CERTIFIED METAL FINISHING

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.

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Types of Anodizing

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

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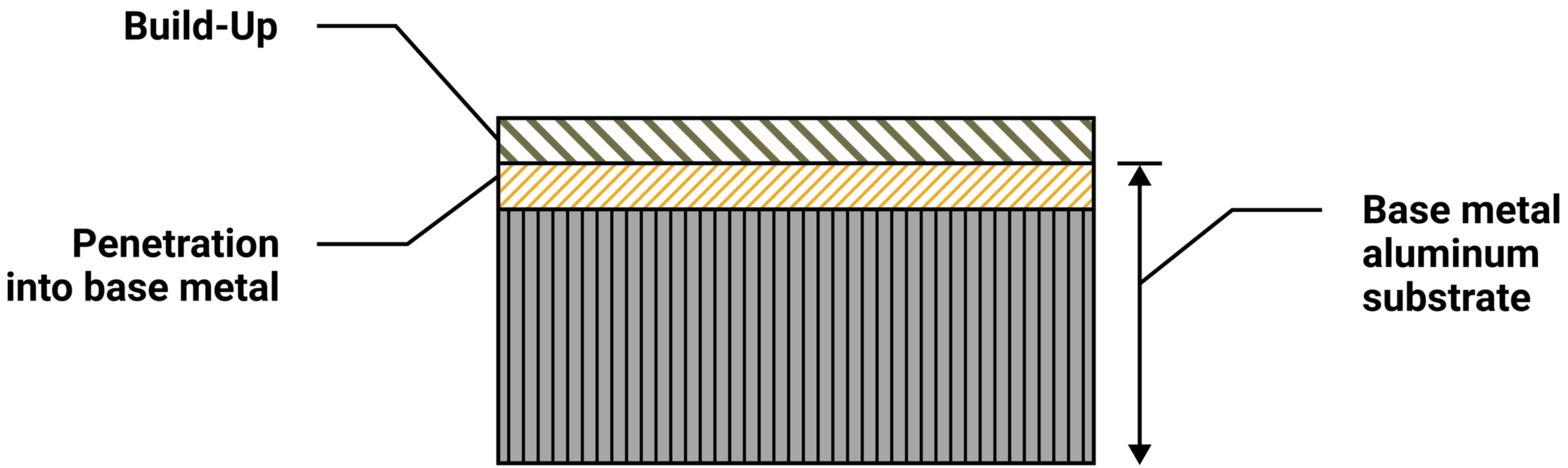
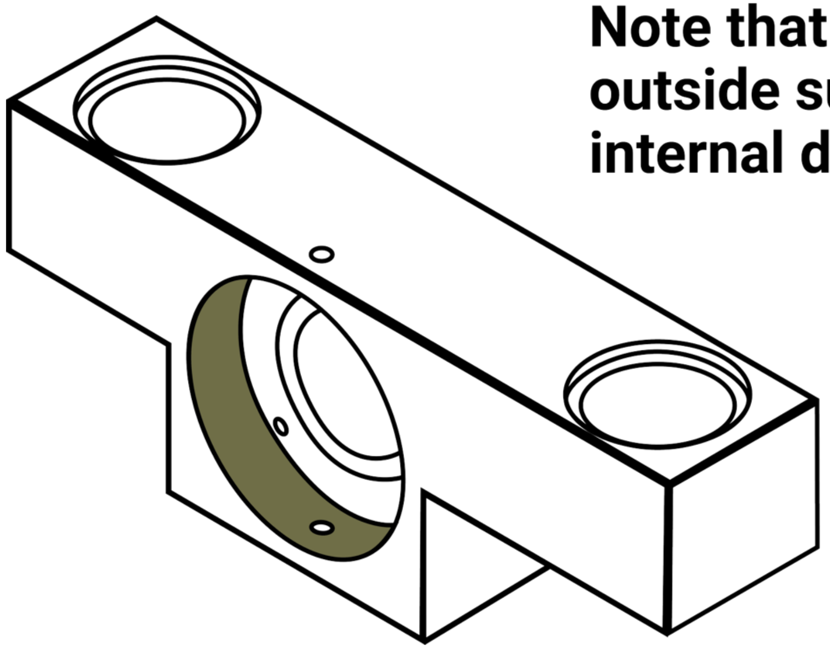
Penetration & Build-Up

