Process Specification for the Anodizing of Aluminum Alloys

Engineering Directorate

Structural Engineering Division

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Process Specification for the Anodizing of Aluminum Alloys

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REVISIONS		
VERSION	CHANGES	DATE
--	Original version	5/96
A	Reformatted, Type III tight tolerance issue addressed, provisions for addition of glass bead or grit blasting prior to anodizing	3/2/99
B	Added color callout in section 3.0, re-write of definition of “sealing”	7/7/00
C	Changed EM references to ES	6/4/03

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1.0 SCOPE

This process specification establishes the technical requirements for anodizing aluminum alloys for use in JSC flight hardware.

2.0 APPLICABILITY

This process specification covers the requirements for six types and two classes of electrolytically formed anodic coatings on aluminum and aluminum alloys. It does not cover the requirements for anodic coatings with controlled optical properties for long-duration exposure to spacecraft external environments.

3.0 USAGE

This process specification shall be called out on the engineering drawing by using a drawing note that identifies the process specification and the anodic coating type and class to be used. For example:

ANODIZE PER NASA/JSC PRC-5006, TYPE II, CLASS 2, COLOR BLUE.

The following types of anodic coating are covered by this specification:

Type I	Chromic acid anodizing, conventional coatings produced from chromic acid bath
Type IB	Chromic acid anodizing, low voltage process, 22 $\pm$ 2 volts
Type IC	Non-chromic acid anodizing, for use as a non-chromate alternative for Type I and IB coatings
Type II	Sulfuric acid anodizing, conventional coatings produced from sulfuric acid bath
Type IIB	Thin sulfuric acid anodizing for use as a non-chromate alternative for Type I and Type IB coatings
Type III	Hard anodic coatings

The two classes of anodic coatings are:

Class 1 -- Non-dyed

Class 2 – Dyed

For Class 2 anodize, color must be included in the drawing callout. If the color is required to be a matte finish, this shall also be specified on the drawing.

Surface preparation is critical to the quality of the anodize that is produced. For example, if the anodized surface will be subsequently coated with a dry film lubricant, it is important to glass bead blast the surface prior to anodizing to produce a surface with less roughness (more of a matte finish). If glass bead or grit blasting is required by the design prior to the anodize process, it shall be called out on the drawing in the following manner:

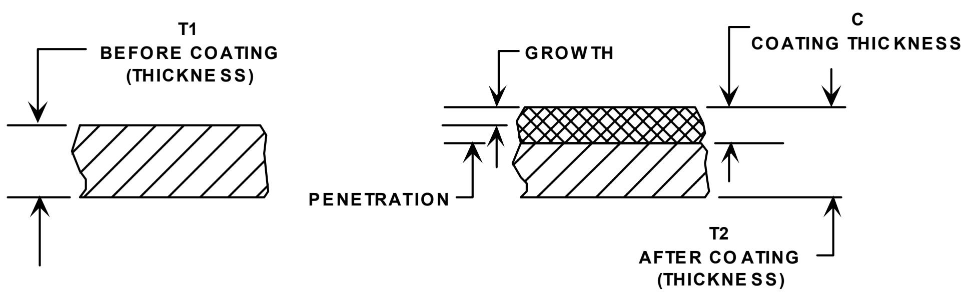
GLASS BEAD BLAST WITH SIZE xx BEADS PRIOR TO ANODIZING

or

GRIT BLAST PRIOR TO ANODIZING

3.1 SPECIFIC DESIGN INFORMATION ON TYPE III COATINGS

The Type III hard anodize coatings are especially difficult to anodize to very tight tolerances (< +/- 0.0012 in.). When the Type III anodic coating is applied, typically half of the coating thickness is comprised of the penetration into the "before coating thickness" and the other half consists of the coating growth, as shown below:



$$T2 = T1 + \frac{C}{2}$$

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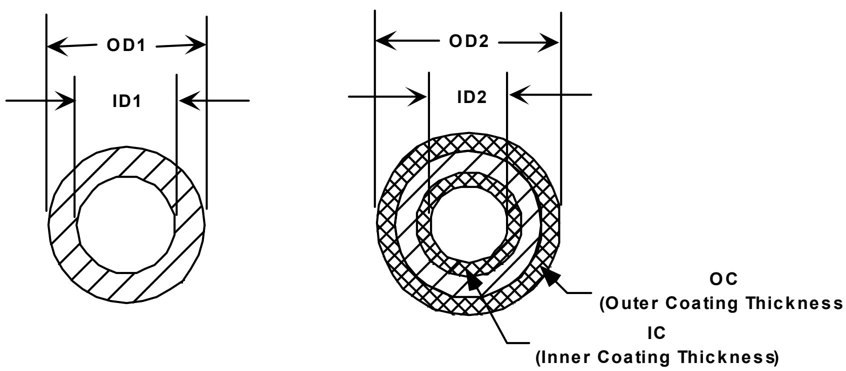
This process is complicated even more for intricate geometries, such as the tube shown below. It should be noted that the Inner Coating Thickness (IC) does not necessarily equal the Outer Coating Thickness (OC). The resulting dimensions and tolerances are determined as a function of part geometry and anodize bath conditions (i.e. uniformity of the supplied current density). The more complex the geometry, the more difficult it becomes to hold tight-tolerances. Normally for tubing, the current density is such that IC < OC.



$$OD2 = OD1 + OC$$
$$ID2 = ID1 - IC$$

For these reasons, if component tolerances will be held to less than +/- 0.0012 in. and the part geometry is intricate, the designer should consult with EM2 materials engineering personnel. It is also recommended that for such Type III applications, both the final dimensions and the "machine to" dimensions should be specified on the engineering drawing.

3.2 WORK INSTRUCTIONS

Work instructions shall be generated for implementing this process specification. The work instructions shall contain sufficient detail to ensure that the manufacturing process produces consistent, repeatable products that comply with this specification.

4.0 REFERENCES

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

MIL-A-8625 Military Specification*, Anodic Coatings for Aluminum and Aluminum Alloys*

5.0 MATERIAL REQUIREMENTS

Material requirements shall be as-specified in MIL-A-8625.

6.0 PROCESS REQUIREMENTS

All anodizing of aluminum alloys shall be conducted in accordance with the technical requirements of MIL-A-8625.

7.0 PROCESS VERIFICATION

Process verification shall be in compliance with MIL-A-8625.

8.0 TRAINING AND CERTIFICATION OF PERSONNEL

All anodizing of aluminum alloys shall be performed by personnel qualified to conduct the process through training or experience. If these processes are to be performed by an outside vendor, the development of an appropriate training program shall be the responsibility of the vendor.

9.0 DEFINITIONS

Anodizing Process	Electrochemical procedure by which aluminum and aluminum alloys are treated electrolytically in a bath containing chromic or sulfuric acid to produce a uniform oxide coating on the metallic surface.
Sealing	Process by which the chemically treated aluminum is immersed in boiling, deionized water for 15-30 minutes; partially converts the alumina of the anodic coating to aluminum monohydroxide. Nickel acetate and sodium dichromate solutions may also be used as anodic coating seals.