



# Hardcoat & Anodize Application Properties

A REFERENCE GUIDE BY CERTIFIED METAL FINISHING, INC.

# Why This Guide Exists

At Certified Metal Finishing, we believe the best customer is an educated customer. With our team's **100+ years** of combined experience, we've created this guide to clarify anodizing and hardcoat processes, avoid miscommunication, and support proper planning.

**Let's all speak the same hardcoat language.**



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# Anodizing Basics

## Anodizing is not metal plating.

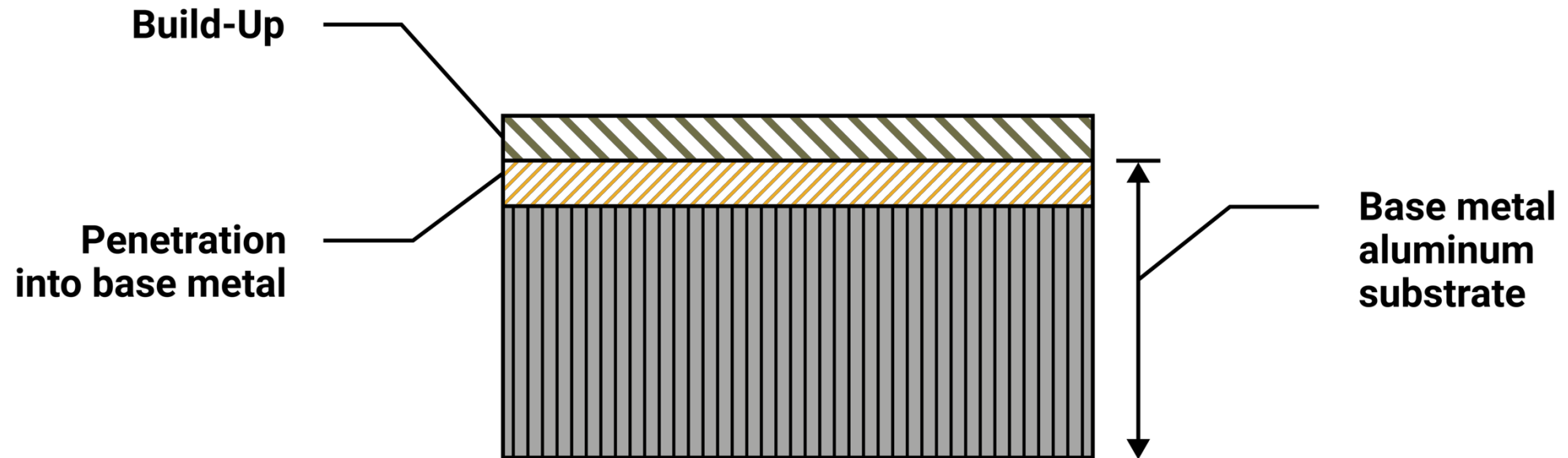
- + These two terms are sometimes confused, but in fact, are completely different processes.
- + In anodizing, the anodic coating is generated from the base aluminum itself—not layered on like plating.
- + Anodizing builds an ultra-thin, non-toxic aluminum oxide layers that constitutes a minute amount of mass to a product.
- + At its most fundamental level, anodizing is an electrochemical process that converts the surface of bare aluminum into an ultra thin, non-toxic aluminum oxide layer.
- + The process begins when the part is submerged in an electrolyte bath and an electrical current is applied. This triggers a controlled reaction between the aluminum and the electrolyte, forming an anodic coating.
- + Unlike plating, this coating is not deposited onto the surface—it's grown from the metal itself. The result is a hard, non-conductive oxide layer that becomes an integral part of the aluminum, contributing both to the thickness and performance of the part.