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



Build-Up + Penetration = Thickness of Coating

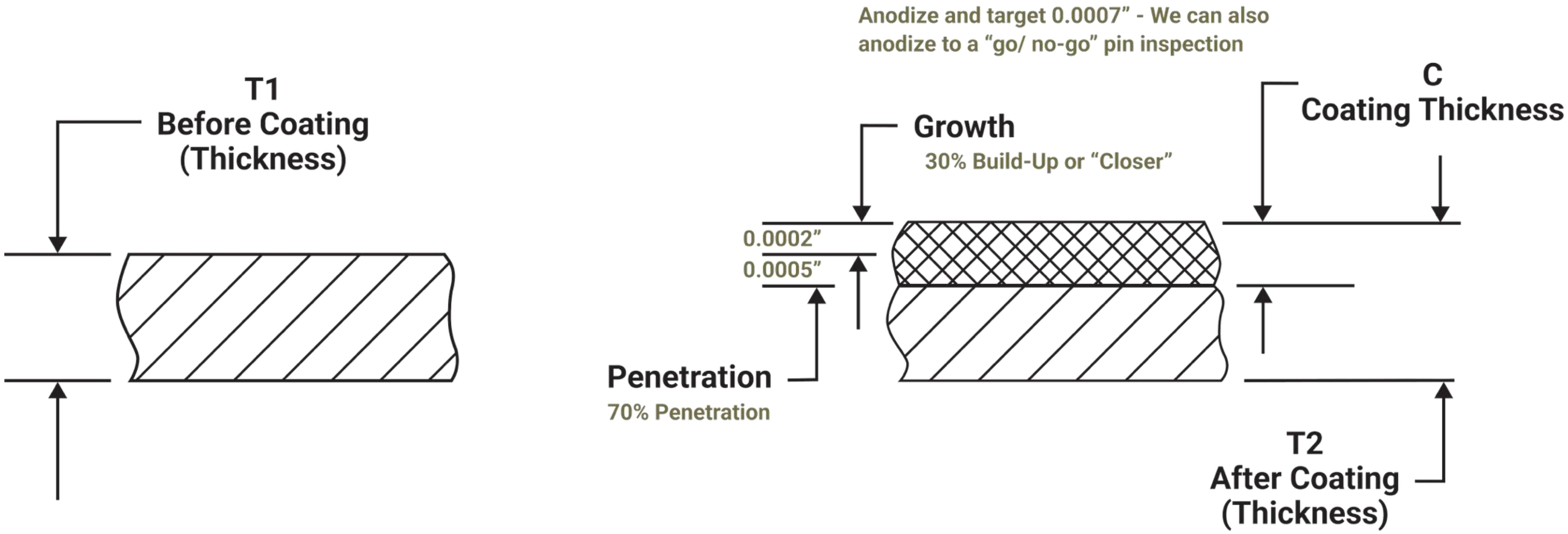
Penetration & Build-Up



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

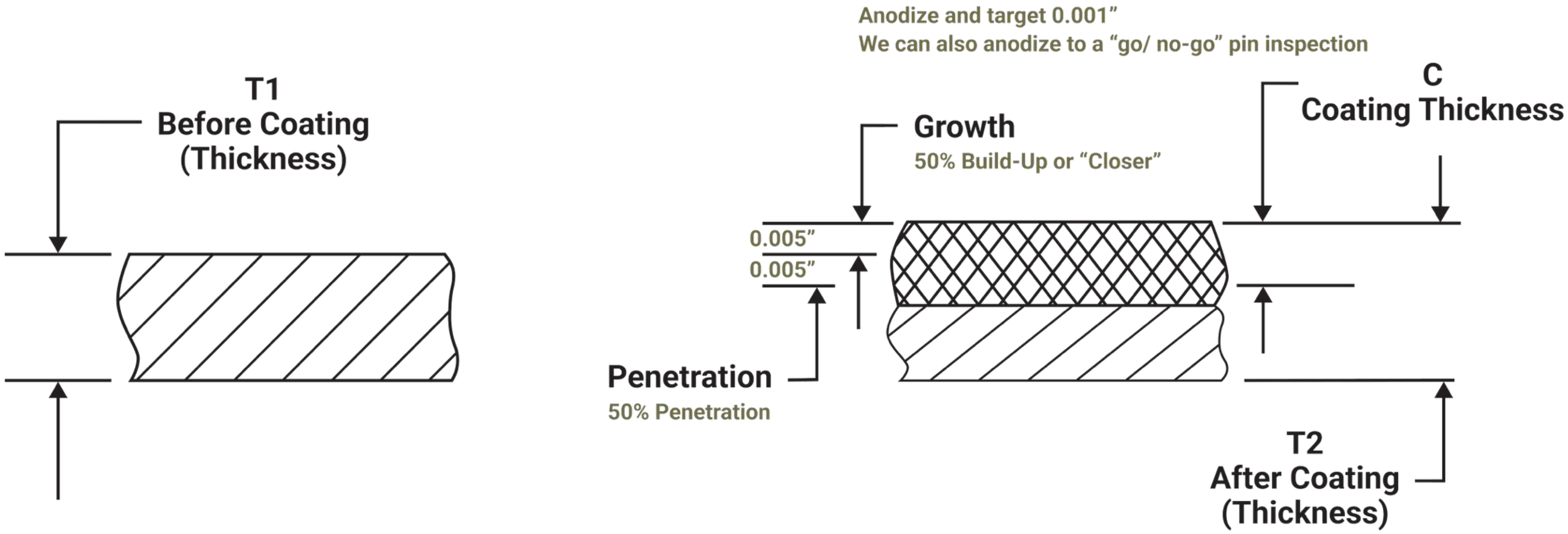
Overview: Type II – Sulfuric Acid Anodize

