

## **Aerospace Metals Plating Specifications** Aerospace Metals, LLC | 2401 Mississippi Ave, Sauget, IL 62201 | PH: 800.398.0790 - FX: 866.650.4357

The Best Customer is an Educated Customer Important Hints To Remember Before And During Design of Product

h. Plating and Painting Tolerances

10. Try to design the most important finish requirement first, then work down a list in priority sequence:

.002 Electroless Nickel will give you excellent corrosion resistance and the hardness of tool steel.

disappear. Any questions, please call Vendor.

smoother if these things are in place.

There could beappreciable time and money to be saved. Contact us at info@aerospacemetalsllc.com

PROCESS

CHEMICAL FILMS

coatings that range in color from

Materials qualified produce

clear to iridescent yellow or

brown, inspection difficulties

may arise with clear coatings

not reveal the presence of a

Corrosion Protective Plating

Copper in color and matte to

resistance when used as

very shiny finish. Good corrosion

undercoat. A number of copper

processes are available, each

designed for a specific purpose. Brightness (to eliminate the need

electroforming); Fine grain ( to

for buffing; High speed ( for

prevent casehardening); etc.

Stress relief steel parts cold

straightened or suspected of

having residual tensile stresses

 $(350^{\circ}F \pm 25^{\circ}F-3 \text{ hours})$ . Parts

with tensile strength over 210

Ksi bake 24 hours within 4 hours

**DOW PROCESS** 

A Chrome pickle treatment for

magnesium. Color varies from

matte gray to yellow-red. Only

fair corrosion resistance (less

than 24 hours 20% salt spray

A dichromate treatment for

magnesium. Color varies from

light brown to gray depending

resistance (less than 24 hours

A galvanic anodize treatment for

magnesium. Produces a dark

Designed to give a protective

film on alloys which do not react to Dow No. 7 treatment. Only

fair corrosion resistance (less

Similar to stainless steel in color.

and cavities (does not build up

on edges). Corrosion resistance

is good for coatings over .001'

thickness. Electroless nickel is

used extensively in salvage of

mis-machined parts. Also, for

inside dimensions and irregular

-Class 1- below RC40. Baking

at 375°F ± 25°F at users option -Class 1-RC40 and above. Bake

at 375°F ± 25°F FOR 3 HOURS.

Shot peen steel parts designed for unlimited life under dynamic

loads prior to plating. Class 2-below RC40. Shot

penned parts designed for

unlimited life prior to plating.

Class 2 coating. Shall have

minimum hardness of 850

at  $375^{\circ}F \pm 25^{\circ}F$ 

Post plating bake 3 hours min.

knoop ( 100gm load) Class 3. Post bake 1-1½ hours

Class 4. Post bake heat treatable

Process electrolytically removes

or diminishes scratches, burrs

and unwanted sharp edges from

most metals. Finishes from satin

to mirror-bright are produced by

controlling time, temperature, or

**ELECTROPOLISHING** 

1-11/2 hours at 240°F-260°F

shapes (where assembly

postcoating procedures:

tolerances need uniformity provided by "electroless" process). Precoating and

Plates uniformily in recesses

**ELECTROLESS NICKEL** 

than 24 hours 20% salt spray

brown to black coating.

resistance).

on alloy. Only fair corrosion

20% salt spray resistance).

after plating.

resistance).

coating.

CHROME

**COPPER** 

because visual inspection does

materials, tolerances, or how new prints should be drawn up.

parts before plating – especially steel, aluminum and magnesium parts.

Class

Class 3

Type I

Type I

Type II

Class 0

Class 1

Class 2

Class 3

Class 4

Type I

Type III

Type IV

Class 1

Class 2

Class 3

Class 4

Grade A Grade B

Grade C

only

1A

11 Substantial cost savings can be achieved by utilizing various metal alloys and various combinations of plating

finishes to substitute for using very expensive and hard to machine alloys. eg. Using cold rolled steel with .001-

12. Always keep communication lines open between Machining, Fabricating, Electroplating and Painting Vendors.

This will save unlimited amounts of time and money which in turn produces a more timely and superior product. (1) Look for best material suppliers, availability, cost, certification if needed, and hard copy confirmation of such.

