

Metal Tolerance Guidelines as it Relates to Hard Coat Classic and Quantum Hardcolor

In this document we will attempt to cover many of the areas that confuse manufacturers of aluminum parts regarding dimensional changes, coating thicknesses, anodizing tolerances and metal removal associated with pre-finishing etching or brightening. We will list items of importance and explain what can or cannot be expected.

A. Typical Type 3 hard coat anodizing (Classic) generally has a thickness of .002 +/- .0004. Approximately half of this thickness is said to penetrate, but a more accurate description is that a surface will grow by half of the coating thickness.

1. Natural and Black hard coat can be expected to behave as above
 - a. Natural is so named because the color that is created “naturally” is dependant on the alloy and temper of the aluminum that is being hard coated. This film is usually a dark greenish brown. This being the case, although it is possible to dye, it is NOT possible to reflect the true color being applied since the true color is disguised by the background color that was created “naturally”. Black is the exception. Black will be black.
 - b. Black Hard Coat is created after hard coating by an organic pigment that is impregnated into the hard coat and then sealed in. This “dyeing” adds no thickness.

B, Colored hard coat anodizing, known as Sanford Quantum Hard Color and developed by Sanford Process Corp. and D-CHN has a normal thickness of .0013 +/- .0003 but can be .002”. Although it is typically not as thick as Classic Hard Coat (although it can be), it possesses much of the same characteristics and will pass salt spray corrosion resistance tests, tabor abrasion and many other requirements.

1. Color and thickness are partners as each color requires thicknesses in a certain range.
2. The “build up” per surface is approximately half of the coating thickness.
3. The color is generally the “controlling” factor and governs thickness because most customers are looking for a specific color.
4. The Quantum Hard Color film, unlike Classic, is clear in nature and therefore allows the color to appear as it is without a “background” color to change or hide the true color being applied.

C. Metal Preparation for anodizing can involve many mechanical methods which will be discussed later but chemically there are two widely used methods. Both of these methods vary with the alloy of aluminum that the parts are made from and the mechanical finishing the part has gone through.

1. Etching.... is usually a sodium hydroxide solution that is designed to remove aluminum from the surface to both clean and “dull” the appearance. Temperature, time and concentration are factors in the rate of metal removal and also appearance. DCHN has strict control on concentration and temperature. We vary time to accomplish the desired results. Time can vary from 15 seconds (on critical dimension parts) to up to 8 minutes (mill finish, heavily marked extrusions). The metal removal can be .0001 to .0006 on a diameter (half per surface) in the 1 to 4 min etch range and as much as .0015 on a diameter at the 8 minutes mark.. This is a very common method of preparing aluminum for anodizing.

2. Chemical Brightening.....is an acid based solution designed to “polish” the part by removing aluminum and attacking the “high points” in the aluminum surface preferentially. This creates a “shiny” or “glossy” or “bright” appearance. It is important to note that this “bright” appearance is usually the requirement the customer specifies and therefore there is a certain amount of material that MUST be removed to accomplish this task. This could range from a minimum of .0001 on a diameter to .00048 on a diameter (half that amount per surface). Since temperature and concentration are strict in order for the chemical to work at all, time becomes the critical factor controlling results. The time is normally from 15 seconds to 2 minutes.

D. Mechanical preparation can take many forms. Parts can be tumbled and/or vibratory finished (in many different media), glass beaded or sand blasted, polished, or grained/time saved just to name a few. Parts can also be left as machined or in “mill” condition (commonly extrusions or sheet).

1. Depending on what mechanical method is applied it can and will affect the chemical process chosen in order to achieve a finish which will be “cosmetically” pleasing to the customer.

a. Bead/Sand blast in most cases is difficult to apply evenly and after anodize can appear “blotchy” or uneven. Heavier etching will help mediate this appearance BUT will affect overall dimensions since metal will be removed. Chemical polish may accentuate this blotchy uneven appearance and will also remove material. (Only recommended when tolerances are NOT a consideration.)

b. Tumble/Vibratory finishes do not usually require excessive etch unless there are lines or marks that are NOT removed in tumbling. Chemical brightening is normally done for brightness and well prepared parts may remove .0002 per surface.

c. Grained/Time Saved parts are problematic. Unless these products are adequately etched, a condition is created called “slivers”. Slivers are sharp edges of aluminum caused by the graining that begin to anodize and then break off because they are so sharp. Etching will round the sharp edges and allow the anodizing to form properly. This usually requires a medium to heavy etch and therefore as much as .001” aluminum may be removed. Graining is NOT recommended on tight tolerance parts. Chemical polishing works well since it attacks high spots first but still graining is not advised on tight tolerance parts. Knurled parts create the same difficult condition.

d. Polished parts normally would NOT be etched so that the integrity of the “shine” is left undisturbed. Chemical polish can be applied in very light doses to enhance a part that is polished.

e. “As is” parts from machining can be etched or chemical polished depending on customer requirements. These are normally the “tight tolerance” parts referred to throughout this paper so we recommend having technical discussions with us before manufacturing the parts. Normally, if no brightening is required, we would apply a light etch. A regular chemical polish would be applied if a bright finish was requested. Remember a regular chemical polish will remove about .0002” aluminum per surface.

f. “AS is” parts from extrusions or sheet may require a heavy etch. Often, cosmetics and tight tolerances are at odds when using “as is” extrusion or sheet.

The above information is designed to help educate the manufacturer to all of the potential difficulties and failure points that can arise when parts are dimensionally manufactured and mechanically pre-finished without regard to the desired outcome expected from the hard coated finish. Each and every factor listed may work against each other when trying to achieve a desired outcome. For instance:

If a part requires a “bright” natural hard coat and the manufacturer leaves their hole(s) dimensions open by .002” assuming the hard coat will close the hole by .002” BUT neglects to remember that the chemical polish may remove as much as .0004” then the parts are bound to fail dimensionally. If the anodizer attempts to achieve cosmetic correctness then they cannot achieve tolerance correctness and vice versa.

If a part requires Blue/Red/Green etc. hard coat (Quantum hardcolor) and the manufacturer allows for .001 per surface build up, regardless of what chemical pre-finishing is desired, then the part WILL BE out of tolerance. IF you add to that the fact that the parts may be bead blasted or other MECHANICAL pre-finish and you can see why dimensions should have been discussed with the finisher BEFORE manufacturing.

Our job is to give the customer both a cosmetically pleasing AND an “in tolerance” part. To achieve this, we need to be supplied parts that are manufactured with the proper dimensional allowances, after considering the desired finish and the changes that will be made to achieve it, in order to put us in a situation that allows success.

We strongly advise communication with our engineering department for conversation regarding the parts and their hard coat and cosmetic requirements before manufacturing begins.



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