TECHNICAL BULLETIN

Aluminum Anodizers Council™

TECHNICAL BULLETIN #1-08

"Guide to Selecting the Proper Adhesive for Anodizing Applications"

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Issued February 2008

Guide to Selecting the Proper Adhesive for Anodizing Applications

PURPOSE

The purpose of this Technical Bulletin is to help evaluate and select adhesives suitable for use with anodized aluminum products. Every situation is unique; while this guide can help to lead you in the right direction, the suggested adhesive may not *always* be the best for your application. Consider all of the variables surrounding your application prior to using this guide. Remember to test your adhesive selection to ensure that it meets your process needs.

CONSIDERATIONS

There are many considerations that will need to be addressed before deciding on an adhesive. Each of these factors should be well understood in order for you to properly identify the adhesive that will work best for your application.

Substrates – The type of substrates you are attempting to bond will have the greatest effect on the type of adhesive to use. Anodized aluminum will bond to most other metals, plastics, glass, wood or rubber, as long as the correct adhesive is applied to bond them.

Application – How your anodized aluminum component is going to be used, what types of stress it will endure, and how the adhesive will be applied will affect your choice of adhesive. Adhesives have different set times, cure times, effective temperature limits, and hardness. Some adhesives are made to endure certain stresses (e.g., shear, tensile, peel, elongation, etc.).

Environment – The effects of the substrate's environment of use will determine the best adhesive to apply. Adhesive bond strengths can be drastically decreased if subjected to chemical, salt fog, extreme-temperature and/or temperature-changing environments.

Type of Anodizing – The type of anodic coating on the aluminum parts could play a role in its ability to create a strong bond with the adhesive. Note that all anodic coatings, if correctly processed, can serve as a good base for paints and adhesives.

> *Type I* – Chromic Acid Anodizing tends to create a less-porous and thinner layer of aluminum oxide than conventional Type II anodizing. Chromic acid anodizing may serve as a pretreatment for subsequent coatings, so may offer a suitable base for adhesion.

Type II – Sulfuric Acid Anodizing is the most common type of anodizing. Coating thickness range is wide and depends on the application.

Type III – Hardcoat Anodizing creates a thicker, harder coating than Type II. Special processing conditions minimize porosity and maximize thickness.

PAA – Phosphoric Acid Anodizing produces a thin layer of aluminum oxide used as a primer coat for adhesive bonding. The coating is not sealed and will not hydrate in the presence of water. Phosphoric Acid Anodizing is the optimum method of preparing aluminum for bonding.

Sealed / Unsealed – If left unsealed, the anodic coating may exhibit increased bond strength. With the pores exposed, the adhesive will have more surface area to bond. Leaving the surface unsealed, however, could lead to poor finish quality and dye fading on areas outside the bond area.

Wetting Agents (Surfactants) – The quality of the bond of any adhesive used on anodized and sealed aluminum can be affected by the surfactants (wetting agents) used in the sealing bath to help remit the amount of *smut* that is formed in the sealing process. Use of any wetting agents at all after anodizing will be deleterious to the adhesion of both bonding agents and paint. In order to facilitate a high quality bond, the anodized parts, if sealed, must be sealed in deionized (DI) water with no wetting agents added. A DI rinse before and after sealing is also recommended.

How Parts Fit Together – Knowledge of how the parts to be bonded actually fit together is important. When the adhesives cure they expand to fill the gap between the substrates. Different adhesives have different cure thicknesses.

ADHESIVES

Each type of adhesive has different characteristics that may be best suited for your application.

Epoxies have the highest bond strength in elevated salt, temperature, and chemical environments. In high-temperature environments, epoxies often increase in bond strength. Mixing and surface preparation are required to obtain good adhesion. The adhesive cure is very rigid.

Acrylics bond to the widest variety of substrates, and may be used successfully with some substrates that otherwise might not be satisfactorily bonded. Unlike epoxies and urethanes, most acrylics do not require surface preparation. Acrylics hold up very well in salt fog, chemical, and heat applications. Some require mixing. Cured acrylics are more flexible than epoxies.

Urethanes generally offer low cost. The cured adhesive is elastic, allowing flexibility and impact resistance. There is good resistance to chemical environments, although urethanes are sensitive to moisture. Urethane bond strength is usually stronger than silicones and urethanes will bond well to thermoplastics and thermoset plastics. Surface preparation is required.

Cyanoacrylates react with surface moisture in a matter of seconds, producing a rigid strong bond on low porosity substrates such as plastics and rubbers. Bond strength decreases significantly in harsh salt, chemical, and heat environments. They offer low resistance to solvents.

Silicones are low-strength, low-cost, soft-cure adhesives. Silicones have good resistance to polar solvents, but poor resistance to non-polar solvents. Silicones are the most flexible adhesive and have great impact resistance. Silicones bond very well to glass applications. Silicones performance is fair in chemical and salt environments; they perform well in heated applications.

ADHESIVE SELECTION GUIDE BASED ON BOND STRENGTH *

The following selection guide is for bonding anodized aluminum with other substrates. The guide will narrow your choices for types of adhesives to evaluate when attempting to bond anodized aluminum. As always, keep all of your considerations in mind when choosing which adhesive category to evaluate:

Substrate	**Adhesive Category**
Other Anodized Aluminum	- Epoxy - Acrylic
Glass	- Silicone - Urethane
Wood	- Epoxy
Plastic	- Acrylic - Epoxy - Cyanoacrylate
Rubber	- Cyanoacrylate - Epoxy
Nylon	- Epoxy

*Note: This table was created with the assumption that anodized aluminum was one of the substrates. Please refer to the references listed below when attempting to bond two aluminum substrates that have not been anodized.

CONCLUSION

Epoxies and acrylics may work best for most applications except when working with glass, for which silicone or urethane should be used. There are many other factors that may be significant to your application. After choosing the adhesive, conduct experimental tests to ensure that product performance meets all of your application requirements. If you have questions or concerns contact your local adhesive supplier.

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