- 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

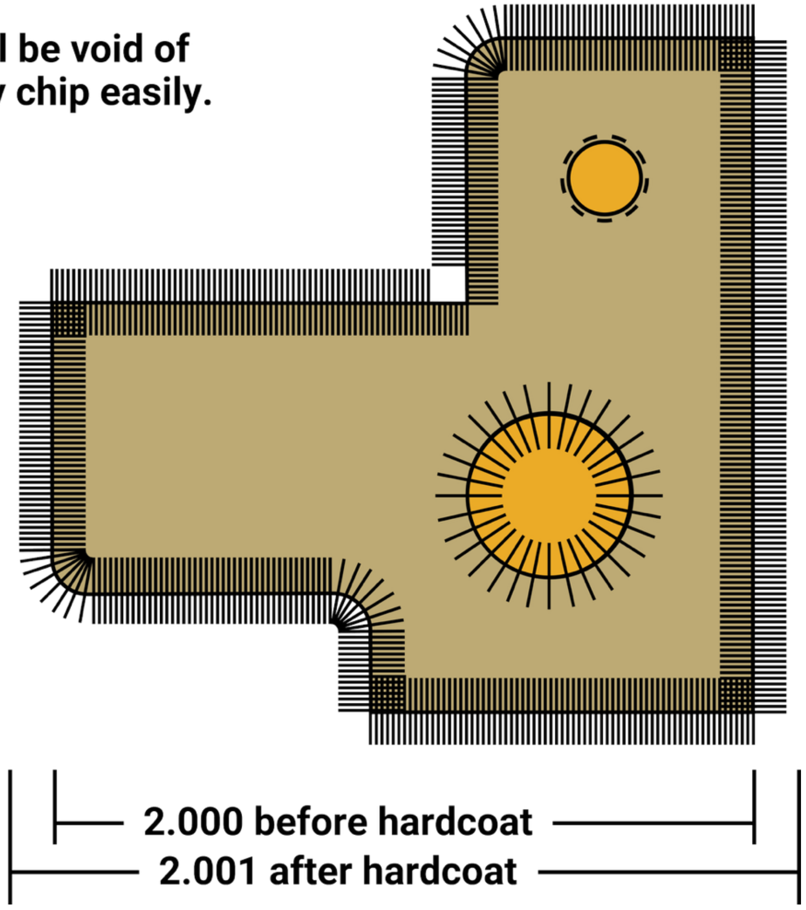


Right Angles

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



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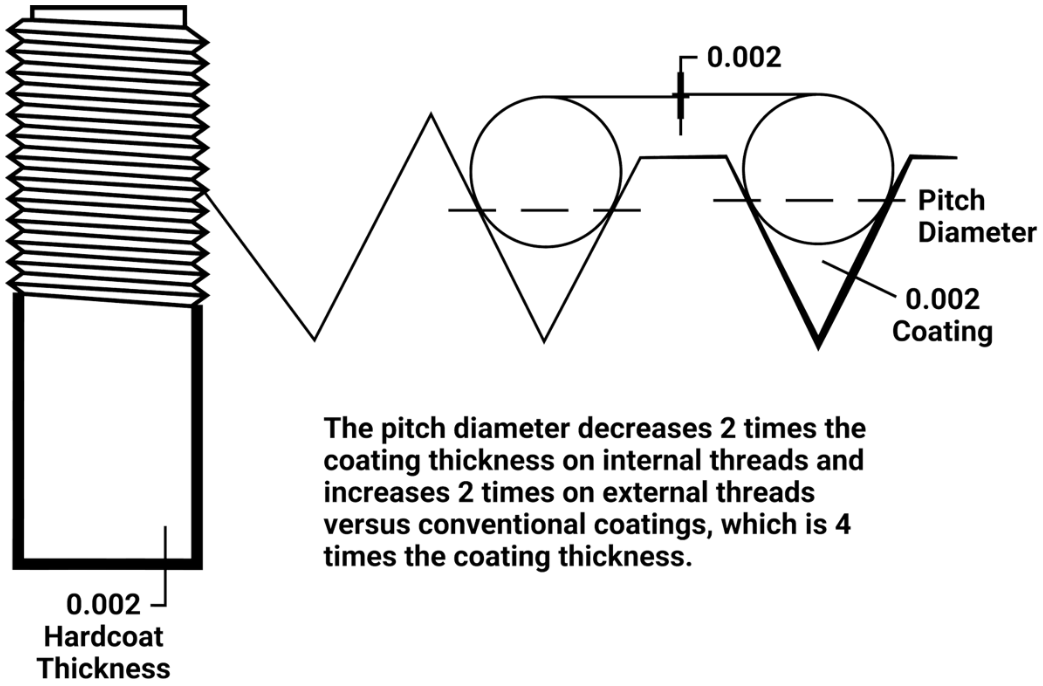
Threads

- 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 × 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 x 4 = .0036 P.D. change; Maximum build-up is .0011 x 4 = .0044 P.D. change. Machine P.D. to .4094/.4127

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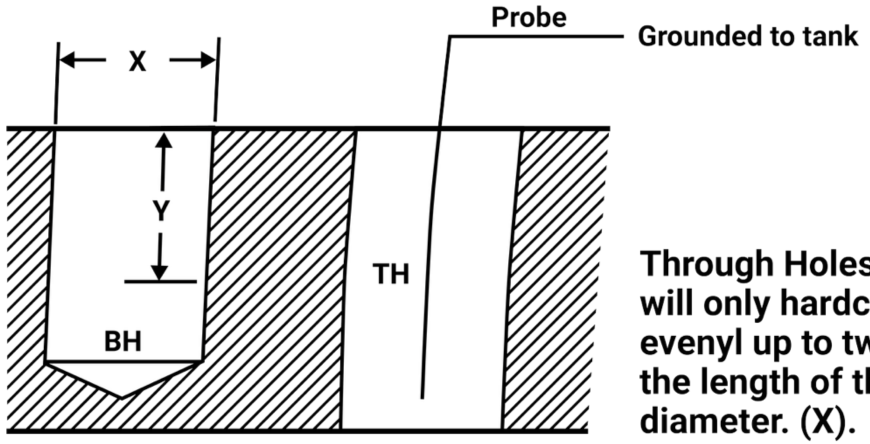
Blind Holes & Through Holes

- 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)



Through Holes (TH) will only hardcoat evenyl up to twice the length of the diameter. (X).

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	

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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

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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 +/- .001 and is to be hardcoated .002 +/- .0002 thick (.001 +/- .0001 build-up per surface), your planning should call out to be machined to 1.498 +/- .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.

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Have a Question?
We’re Here to Help

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Planning Department available for spec consultation.