

Finishes

There are many ways to finish the surface of an extruded aluminum component; the choice of finish depends upon a number of factors, most notably the desired appearance and (more importantly) the product's environment of use. Aluminum is naturally protected from many environmental stresses. As soon as unfinished aluminum is exposed to the atmosphere, a protective oxide coating naturally begins to form. For many applications, aluminum profiles require no more protection than this thin, transparent oxide film.

Aluminum profiles can be treated with a wide range of coatings wherever additional surface protection or an enhanced appearance is desired. Common finishes include liquid paint, powder coat, and anodized finishes.

Types of extrusion finishes are typically sorted as follows:

Liquid Coatings. A broad range of paints (e.g., polyesters, acrylics, siliconized polyesters, and fluoropolymers) are available in a virtually unlimited array of colors.

Powder Coatings. Wherever it is desirable to reduce emissions of volatile organic compounds, powder-coat finishes are available with little or no use of solvents. Whereas most applications in North America are on horizontal lines, vertical coating lines tend to be more prevalent in Europe. However, two new vertical powder coating lines recently have been installed in the United States.

Anodizing. Anodized aluminum profiles retain their metallic luster while accepting durable and vibrant color through an electro-chemical process.

Mechanical Finishes. A wide variety of mechanical methods (e.g., sanding, polishing, grinding, buffing, blasting) can be used to obtain a wide variety of textures.

Chemical Finishes. Etching yields a frosted, matte surface appearance, while bright-dipping produces a specular (mirror-like) finish.

Powder Coatings

Powder coatings are applied electrostatically from an air fluidized hopper. Electrostatic application enables positively charged powder particles to adhere to a negatively charged (or grounded) aluminum profile. After the proper amount of powder is applied, the profile is baked in an oven where the powder particles are melted to a liquid state, fusing together to form a homogenous film. Most applications in North America are on horizontal lines.

The primary powder ingredients are as follows:

- Binders consist of the resin, polymer, and crosslinker. This ingredient provides the powder with its fundamental film properties.
- Prime Color Pigments can be either organic or inorganic and provide the paint with its color.
- Additives serve numerous functions but generally affect fluidization and application properties.

Powder coatings perform comparably to liquid coatings of the same resin chemistry and are available in an increasingly wide range of colors.

Because powder coatings contain little or no volatile organic compounds (VOC), they offer an environmentally friendly coating alternative. Powder coating serves a growing market and is expected to play a significant part in the finishing of aluminum profiles in the years to come.

Anodizing

Anodizing is an electrochemical process that enhances aluminum's natural oxide surface layer by forming an even more durable oxide film that can accept a variety of (usually translucent) colors. The resultant finish shows off the natural luster of the aluminum substrate. Anodic coatings can yield a wide range of characteristics; features such as thickness, hardness, porosity, and protective value are dependent upon on the specific process used, the alloy being anodized, and the length of treatment time.

What's Underneath the Finish Matters

All aluminum alloys that can be extruded may also be anodized; variables such as color and film density depend upon the alloy of the product being anodized.

The anodic finish greatly increases the resistance to corrosion and abrasion over a mill-finished product, without altering the texture of the metal's surface.

Pretreat for Success

The anodizing process typically includes three or four pretreatment steps:

- Alkaline cleaning removes organic contaminants like oils, greases, marking pens, fingerprints, or shop dirt.
- Acid cleaning (optional) is used to remove inorganic contaminants like oxide films and intermetallics, which might interfere with a quality finish.
- Etching takes place in a hot caustic solution and yields a matte or satin finish that can diminish the effect of die lines.
- Deoxidize and desmut steps remove oxides and intermetallics, which appear as loose particles (gray to black in color) on the surface of the etched aluminum.

Here's How it Happens

The aluminum profile is immersed in a tank that holds an acid-based electrolyte solution. Electrical current is passed through the solution while the temperature is carefully controlled. The electrically-conductive aluminum profile serves as an anode, the result of which is that oxygen ions are released from the electrolyte and drawn to the surface of the aluminum. The oxygen immediately combines with the surface aluminum to form a hard aluminum oxide film.

Unlike other finishes, in which a separate coating is applied, the anodic coating is an integral part of the aluminum surface, since it is formed by oxidation of the surface atoms themselves.

Mechanical Finishes

The surface of an aluminum profile can be buffed and burnished to a mirror finish or scored and blasted to a rough texture. Blasting methods include abrasive blasting, shot blasting, and glass-bead blasting. Other mechanical finishing methods (in addition to the buffing and burnishing already mentioned) include sanding, polishing, and tumbling.

Any of these methods may be applied as a final surface finish, or to enhance surface quality, or in preparation for a final cosmetic finish.

Chemical Finishes

Etching

A silvery-white, frosted appearance can be given to an aluminum profile by applying a caustic solution to its surface in a process known as chemical etching. The aluminum profile is passed through a hot bath, rinsed, and then immersed in what is called a deoxidized desmut bath that removes undissolved alloy constituents or surface impurities. To complete the process, further rinses are usually required.

Bright Dipping

Bright dipping is a specialized kind of chemical-finishing that yields a bright, mirror-like finish (known as a specular finish). The bath usually contains both phosphoric acid and nitric acid, heated to an elevated temperature. The profile to be bright-dipped must first be polished to remove fine scratches, and afterwards is usually anodized. Anodizing the bright-dipped part serves two purposes: it protects the surface finish, and can be used to apply color to the profile.