PRF-32239 label.

6.3.4 Safety Data Sheets (SDS).

Contracting officers should identify those activities requiring copies of SDS's prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313; and 29 CFR 1910.1200 requires that the SDS for each hazardous chemical used in an operation must be readily available to personnel using the material. Contracting officers should identify the activities requiring copies of the SDS.

Downloaded from http://www.everyspec.com

6.4 Coating system definition.
The definition of a coating system qualified to this specification in 1.1 includes a chemical stripper and a cleaning compound. It is not the intent of this specification or of the above Government testing laboratory to qualify chemical strippers and cleaning compounds. The manufacturer is required to select current qualified cleaning products (see 4.6.22.2) and chemical strippers (see 4.6.23) that give optimal performance to the coating system being submitted for qualification. A manufacturer may formulate the components of their coating system to achieve maximum cleanability and strippability with respect to specific qualified cleaners and strippers while meeting all requirements of this specification.

6.5 Manufacturer partnerships.
The formation of partnerships among individual component suppliers should result in superior overall coating system performance. However, partnerships between individual manufacturers of coating system components are not required to achieve listing on the qualified products list.

6.6 Innovation.
While the concept of an advanced performance coating system is not new, the encouragement within this specification of innovation and use of emerging technologies to produce and qualify an advanced performance aerospace coating system is new. Deviations from current best aerospace practices, materials and processes are allowed but the resulting coating system must meet or exceed the performance requirements of this specification and be able to perform in the maintenance environment of legacy aerospace weapon systems. For guidance on depot and field level maintenance environments, contact the Air Force Research Laboratory (AFRL), Materials and Manufacturing Directorate, Attn: AFRL/RXSSO (CTIO), 2179 12th Street, WPAFB, Ohio, 45433-7718 (see 6.3).

6.7 Special application conditions.
Procuring activities may request minor solvent and/or additive modifications to qualified products to solve unique application problems, such as faster drying time and shorter pot-life coatings formulated for plural-component spray equipment. Only application conditions are permitted to be modified. The cured coating (dry film) properties of the coating are not permitted to be changed. Any modified coatings must be clearly identified as such on its container and may only be furnished to the requesting activity. The specific modifications and labeling instructions should be detailed in any procurement request for the modified material.

6.8 Definitions.
Definitions of terms and expressions used for coatings as given in ISO 4617 and ISO 4618 apply, with the exception of those defined below:

Batch	Quantity of one component of a product with the same composition and resulting from the same production run.
Coating system	The materials and processes necessary for finishing an aircraft consisting of one or more applications of specific products, methods or techniques necessary to fulfill the requirements of this specification. This definition includes materials and processes for surface pretreatment, cleaning and chemical removal.
Livering	Related to gelling when a material takes on body caused by the evaporation of solvents or the oxidation of the material.
OEM	Original equipment manufacturer.
Pot-life	The time period after the coating is mixed for which it can be applied and meet the performance requirements of this specification.
Volatile organic	VOC is composed of one or more volatile organic compounds, containing at

Downloaded from http://www.everyspec.com

compound (VOC) least elements of carbon and hydrogen or in which hydrogen is partially or completely replaced by halogens, oxygen, sulfur, phosphorus or nitrogen, and with the exception of carbon monoxide, carbon dioxide and carbonates, and which has a vapor pressure of 10 mmHg (1.3 kPa) or more, at 68 °F (20 °C). This specification recognizes by exception, the use of EPA defined exempt solvents.

6.9 General packaging information.

The following packaging and packing procedures are applicable, wherever possible, to the various components of the coating system. Since the coating system concept does not lend itself to kit packaging, these requirements may be modified by the procurement document (see 6.2). At times, the procurement document may state the purchase of only one or two components of a coating system as they appear on the qualified products list.

6.9.1 Marking and labeling.

The container or package of each component or materials comprising a component of a qualified coating system should be marked in accordance with MIL-STD-129. In addition to the markings specified in MIL-STD-129, individual containers/packages should bear a printed, weather-proof label showing the following nomenclature and information as applicable.

Pretreatments:

- Title, number, and date of the specification
- Type required (see 1.3)
- Unit of issue required
- Quantity required
- Lot size
- Packaging requirements
- Warning and precautions as applicable

Primers:

- Title, number, and date of the specification
- Component Identification
  - Component A – Pigmented resin component
  - Component B – Catalyst (curing agent) resin component
  - Component C – Reducer
  - Component D – Single component
- Name and plant address of manufacturer
- Date of manufacture by month and year
- Type, class, and grade required (see 1.3)
- Lot number/net contents
- Storage instructions
- Warning and precautions as applicable

Topcoats:

- Title, number, and date of the specification
- Component Identification
  - Component A – Pigmented resin component
  - Component B – Catalyst (curing agent) resin component
  - Component C – Reducer

Downloaded from http://www.everyspec.com

Component D – Single component
Name and plant address of manufacturer
Date of manufacture by month and year
Class required (see 1.3)
Color as required (see 1.4)
Lot number/net contents
Storage instructions
Warning and precautions as applicable

6.10 Subject term (key word) listing.

Cadmium
Carbon black
Chromium
Chromium-free
Flexibility
Fluid resistance
Low-IR
Pigment
Reflectance

6.11 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.

CONCLUDING MATERIAL

Custodians:
Army – MR
Navy – AS
Air Force – 20

Review activities:
Army – AR
Navy – CG, MC, SH
Air Force – 84
DTRA – DS

Preparing activity:
Air Force – 20

(Project No. 8010-2012-004)

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 https://assist.dla.mil.