# Types of Anodizing

| Type                                                                                                     | Coating Thickness              |
|----------------------------------------------------------------------------------------------------------|--------------------------------|
| <b>Type 1</b><br>Conventional coatings – Chromic Acid (CAA)                                              | 0.000030 - 0.00007 / .0001 “   |
| <b>Type IB</b><br>Low Voltage Chromic Acid Anodizing<br>(20 Volts ± 2 Volts) Used for 7xxx series alloys | . 0.000030 - 0.00007 / .0001 “ |
| <b>Type II</b><br>Conventional Coatings – Sulfuric Acid                                                  | 0.0004 – 0.0007 “              |
| <b>Type III</b><br>Hardcoat (Uniform Anodic Coatings)                                                    | 0.0005 / .002 ± 0.0004         |
| <b>*Class 1</b>                                                                                          | Non-dyed                       |
| <b>*Class 2</b>                                                                                          | Dyed                           |

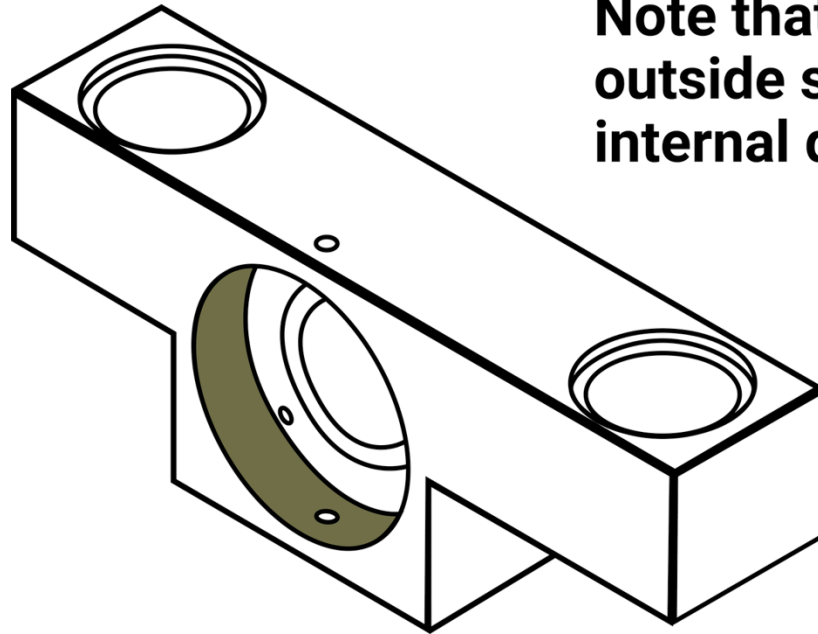
# Penetration & Build-Up

Here you can see the relationship between base metal, penetration, and build-up.



