# Anodizing Overview – Type II (Sulfuric Acid Anodizing)

**What Is Anodizing?**

Anodizing is an electrochemical surface conversion process used to improve the performance and appearance of aluminum. Unlike paint or plating, anodizing does not apply a coating on top of the metal. Instead, it converts the aluminum surface itself into aluminum oxide, a hard, stable, and corrosion-resistant material.

Because the anodic layer is grown from the base metal, it becomes an integral part of the aluminum. The finish will not peel, chip, or delaminate, even under normal wear or environmental exposure. This makes anodizing a preferred finish for both decorative and functional aluminum components.

**How Type II Anodizing Works**

Type II anodizing is performed in a sulfuric acid electrolyte using direct current. The aluminum part acts as the anode in the electrical circuit, which is where the process gets its name.

Before anodizing, parts are thoroughly cleaned to remove oils and surface contaminants. Depending on the desired appearance, parts may also be lightly etched in a caustic solution to produce a uniform matte finish. Once prepared, the parts are immersed in the anodizing bath and electrical current is applied. This causes controlled oxidation of the aluminum surface, forming a porous aluminum oxide layer.

After anodizing, the porous structure can be colored using an electrolytic process. The final step is sealing, which closes the pores and significantly improves corrosion resistance, color retention, and overall durability.

**Anodic Coating Characteristics**

The anodic oxide layer produced by Type II anodizing grows both into the aluminum substrate and outward from the original surface, with approximately 50% of the thickness occurring in each direction. Typical Type II anodizing thickness ranges from 0.0002” to 0.0010”, depending on application requirements.

The resulting surface is harder than the base aluminum, electrically insulating, and highly resistant to corrosion when properly sealed. Prior to sealing, the coating is microscopically porous, which is what allows it to accept dyes or electrolytic color.

**Benefits of Type II Anodizing**

Type II anodizing significantly improves aluminum's resistance to corrosion, particularly in indoor and moderate outdoor environments. Sealed anodic coatings slow oxidation and protect the base metal from moisture, chemicals, and environmental exposure.

In addition to corrosion protection, anodizing increases surface hardness and wear resistance. While not as thick or hard as hardcoat anodizing, Type II provides excellent durability for decorative and light-to-moderate wear applications.

A major advantage of anodizing is its aesthetic versatility. The finish maintains the natural metallic appearance of aluminum while allowing for a wide range of colors and surface finishes. Because the coating becomes part of the metal, it retains a clean, professional appearance over time.

Anodizing is also considered an environmentally responsible finishing process. It does not involve heavy metals, produces minimal volatile emissions, and converts existing aluminum rather than adding foreign material.

**Two-Step (Electrolytic) Coloring**

Two-step anodizing is a coloring method used when long-term color stability and UV resistance are critical. After the aluminum is anodized, the part is immersed in a second bath containing metal salts. Electrical current deposits metallic particles into the pores of the anodic coating, after which the coating is sealed.

Compared to organic dyes, two-step coloring offers superior resistance to fading, improved color consistency, and excellent performance in outdoor or high-temperature environments. Common two-step colors include black, bronze, and champagne, making this process especially popular for architectural, automotive, and exterior components.

**Aluminum Alloy Considerations**

The aluminum alloy used has a significant impact on anodized appearance, color consistency, and overall quality.

**Alloys Well-Suited for Type II Anodizing**

Wrought aluminum alloys with low copper and silicon content generally anodize best. Commonly recommended alloys include:

- 6061 – Excellent overall anodizing performance, widely used
- 6063 – Superior cosmetic results, commonly used for architectural applications (recommended alloy for 2-Step)
- 5005-(Sheet alloy) Considered the standard for anodized sheet metal, providing a high-quality, consistent finish for cosmetic applications. Many people substitute 5052 for 5005. While 5052 can produce acceptable results, it has more imperfections and is more prone to color variation than 5005 alloy aluminum

These alloys produce consistent oxide layers and predictable coloring results.

**Alloys That May Present Challenges**

Alloys containing higher levels of copper, silicon, or zinc can produce darker, uneven, or non-uniform finishes. Examples include:

- 2024 – High copper content; often dark, blotchy, or inconsistent
- 3003-**DO NOT** attempt to anodize aluminum alloys like 3003 or 3105 if you want the finish to be attractive and consistent. These alloys will show imperfections such as structural streaks, cloudiness, blemishes, and **EXTREME** color variation
- 7075 – Zinc-rich alloy; may appear gray or yellowish after anodizing
- Cast aluminum alloys – Silicon content can cause streaking, shadowing, or poor cosmetic appearance

While these alloys can still be anodized for corrosion protection or functional purposes, they may not be suitable for decorative finishes or tight cosmetic requirements.

**Dimensional Considerations**

Because anodizing is a conversion coating, it affects part dimensions. In addition to oxide growth, any pre-anodizing etching removes base metal. For parts with tight tolerances, mating parts or threaded features, these dimensional changes must be considered during design and machining.

Customers are encouraged to consult with the anodizer early in the design process or refer to detailed anodizing tolerance documentation for guidance.

**Typical Applications**

Type II anodizing is commonly used for consumer products, architectural components, electronics housings, automotive trim, industrial equipment, and general aluminum parts requiring a durable and attractive finish.

**Summary**

Type II anodizing enhances aluminum by forming a durable, corrosion-resistant oxide layer that becomes part of the metal itself. With a balance of performance, appearance, and environmental responsibility, it is one of the most versatile finishing options available. When combined with two-step coloring, Type II anodizing delivers long-lasting color and professional aesthetics suitable for both indoor and outdoor applications.