(2) Always review Plating Spec for material you are having processed - don't ask for cold rolled steel to be passivated or any material other than aluminum or magnesium or titanium to be anodized, or your parts will

(3) Always review final tolerance of your parts to see if they will be in tolerance after the final process you require.

(4) When preparing your quotation, you should find the necessary vendors you will need. Make sure that they are in compliance with all State and Federal regulations that are required for their process and that they are

approved for all Military And Federal Specifications -0.Q., Mil, AMS and ASTM requirements. If approved for

IS09001:2000 and AS9100 or Nadcap AC7108 - make sure they are in conformance - it would be a terrible

(5) Get prints out or discuss your requirements to vendor before drawing up blueprints. Always send the latest

print revision for quotation or when sending your final machined parts to vendor. Inquire as to necessary time

(6) If you have any questions regarding your material, please call our engineering people and we can discuss

(7) Before you send your parts out, be sure parts are not damaged, count is correct all the paperwork and specifications are in order when packaging your parts. Use white gloves. Some people have more acid in their

system than others, which can leave deep finger-prints on your finished parts, which means re-working your

**Bright Finish** 

Satin Finish

Unless

.001"

.0005"

.0002"

.0001"

Removes

metal

Approx

.0006" for

wrought-less diecast-

dimensional

dimensional

change

Unless

otherwise

specified

.0005" min

.0015" min

**Typical** 

Thickness

Loss.0002'

ings. No

change.

otherwise specified

.001-.005

and cost to do your work if any special materials are needed so they can be ordered - the job will proceed much

and costly situation if your vendor can't complete your job because of compliance problems.

i. Base material best for application;

Operating & Temperature environment

IMPORTANT:

PLEASE READ ABOVE

COMMENTS & SPEC NO.

For maximum protection against

For protection against corrosion where

low electrical resistance is required.

corrosion, painted or unpainted

MIL-DTL-5541

QQ-C-320

MIL-C-14550

For heat treatment stop-off.

For carburizing and decarburizing shield,

also plated through printed circuit boards.

To prevent basis metal migration into tin

Used mainly for protecting magnesium

during shipment, storage, and machining.

Can be used as a paint base. NOTE: Must

Good paint base and protective qualities

for all magnesium alloys except EK30A, EK41A, EZ33A, HK31A, and M1A.

NOTE: Precleaning and pickling may result

in dimensional changes due to metal loss.

applicable to all magnesium alloys. Used

required on close tolerance parts (camera

\* The minimum thickness of the

inch(grade B) for copper-, nickel-,

nickel coating shall be 0.0005

and cobalt-based titanium and

As plated, no subsequent heat treatment. A bake for hydrogen embrittlement relief is not considered a treatment.

Heat treated to obtain required hardness.

May be used on all metals not affected

Aluminum alloys non-heat-treatable, and

Aluminum alloy, heat treatable, processed to improve adhesion of the nickel deposit.

(NO MIL-SPEC NO.)

Process is not recommended for close

Typical dimensional change.

tolerance surfaces.

beryllium alloys processed to improve adhesion of the nickel deposit.

by heating to 500°F and above.

Can be used as a paint base, and is

where optical properties (black) are

parts, etc.). NOTE: Precleaning and

pickling may result in dimensional

changes due to metal loss.

MIL-C-26074

beryllium alloys.

remove Type 1 coating before applying

Type III and Type IV treatments.

As an undercoat for nickel and other

(prevents poisoning solderability).

MIL-M-3171

CL1 .00001

## 1. Electroplating has irregular plating distribution, be sure to make allowances for edge and corner buildup. 9. When painting is necessary, please remember some Military specifications of Flight Programs that require as much as .003 total thickness of primer and paint which does not include build up on edges. The BlackSteel Plated Rod is .001" thick - Note the irregularity a. Corrosion Resistance g. Esthetics of Product

of plating thickness on ends of rod.
The plating is .001" thick, the end plating is .002" - .003" thicker

b. Surface Hardness due to edge and corner buildup. c. Ductility

Electroplating will not plate all the way into blind holes and will not cover uniformily through, or through threaded d. Solderability holes in excess on ½" depth and .100 diameter as illustrated. As hole becomes larger, coverage will increase. e. Conductivity

2. Electroless Plating plates uniformily within .000020 of an inch or less on all sufaces it comes in contact with. It will not plate in blind areas or blind holes unless constant turnover of solution is maintained. eg.