**Build-Up + Penetration = Thickness of Coating**

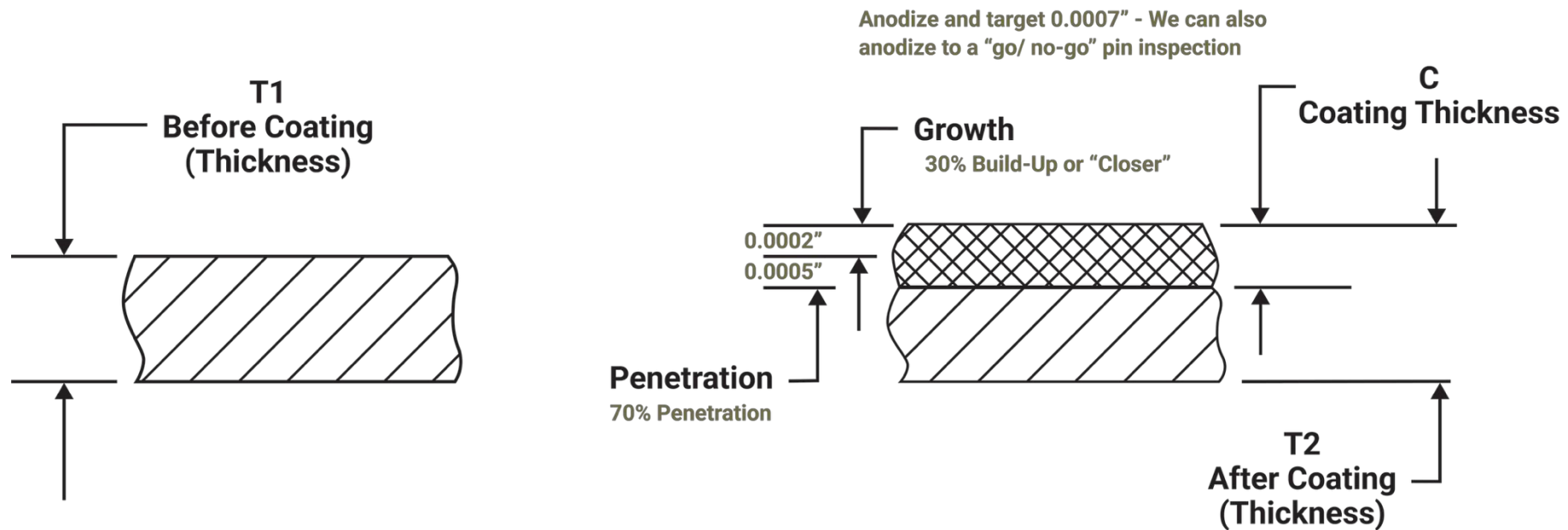
# Penetration & Build-Up



**Note that in Type II & III Anodizing,  
outside surfaces will “grow” and  
internal dimensions will “close”.**

# Overview: Type II – Sulfuric Acid Anodize

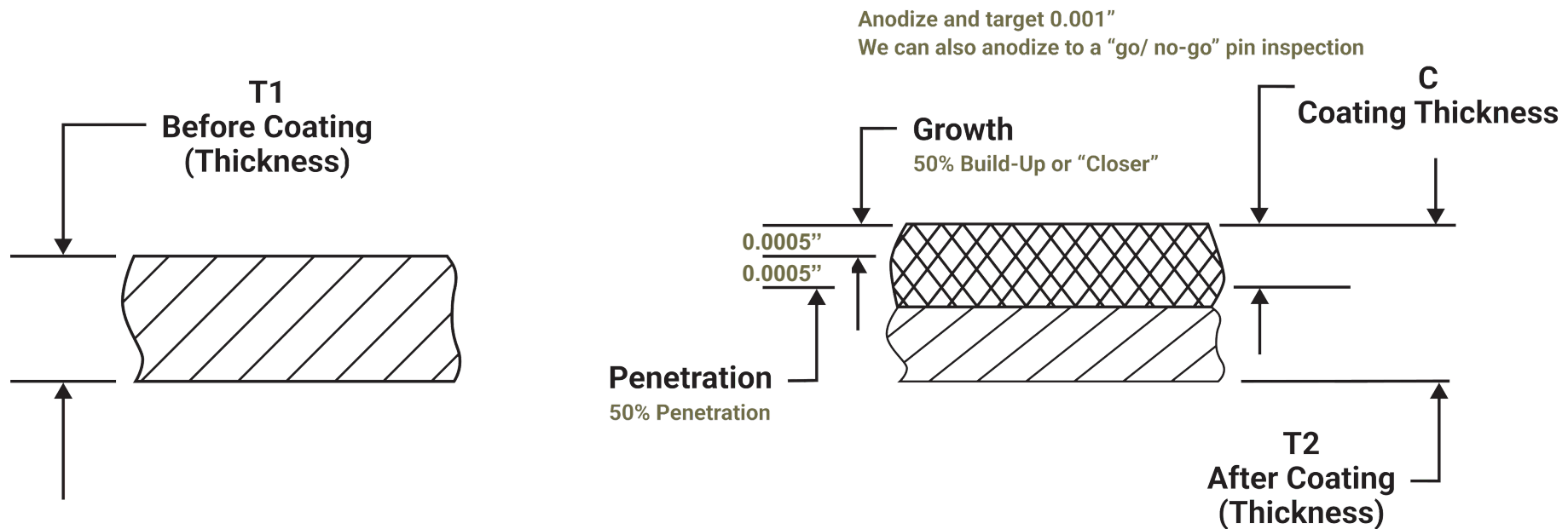
- + This diagram depicts a piece of metal before and after Type II Anodizing
- + Type II Anodizing produces thickness of 0.0004 – 0.0007 inches
- + Build-Up Per Surface + Penetration = Thickness





