SELECTIVE ANODIZING

RESIZE

REFINISH

RESURFACE

REBUILD

Anodizing is a widely used electrochemical surface treatment process for aluminum and its alloys. Depending on the particular type of anodizing process used, the resulting anodic coatings provide improved wear resistance, corrosion protection, and improved adhesive properties for subsequent painting or adhesive bonding repair.

Selective anodizing is used on a wide range of aluminum components from small, simple areas to large, complex components that require anodizing to either restore a previously anodized surface or to fulfill an original specification requirement. The SIFCO Process® of selective anodizing can be used for many different, demanding OEM and repair applications. This portable process can be used both in the shop and in the field.

Types of Anodized Coatings

- Chromic (Type I)
- Sulfuric (Type II)
- Hard Coat (Type III)
- Phosphoric
- Boric-Sulfuric

Selective Anodizing Advantages

- **Anodizes virtually any aluminum surface**
- **Utilizes Selective Electrofinishing technology**
- **Forms non-conductive coatings using either solutions or gels.**
- **Applies coatings for surface enhancement, defect repair, or resizing of worn or mismachined components.**
- **Meets performance requirements listed in MIL-A-8625.**
- **Permits the performance of on-site, cost-effective, permanent repairs.**

Solution	Typical process time (minutes)	Typical thickness µm (inches)	Purpose of Coating
Chromic (Type I)	15-60	2.5 (0.0001)	Corrosion protection
Sulfuric (Type II)	1-10	12.5 (0.0005)	Corrosion protection with some wear resistance. Dimensional restoration.
Hard Coat (Type III)	10-45	50 (0.0020)	Wear resistance and some corrosion protection. Dimensional restoration.
Phosphoric	10	.25 (0.000010)	Improve strength of adhesive bonds.
Boric-Sulfuric	15	2.25 (0.00009)	Corrosion protection

THE ANODIZING PROCESS

Anodizing is the formation of an oxide film or coating on an aluminum surface using reverse current (part is anodic) and a suitable electrolyte. Principal types of anodized coatings are chromic, sulfuric, hard coat, phosphoric and boric-sulfuric. SIFCO has adapted the SIFCO Process of electroplating to provide a portable method of selectively applying these anodized coatings for a variety of localized area applications.

Selective (brush) anodizing utilizes similar techniques to that of selective plating, but reverses the current flow.

When anodizing, the tool becomes the cathode (negative) and the workpiece becomes the anode (positive). The anodized coating (an oxide film) is formed on a localized area of the aluminum surface in the presence of the anodizing solution or gel.

Three processes occur simultaneously during anodizing:
1. Electrolytic etching of aluminum.

2. Formation of the aluminum oxide (Al_2O_3) at the aluminum surface.

3. Dissolution of some aluminum oxide by the anodizing electrolyte.

The first two processes are developing the anodic coating, but the third one hinders its buildup and causes decreased coating hardness. When the anodic coating hardness is a primary requirement, such as in Hard Coating (Type III), the anodizing process is carried out at temperatures near 0°C (32°F) to minimize the coating dissolution. This requires the use of high-capacity cooling equipment.

Depending on the application requirements, some anodized coatings need to be sealed as a final step while others require dyeing. The dyeing step is performed after anodizing and prior to sealing. Dyed coatings are always sealed. Often, however, the anodized coating is left as formed and is subsequently finished by painting or other similar methods.

In military and commercial applications, anodized coatings are usually applied for dimensional reasons (salvage), adhesive bonding, corrosion protection and/or wear resistance purposes. Selective anodizing meets the performance requirements of MIL-A-8625 for type I, II, and III anodized coatings. In the consumer marketplace, anodizing is often utilized for cosmetic appearance reasons.

Electrolytes for selective anodizing may be in the form of solutions or gels. Solutions are available for all five types of anodizing. Gels are available for chromic acid, phosphoric and boric-sulfuric acid anodizing. The operating parameters for the gels are the same as for their respective solutions and provide coatings of the same quality. The gels are used when processing components that may be damaged by splashed or running anodizing solutions. The gels stay over the work areas and do not run into inapproprate places such as aircraft instrumentation, airframes, equipment and crevices where corrosion would start.

ANODIZED COATINGS

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Hard Coat (Type III)

Selective hard coat deposits are applied for wear resistance, corrosion protection, and dimensional restoration of worn or mismachined parts. The coatings meet the performance requirements of AMS 2468, AMS 2469, and MIL-A-8625. Thickness of up to 100µm (0.004 in.) can be achieved using SIFCO's Hard Coat Solution.

Applications

- **Restores worn or mismachined aluminum surfaces to blueprint requirements.**
- **Replaces tank hard coat in new part manufacture.**
- **Provides wear resistance and/or corrosion resistant coatings.**

Examples -

- Tail Rotor Drive Shaft: OEM application. Hard Coat (Type III) Anodized Coating on flange faces for wear resistance.
- Repairing the leading edge of heavily corroded vanes with Hard Coat (Type III). The eroded areas were first ground to a smooth finish and were then hard coat anodized with a coating thickness of 100µm (0.004 in.) to provide maximum corrosion and wear resistance.
- Underwater Diving Motor Control and Motor Control Base: Salvage of mounting faces and seal areas using Hard Coat (Type III) Anodized Coating.
- Torpedo After Body Shell: Salvage application. Hard Coat (Type III) Anodized Coating on O-ring seal area for dimensional restoration and corrosion protection.