Steel tubing .500 O.D. - .250 I.D. .001 thk. Electroless Nickel Plating After plating: .5002 O.D. – 248 I.D.

Make allowances on all diameter to increase outside diameter by twice the plating thickness and to decrease the inside diameter by twice the plating thickness. Also make allowances to decrease threaded pitch diameters by 4 times the plating thickness. Please ask for our precise illustration on tapped holes.

4. Hardcoating builds up 50% into alloy (penetration) and 50% out on surfaces. eg. .002 thk hardcoating 6061 Al. 1" O.D. – 750 I.D. After Anodize – 1" O.D. 1.002 .750 I.D. .748. Notice you have decreased I.D. and increased O.D. by .002

possible, try not to use 2024 alloy. Always specify hardcoating requirement in thickness (.001 thk, .002thk, etc.) 5. Anodizing: When fabricating any assembly consisting of two or more parts, make certain the same alloy and the same finish is specified from all vendors. If this is not precisely followed, finish will not match when parts are assembled, especially when a color anodize is used. Note: always put hardware into part after anodizing or

chromating.

of the parts and with subsequent painting procedures.

PLEASE READ ABOVE

5% solution per method 811.1 of

FED-STD-151 or ASTM B117

none larger than 1/32 inch in diameter, in a total of 150 sq. in. of test area grouped from 5 or

pieces.

more test pieces; or no more than 5 isolated spots or pits in a total of 30 sq.in. from one or more test

colors depending on thickness. Coating PENETRATES base metal

as much as builds up on the

surface. The term THICKNESS

includes both the buildup and

coatings where main function is

to obtain maximum abrasion or

dichromate solution, or other

suitable chemical solutions).

Abrasion resistance for unsealed

coatings tested by method 6192

of FED-STD-141 using CS-17

wheels with 1000 gm load. For

2024 and other copper bearing alloys the anodic coating loss shall

not exceed 40 milligrams - for all

other alloys shall not exceed 20

Minimum weight Type II coatings after sealing: Class 1-600

milligrams/sq.ft.
Class 2-2500 milligrams/sq.ft.
(For wrought alloy 2000 series

and casting alloys with 1.0% or

greater copper content minimum weight shall be 1400

resistance requirements (same

**BLACK OXIDE COATING** 

milligrams/sq.ft.) Corrosion

as chromic anodize). Type III

processes may be used to produce Type II coatings.

A uniform black coating for

decorative coating Only very

be given a supplementary

**CADMIUM** 

limited corrosion protection under

mild corrosion conditions. Black

oxide coatings should normally

treatment (i.e., oil displacement per Mil-C-16173 Grade 3 or

protective treatments of Mil-C-

Bright silvery white. Supplementary

treatments for Type II can be golden,

iridescent, amber, black, olive drab.

Corrosion resistance is very good,

especially with Type II finish. Type

Type II shall show no surface nor basis metal corrosion products after

96 hours salt spray exposure except

that white corrosion products at the

edges of specimens shall not

STD-1312, test 1 for fastener

room temperature for 24 hours

before subjection to salt spray.

Unless otherwise specified, steel

parts with tensile strength greater

than 240,000 lbs. per sq. inch shall

not be plated. All steel parts having

150,000 psi and above, which are

machined, ground, cold formed or

cold straightened, after heat

plating.

**GOLD** 

**PROCESS** 

treatment, shall be baked at a

minimum of 375°F ± 25°F for 3

Yellow to orange color depending

Will range from matte to bright

finish depending on basis metal.

Good Corrosion resistance, and

has high tarnish resistance.

Provides a low contact

resistance, and is a good

conductor. Has excellent

specified, Type I shall be

inch shall be plated.

**NICKEL** 

Soft Gray ductile nickel plate.

Additives may be used to harden.

There is a nickel finish for almost

deposited soft or hard-dull or

bright, depending on process

used and conditioned employed

in plating. Thus, hardness can range from 150-500 Vickers.

operations necessary for the

from metals to ensure (1)

appearance.

