



Aerospace Anodize Finishes

A PROCESS OVERVIEW.

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Phosphoric Acid Anodizing: developed to improve bond reliability for “metal-bond” structure parts, it was established in the mid 1970s as a reliable production process. Furthermore, the hydration resistant oxides of PAA result in environmentally durable bonded part components. The prescribed surface preparation and anodize process provides a method for producing and controlling the unique oxide characteristics. Robust processing is evident via the relatively wide operating process ranges and the known long bath life of PAA.

Chromic Acid Anodizing: used for forming coatings on structural parts, it has little or no effect on the fatigue strength of finished parts because they are very thin. CAA is often used where the possibility of solution retention in holes, recesses and crevices exists. High chloride content causes pitting, and over time the chromic acid concentration is depleted by neutralization with dissolved aluminum. Therefore, free chromic acid and aluminum content must be monitored as the bath ages. Additionally, hexavalent chromium content (free chromic acid) decreases as the bath ages, while trivalent chromium

and aluminum content increase. If sulfate concentration in the electrolyte is too high, the resulting coating can become more transparent. A CAA coating has an appearance that varies from opaque iridescent to dark gray depending on the type of alloy. Since CAA coatings are very thin, there is not any substantial abrasion resistance. The coating has substantial corrosion resistance and is also an excellent base for paint. Solution entrapped in faying surfaces does not promote corrosion. Increasing the temperature increases the electrolyte conductivity, resulting in a substantial increase in coating weight over a given time period. However, even though the coating weight is higher, there is more porosity and decreased corrosion resistance.

Boric-Sulfuric Acid Anodizing: like CAA, BSAA is used to form coatings on structural parts and also has little or no effect on the fatigue strength of finished parts because they are very thin. While CAA produces a chromium mist that is hazardous to health if inhaled, BSAA is an alternative that eliminates this concern and the need for mist control. In 1990, the Boeing Company



developed BSAA as a direct replacement for CAA due to pressing environmental and safety concerns. The resulting patent has equivalent or better fatigue life on aircraft structures. Another patent that followed in 2000 demonstrates the addition of an organic acid can mitigate bio-contamination.

Sulfuric Acid Anodizing: conventional SAA coatings are thick enough that they reduce the fatigue characteristics of an aluminum alloy, so they are not used on structural parts. Although the majority of the anodic coating is composed of aluminum oxide, there is about 10-15% of SO₃ incorporated into the coating. Consequently, there is a potential for corrosion when there is solution entrapment in part faying surfaces. On most aluminum alloys, the sulfuric acid anodic coating is colorless and transparent. Alloys containing high manganese and silicon levels tend to give grayish or brownish colored coatings. The transparency of the coating decreases with increasing coating thickness. Small changes in operating conditions can be detrimental to the coating, especially electrolyte temperature. Lower temperatures and dilute solutions favor harder coatings. Higher temperatures and more concentrated solutions favor dissolution and may produce coatings with a soft, powdery, or spongy surface.

The surface layers will be less resistant to abrasion and may rub off easily.

THIN FILM SULFURIC ACID ANODIZING

Thin Film Sulfuric Acid Anodizing meets or exceeds the requirement of MIL-A8625F, Type IIB. Comparatively, SAA (per MIL-A-8625, Type II) is a thick porous coating and is easy to dye color but has relatively poor corrosion resistance and an adverse effect on latent metal flexural fatigue. TFSAA is an improvement over conventional SAA in terms of corrosion resistance and as a base for paint adhesion. These anodize properties enhancements were achieved by reducing the concentration of the sulfuric acid and thereby lowering the electrical conductivity. This in-turn reduced the generated heat to an ambient level and also decreased the rate of the oxide growth at the anode resulting in a finer grain and also a thin film of aluminum oxide on aluminum parts. ■

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