Sulfuric (Type II)

Coatings are used to provide corrosion protection, wear resistance, and dimensional restoration of worn or mismachined parts. Coating thickness of up to 50µm (0.002 in.) can be obtained. Selective sulfuric acid anodizing also can be used to repair damaged anodized coatings. SIFCO's sulfuric acid anodized coatings meet the performance requirements of AMS 2471, AMS 2472, and MIL-A-8625.

Applications

- **Provides localized area anodizing on previously uncoated parts for corrosion and/or wear resistance.**
- **Repair an anodized area for dimensional reasons.**
- **Repairs damaged anodized coating for corrosion resistance.**

Example --

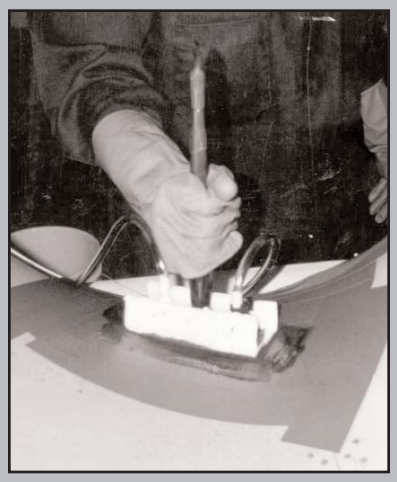
- The SIFCO Process of Selective Anodizing has been used to repair Main Gearbox Support Fittings, Forward Sponson Mounts and Tail Cone Fuselage Support Fittings. Mating surfaces of these various helicopter components often are corroded. Repairs are made, in place, with a 12.5 µm (0.0005 in.) thick Sulfuric (Type II) anodized coating to resize the mounting faces and bores.

Chromic (Type I)

Can be applied in as little as 15 minutes as a base for organic coatings and finishes, and in one hour to provide coatings for corrosion protection. The use of Chromic Gel is beneficial for on-site applications, such as the underside of a part, where pumping solution could present a problem. SIFCO's chromic acid anodized coatings meet the performance requirements of AMS 2470 and MIL-A-8625.

Applications

- **Provides localized area anodizing on previously uncoated parts for corrosion and/or wear resistance.**
- **Repairs damaged anodized coatings to restore corrosion protection.**



Examples --

Refueling tubes and slat skin sections of helicopter components required Chromic (Type I) anodizing on areas of damaged coating, for corrosion protection.

Wing droop leading edge on aircraft skin was repaired where coating often was damaged during maintenance or in-service use.

Phosphoric

Coatings are used to prepare aluminum surfaces for adhesive bonding and as a preparatory procedure for a subsequent plating operation. Both solution and gel are available for the phosphoric coatings, which can be applied in 10 minutes.

Applications

- **Prepares aluminum surfaces for adhesive bonding.**
- **Repairs damaged frames or punctured aircraft skins with repair plates.**

Example --

Punctured aircraft skin was repaired using Phosphoric Acid Anodizing to assist the adhesive bonding process and accomplish a permanent repair.

Boric-Sulfuric

Produces a protective film that provides corrosion resistance equal to or greater than chromic acid anodized coatings without the use of chromium in the anodizing solution. Anodic coating weights exceed the minimum values listed in MIL-A-8625 (Type I). Also, boric-sulfuric offers an environmentally suitable alternative to chromic acid anodizing. In addition, boric-sulfuric is superior to chromate conversion coating repairs.

Applications

- **Provides localized area anodizing on previously uncoated parts for corrosion protection.**
- **Repairs damaged anodized coatings to restore corrosion protection.**

Example --

Guide cylinder and accumulator pistons required repair of damaged areas on outside diameter, which were then sealed for additional corrosion protection.

EQUIPMENT & ACCESSORIES

Much of the equipment and accessory items used in traditional SIFCO Process plating applications can be used for selective anodizing. Chromic acid and boric-sulfuric acid anodizing require heating of the electrolyte. Flow systems heat and circulate solutions as required by the application. Solution coolers are used for hard coat applications.

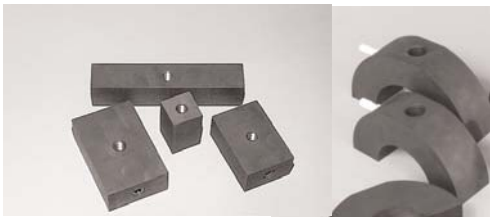
Power Packs

The SPL 10/45 Power Pack was specially developed for selective anodizing applications. It is designed to fulfill the voltage and current density requirements of chromic acid anodizing, boric-sulfuric acid anodizing and hard coating. The model SPL 10/45 provides up to 10 amperes DC at 0 to 45 volts. The unique feature of this power pack is its ability to operate at either constant current or constant voltage. In the constant current mode, the current may be pre-set between 0 and 10 amperes with a voltage limit pre-set at any value between 0 and 45 volts. A voltage between 0 and 45 volts may be pre-set for operating in the constant voltage mode. This flexibility is important in selective anodizing because some processes, such as selective chromic anodizing, are better done at constant voltage. Other processes, such as selective hard coating are better done at constant current with a voltage limit to prevent burning.