3 hours.

RHODIUM

removal of surface contaminates

maximum corrosion resistance

of the metal; (2) prevention of

product contamination; and (3) achievement of desire

Metallic and similar to stainless

steel in color. Excellent corrosion

resistance. Almost as hard as

chromium. Very good abrasion resistance. Thicker coatings are

very brittle. Has high reflectivity.

Parts having hardness of Rockwell C33 or above shall be baked at 375°F for 3 hours prior

to cleaning. Parts having hardness of Rockwell C-40 and

above shall be baked within 4

hours after plating at 375°F for

any need. Nickel can be

solderability. If the hardness

grade for the gold coating is not

on proprietary process used.

hours or more before cleaning and

constitute failure. Corrosion test

shall conform to ASTM B117 (MIL-

hardware). Type II shall be aged at

I plating shall show no red rust.

ferrous metals. Mostly a

**SULFURIC ANODIZE** 

milligrams.

Rule of thumb coverage in I.D. hardcoatings will go in to each end of the tube three times I.D. opening. In this

case,  $.750 \times 3 = 2.250$  into I.D. Caution: when stripping you will lose all material buildup into part by 50%. When

6. When making machine parts try to eliminate blind tapped and straight diameter holes. Radius all inside and outside corners which will allow more uniform plating over all. 7. When fabricating sheet metal allow enough relief on lapped bends and all seams tack welded. For proper

rinsing of plating solutions, entrapped chemicals cause numerous problems later in production with the integrity

8. Do not overlook baking specification prior to and after plating operations of steel alloy 40RC and over. Also

alloys with tensile strength of 1000 MPA and over, these baking procedures are mostly for relief of hydrogen

Please allow us to assist your company prior to new product design by reviewing existing product specifications. IMPORTANT:

**PROCESS** TYPE CLASS COMMENTS & SPEC NO. NESS

MIL-A-8625

Minimum weight type 1 after 0.00002"-Conventional chromic acid bath. Shall not

CHROMIC ANODIZE

Type IA 0.0003"sealing: class 1 – 200 milligrams/sq.ft.

be applied to aluminum alloys with over 5.0% copper, 7.0% silicon, or total alloying constituents over 7.5% (Note: alloys with

Class 2 – 5000 milligrams/sq.ft. higher than 8.0% silicon may be anodized Corrosion Resistance

subject to approval of acquiring activity if Requirements: Salt spray requirement is 336 supplier shows coatings equivalent to that on lower silicon contents).

Low voltage chromic acid anodizing (20V).

Use Type IB for 7000 series alloys. Heat Type IB 0.00002"hours

0.0003"

(surface inclined approximately 6 treatable alloys which are to receive Type I coatings should be tempered (such as degrees from the vertical). The specimen panels or finished Class 1 products shall show no more than a total of 15 isolated spots or pits, Class 2 Non-dyed (natural, including dichromate sealing) Dyed. Specify color on contract.

MIL-A-8625 HARD ANODIZE Hard coatings may vary in thickness from 0.0005" to 0.0045" Color will vary from light tan to Type III As specified black depending on alloy and on drawing. I thickness. Can be dyed in darker not specified

penetration. Provides very hard Class 1 Not dyed or pigmented. ceramic type coating. Abrasion resistance will vary with alloy and thickness of coating. Good Class 2 Dyed. Specify color on contract. Process can be controlled to very close dielectric properties. Do not seal

wear resistance. When used for required, consult metal finisher for best exterior applications requiring alloy choice. Thick coatings (over .004") corrosion resistance but permitting will tend to break down sharp edges. Typical applications: Hydraulic cylinders, wear reduced abrasion resistance, the coating shall be sealed (boiling surfaces, actuating cams, etc. Can be used deionized water or hot 5% sodium as an electrical insulation coating. "Flash"

0.00007"-

0.0010"

No

dimensional

.0005" min.

.0003" min.