# Overview: Type III – Hardcoat Anodize

- + This diagram depicts a piece of metal before and after Type III Anodizing
- + Type III Anodizing produces thickness of 0.0005 – 0.0024 inches
- + Hardcoat can be maintained to +/- 0.0002 thick



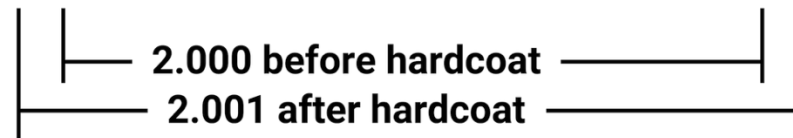
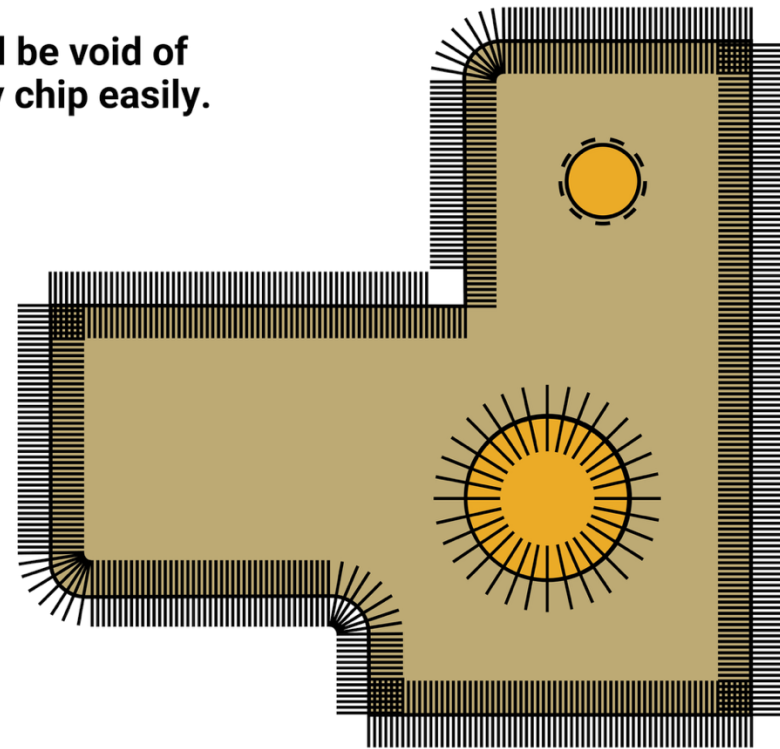
## PENETRATION & BUILD-UP

# Right Angles

An inside or outside radius or 0.015 assures continuity in the coating.

Sharp corners will be void of hardcoat and may chip easily.

