Process Specification for Specialty Anodizing of Aluminum Alloys for Optical Property Control

Engineering Directorate

Structural Engineering Division

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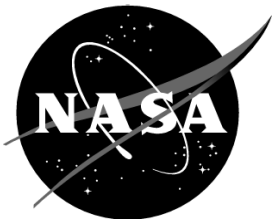

National Aeronautics and
Space Administration

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REVISIONS		
VERSION	**CHANGES**	**DATE**
Baseline	Original version	1/30/98
A	Changed EM references to ES	6/28/02
B	Changed document title, added sealing requirements, expanded to include color anodize, heavily reorganized the document.	6/20

1.0 SCOPE

This process specification establishes requirements for anodizing of aluminum alloys for JSC flight hardware, when controlled optical properties are required.

2.0 APPLICABILITY

This specification includes two types and two classes of clear, sulfuric acid anodic coatings. It is to be used only when tightly controlled optical properties are required and shall not be used without prior approval of the appropriate JSC/ES4 materials engineering personnel. If controlled optical properties are not required, a standard anodize should be used per NASA/JSC PRC-5006, *Process Specification for the Anodizing of Aluminum Alloys.*

3.0 USAGE

The following types and classes of anodic coating are applicable to this procedure:

Type II	Sealed sulfuric acid anodic coating, produced from sulfuric acid bath, thickness 0.0004 inches or greater.
Type III	Unsealed hard anodic coating, thickness 0.002 +/- 0.0004 inch.
Class 1	Optical properties measured directly on the production hardware.
Class 2	Optical properties measured indirectly on coupons electrically connected to the production hardware during the anodizing process.
Color	Yellow/Gold, Blue, Red, Black, or None.

This specification shall be called out on the engineering drawing by using a drawing note that identifies this process specification, type, class and color. Sample drawing notes are as follows:

SPECIALTY ANODIZE FOR OPTICAL PROPERTY CONTROL PER NASA/JSC PRC-5008, TYPE II, CLASS 1, COLOR YELLOW

SPECIALTY ANODIZE FOR OPTICAL PROPERTY CONTROL PER NASA/JSC PRC-5008, TYPE III, CLASS 2, COLOR NONE. VERIFY OPTICAL PROPERTIES ON PRODUCTION HARDWARE AT SPECIFIED LOCATIONS.

This PRC requires the STP0552 process specification for color anodizing or STP0554

when no color is specified (none). As tight control of optical properties by anodizing is very challenging, these specifications require optical property characterization both on pre-production samples and production-level hardware. Whenever possible, optical properties should be measured directly on the production hardware. Should the hardware size or geometry preclude the measurement directly on the production hardware, these properties can be measured indirectly on coupons instead.

Engineering drawing(s) shall specify the number and location of measurement points on both the pre-production and production hardware/coupons in accordance with the relevant standard. When coupons are specified, they shall be made from the same alloy, temper, and form as the production hardware (with representative surface finishing), preferably from the same lot of material used for the production hardware. Production of these test coupons are the responsibility of the hardware developer and must be presented with the hardware to be anodized.

The optical properties achieved vary significantly with the aluminum alloy, product form, temper, and surface finish. STP0552 or STP0554 should be consulted during material selection. Additionally, experience has shown that aluminum product forms which are formulated using high levels of re-melted scrap during the alloying process have resulted in diminished optical properties. In order to reduce the risk of pre-production and production optical quality failures, it is recommended that the design specify the use of prime (virgin) aluminum billets in formulation of the selected alloy and product form.

Extensive evaluation of alternate sealing methods and materials (such as nickel acetate) has been shown to cause significant darkening during exposure to space environments in Low Earth Orbit. Any proposed alternate sealing materials and methods should be fully qualified in accordance with either of the selected standards and approved by the responsible Materials and Processes engineer.

4.0 REFERENCES

All documents listed are assumed to be the current revision unless a specific revision is listed.

JPR 8500.4	*Engineering Drawing System Manual*
PRC-5006	NASA/JSC PRC, *Process Specification for the Anodizing of Aluminum Alloys*
STP0552A	McDonnel Douglas Standard: *Anodic Coatings, Colored, Controlled Optical Properties for Aluminum and Aluminum Alloys*

STP0554L	McDonnell Douglas Standard, *Sulfuric Acid Anodic Coatings With Controlled Optical Properties for Aluminum and Aluminum Alloys*
MIL-A-8625F	Military Specification, *Anodic Coatings for Aluminum and Aluminum Alloys*

The following references were used in developing this process specification:

SOP-007.1	Preparation and Revision of Process Specifications
JSC 8500C	Engineering Drawing System Requirements

5.0 MATERIAL REQUIREMENTS

None.

6.0 PROCESS REQUIREMENTS

The process shall meet the requirements as specified below:

Color	STP0552
No Color (“None”)	STP0554

Should a conflict exist between these two documents, this PRC shall take precedence over McDonnel Douglas Standards when processing JSC flight hardware.

6.1 Work Instructions

All work shall be performed to written procedures. The work instructions shall contain sufficient detail to ensure that the manufacturing process produces consistent, repeatable products that comply with this specification.

The contractor shall be responsible for preparing, maintaining, and certifying written work procedures that meet the requirements of this specification.

6.2 Sealing

The anodized coating shall be sealed, but the only sealing operation allowed is by immersion in boiling deionized water.

6.3 Rework

Upon NASA/JSC pre-approval, the anodic coating of the production hardware may be reworked once by stripping and re-anodizing, using the stripping agent listed in MIL-A-8625F, section 4.5.2.1b. Stripping with any other solution will alter the optical properties of the material and is expressly prohibited. In the event that rework is approved, the pre-production articles shall be stripped and re-anodized using the identical process as the production hardware.

7.0 PROCESS QUALIFICATION

Vendors shall be qualified in accordance with the qualification test requirements specified in the relevant standard and are specifically listed in either STP0552 or STP0554. Should no qualified vendors listed in the specification be available, vendor process qualification must be coordinated with the responsible Materials & Process engineer.

7.1 Pre-production Test Articles

The hardware developer will supply pre-production test articles in addition to the production hardware. The vendor shall process the parts in accordance with the standards and perform the required verifications.

8.0 PROCESS VERIFICATION

Process verification requirements for production hardware are found in STP0552 and STP0554. This includes direct verification of optical properties, coating thickness, corrosion resistance, and abrasion resistance.

9.0 TRAINING AND CERTIFICATION OF PERSONNEL

All anodizing of aluminum alloys shall be conducted by trained personnel. Training of personnel shall be the responsibility of the vendor.

10.0 DEFINITIONS

Anodizing Process	Procedure by which aluminum and aluminum alloysare treated electrolytically in a bath containing sulfuric acid to produce a uniform anodic coating on the metallic surface.

Infrared Emittance	Fraction of energy that is re-radiated in the infrared spectrum by a surface when compared relative to a blackbody (i.e. a perfect emitting surface).
Optical Properties	Values obtained from the measurement of solar absorptance and infrared emittance.
Sealing	Process by which aluminum is immersed in boiling, deionized water for a controlled period of time (typically 15-30 minutes); partially converts the alumina of the anodic coating to aluminum monohydroxide.
Solar Absorptance	Fraction of incident energy in the visible spectrum that is absorbed by a surface.