Equipment

During hard coat anodizing, the solution must be cooled prior to use and while the process takes place (the anodizing process generates heat). For this requirement the hard coat solution cooler will refrigerate and maintain the solution temperature within operating parameters.

When using chromic and boric-sulfuric anodizing gels, a water heated tool is required. For this requirement, the anodizing water heating system is available to heat and circulate the water through the anodizing tool.



Tooling

Any SIFCO graphite tooling or bulk graphite can be used. For anodizing with phosphoric anodizing gel, stainless steel type 304 perforated sheet 0.76mm (0.030 in.) thick is used for tool fabrication. For chromic acid or boric-sulfuric acid anodizing with gels, a special hot water tool can be designed for your specific application.

Tool Covering and Masking Material

Polyester tool cover material and Aeronikl tapes are used as outlined in the anodizing instruction manual.

Pumps and Flow Systems

The flow systems, submersible pumps and the peristaltic pump described in SIFCO's Product Guide are recommended for selective anodizing.

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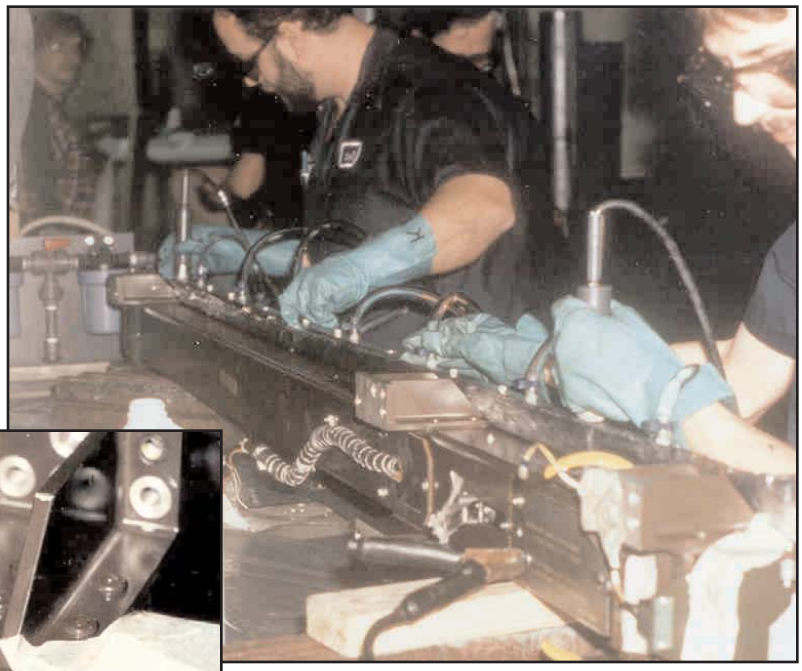

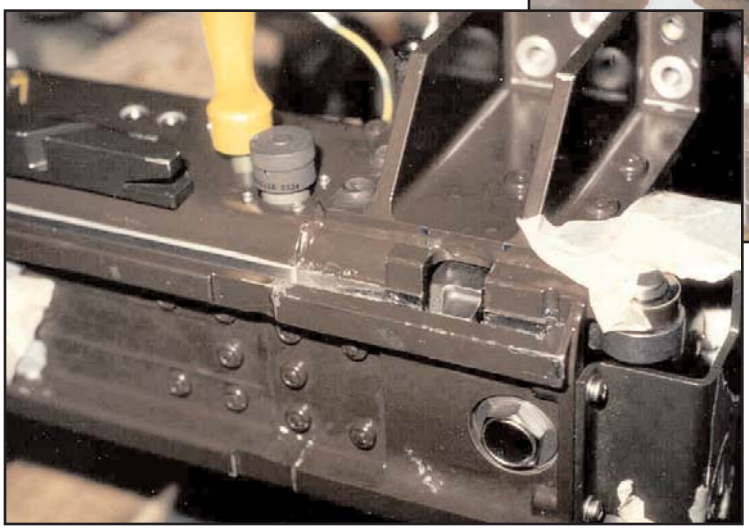

REFERENCES

Hammer, Francine and Moskowitz, Michael. Selective (Brush) Boric-Sulfuric Acid Anodizing. 1994. AESF 1994.

Norris, Joseph C. Brush (Selective) Chromic Acid Anodizing and Applications in the Aerospace Industry. 1992. AESF 1992.

Norris, Joseph C. Brush Anodizing in the Aircraft/ Aerospace Industries. 1991. Plating and Surface Finishing 1991.

Norris, Joseph C. Brush Hard Coating Aluminum and Aluminum Alloys. SAE Technical Paper SEries 900967. SAE 1990.

Norris, Joseph C. "Brush and Flow Selective Sulfuric Acid Anodizing". 1990.

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