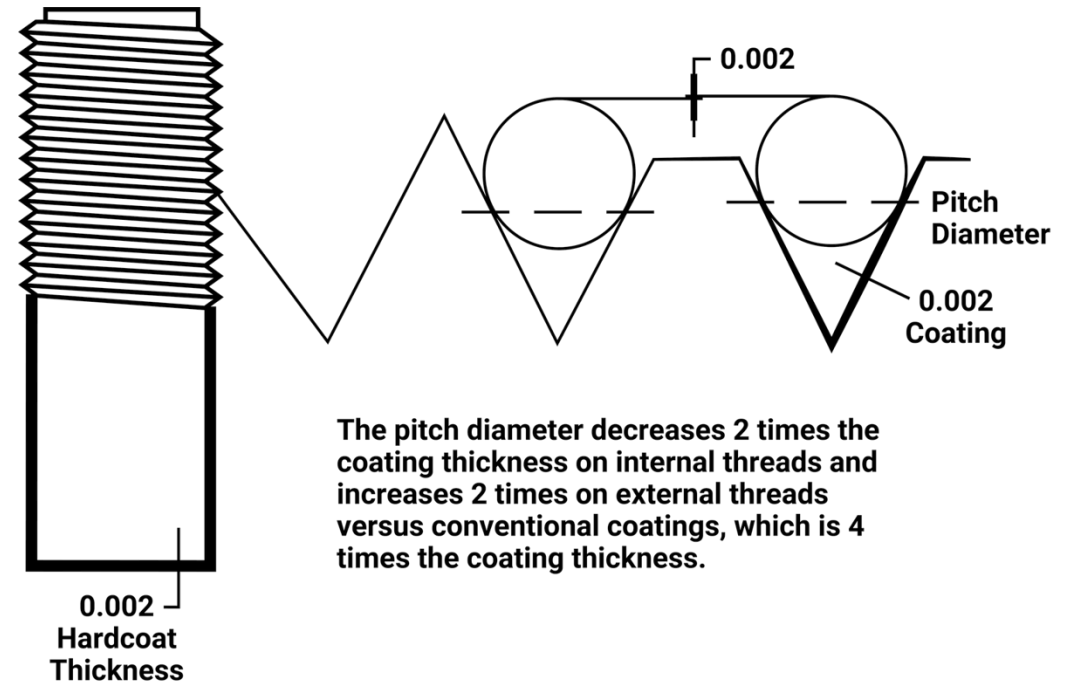
 = Hardcoat



## PENETRATION & BUILD-UP

# Threads

- + Hardcoat thickness is typically 0.002" (0.0508 mm)
- + Half the coating thickness is build-up and half is penetration into the base metal
- + Example: For the threaded rod on the right, the diameter increased by 0.002" since half of the coating thickness (0.001") built up the diameter on each side of the rod.

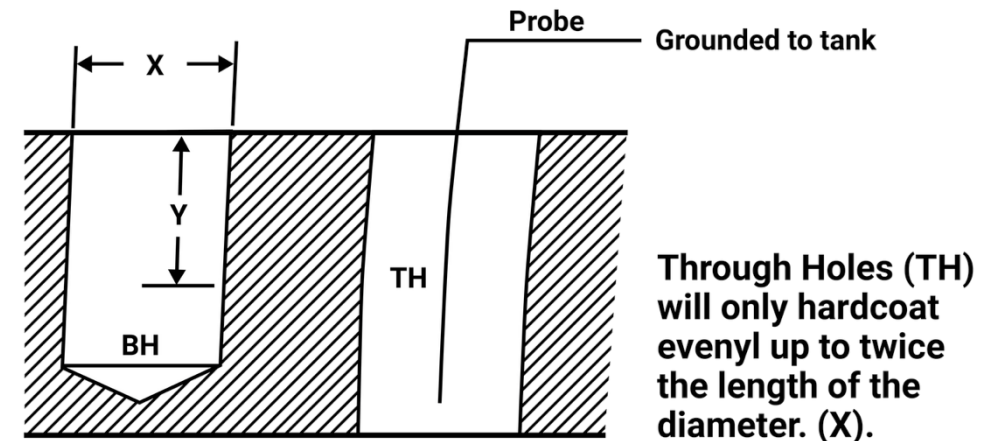


When a "V" thread is to be cut, allow for hardcoating by using the formula: build-up  $\times$  4. This will equal the pitch diameter change. A typical example is: Desired P.D. = .405/.4091 (7/16 N.F. Internal Thread) Coating thickness .002 +/- .0002 (.001 +/- .0001 build-up). Minimum build-up is .0009  $\times$  4 = .0036 P.D. change; Maximum build-up is .0011  $\times$  4 = .0044 P.D. change. Machine P.D. to .4094/.4127

# Blind Holes & Through Holes

- + Through holes on a drawing will hardcoat evenly up to twice (2x) the length of the diameter of the through hole
- + Blind holes will only hardcoat to a depth equal (=) to the diameter of the hole
- + Example: Hardcoating a shaft .002 thick will increase the diameter by .002. Plating the same shaft would increase the diameter .004 since plating is 100% build-up.

**Blind Holes (BH) will only hardcoat to a depth equal to the diameter of the hole. ( $X = Y$ )**



# Aluminum Alloy Reference for Anodizing

| Series (AA)* | Alloying Constituents | Metal Properties                  | Coating Properties      | Uses                                  | Non-A.Q. ** Types      | Finishing Advice                                                                                                                 |
|--------------|-----------------------|-----------------------------------|-------------------------|---------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 1xxx         | None                  | Soft Conductive                   | Clear, Bright           | Cans, Architectural                   | 1100, 1175             | Care should be taken when racking this soft material; good for bright coatings; susceptible to etch staining                     |
| 2xxx         | Copper                | Very Strong, Hard Low, Elongation | Yellow, Poor Protection | Aircraft, Mechanical                  | 2011, 2017, 2219, 2224 | Since copper content is >2%, these produce yellow, poor weather-resistant coatings; don't mix with other alloys on load          |
| 3xxx         | Manganese             | Strong Small Grains               | Grayish-brown           | Cans, Architectural, Lighting         | 3003, 3004             | Difficult to match sheet-to-sheet (varying degrees of gray/brown); used extensively for lighting                                 |
| 4xxx         | Silicon               | Strong Fluid                      | Dark Gray               | Architectural, Welding Wire           | 4043, 4343             |                                                                                                                                  |
| 5xxx         | Magnesium             | Strong Ductile Fluid              | Clear Good Protection   | Architectural, Welding Wire, Lighting | 5052, 5252             | For 5005-keep silicon<0.1% and magnesium between 0.7% and 0.9%; watch for oxide streaks; 5005 used extensively for architectural |
| 6xxx         | Magnesium & Silicon   | Strong Ductile                    | Clear Good Protection   | Architectural, Structural             | 6061, 6101             | Matte-iron>0.2%; bright-iron<0.1%; 6063 best match for 5005; 6463 best for chemical brightening                                  |
| 7xxx         | Zinc                  | Very Strong                       | Clear Good Protection   | Automotive                            | 7029, 7046, 7075       |                                                                                                                                  |



# Test Methods for Type II Anodized Aluminum

| Oxide Coating Weight and Apparent Density |
|-------------------------------------------|
| ASTM B 137-xx                             |

| Oxide Coating Thickness |
|-------------------------|
| ASTM B 244-XX           |
| ASTM B 487-XX           |

| Corrosion Resistance |           |           |
|----------------------|-----------|-----------|
| ASTM B 117-xx        |           |           |
|                      | Min Hours | Max Spots |
| Class I              | 3000      | 15        |
| Class II             | 1000      | 15        |

# Best Practices

- + Be positive before you machine your parts that you are allowing for the hardcoat **build-up per surface** and not **plating build-up**.
  - + If you have any questions, call us immediately at 954-979-0707. **It is easier to correct the problem at the beginning!**
- + Allowing a tolerance on coating build-up means that you must machine closer than blueprint dimensions.
  - + Example: A shaft diameter which is to finish at  $1.5 \pm .001$  and is to be hardcoated  $.002 \pm .0002$  thick ( $.001 \pm .0001$  build-up per surface), your planning should call out to be machined to  $1.498 \pm .0008$ . The part will then be to finished dimensions after hardcoating.
- + Hardcoat is not compatible with anodizing and parts may be damaged if they are anodized after hardcoating. When there is a requirement for hardcoat and any other type of chemical processing, such as iridite, alodine or anodize, contact our Planning Department for recommendation. Many manufacturing companies are now using the flash hardcoat (.0002/.0004) instead of other anodic processes in order to save time, money and possible damage.
- + Difficulties can arise if an order of parts is manufactured from different alloys and this fact is not made known to the processor. Each alloy has different rate of coat formation. When different alloys are processed at the same time, different thicknesses of oxide are formed on the different alloys. This could result in an “out of tolerance” condition on some of the parts. It is imperative that the alloys always be designated. The processor will always coat to the specifications furnished with the order. It is the responsibility of the manufacturer to make sure the correct information for processing accompanies the work.



# Have a Question? We're Here to Help

(954) 979-0707 | [certifiedmetalfinishing.com](https://www.certifiedmetalfinishing.com)

*Planning Department available for spec consultation.*