.0002" min.

change

Type II

Class 1

Class 2

Class 4

Type I

Type II Class 1

Class 2

Class 3

Type I

Type II

Type III

Grade A

Grade B

Grade C

Grade D

Class 00

Class 0

Class 1

Class 2

Class 3

Class1

nominal

shall be

0.002"

thickness

resistance and may be more economical in conjunction with other hard anodized

Specify thickness on contract or applicable

thickness tolerances. Where maximum

serviceability or special properties are

hard anodize may be used instead of

Conventional coatings from sulfuric acid

bath for all aluminum alloys, but not to be

conventional anodize for corrosion

MIL-A-8625

used where solution will entrap. Intended to improve surface corrosion protection under severe service conditions or as a base for paint systems. Non-dyed.

Dyed. Specify color on contract.

For moving parts which cannot tolerate the

resistant finish. For decorative applications

Where Class 1 is specified, all other visible surfaces

dimensional change of a more corrosion

MIL-C-13924

and can be used to decrease light reflection. Alkaline oxidizing. For 300 series corrosion resistant steel alloys only.

Supplementary chromate treatment.

shall be Class 2 minimum thickness. If the maximum thickness for Class 1 is not specified in the contract. order or applicable drawing, the thickness shall not exceed 0.0008 inch (0.8 mil). Where Class 2 is specified, all other visible surfaces shall be class 3

minimum thickness. Where class 3 is specified, all other visible surfaces shall be not less than 0.00015 inch minimum thickness. For fastener hardware. Unless otherwise specified fastener shall have Class 3

thickness plating. There shall be no bare areas. For other than fastener hardware the cadmium plating shall be Class 1 thickness unless otherwise specified in the contract. Articles with portions externally threaded

shall have a minimum of Class 2 thickness on the threaded portions. Holes and other openings and articles with internal

threads from which the external environment is completely excluded shall not be subjected to thickness

requirements but shall show evidence of coating. There shall be no bare areas. Type II best for corrosion resistance. Excellent for plating stainless steels that are to be used in conjunction with aluminum to prevent galvanic corrosion. Cadmium deposition should not be used when an alternate process meets the

performance requirements of this specification. COMMENTS & SPEC NO. MIL-DTL-45204 99.7 gold minimum (Grades A, B, C). 99.0 gold minimum (Grades A, B, C). 99.9 gold minimum (Grades A, B, C). 90 Knoop maximum. 91-129 Knoop maximum. 130-200 Knoop maximum.

201 Knoop and over.

Electroforms, Molds, Electronic leads for ductility. Flexible circuits, soldering, Brazing, PC Boards, diffusion barrier in between Gold over Copper.

Medium temperature nitric acid solution.

Medium temperature high concentrate

Over nickel, silver, gold, or platinum.

Used on silver for tarnish resistance.

Applications range from electronic to nose cones-wherever wear, corrosion

resist solderability and reflectivity are

Over other metals, requires nickel

nitric acid solution.

MIL-R-46085

undercoat.

important.

NOTE: All steel parts having a tensile strength of 220,000 or greater shall not .0016" Grade A be nickel plated without specific approval Grade B  $.0012^{\circ}$ .0010" Grade C of procuring agency. Grade D .0008' For corrosion protection. Plating shall Grade E .0006'Grade F be applied over an underplating of copper .0004

QQ-N-290

.0002'or yellow brass on zinc and zinc based Can be similar to stainless steel Grade G alloys. In no case, shall the copper in color, or can be a dull grey or light grey (almost white) color. Class 2 underplate be substituted for any part of the specified nickel thickness. Corrosion resistance is a

function of thickness. Has a low coefficient of thermal expansion - is magnetic. All steel parts having a hardness of RC-40 or greater require a post bake at  $375^{\circ}F \pm 25^{\circ}F$  for 3 hours. For engineering applications.

**PASSIVATE** QQ-P-35 Specifications covers standard Type II No Medium temperature nitric acid solution recommendation practice for dimensional with sodium dichromate additive. cleaning and descaling stainless change Type VI Low temperature nitric acid solution. steel parts, equipment and systems. Cleaning includes all

Thickness: .000002"

min.

Type VII

Type VIII

Type I

Type II

Class 1

furnished at hardness Grade A. Class 4 .00030" min. and type II shall be furnished at .00050" min. Class 5 hardness Grade C. For soldering, .00150" min. Class 6 a thin purity soft gold coating is preferred. A minimum thickness of 0.000050 inch and a maximum thickness of 0.00010 **SULFAMATE NICKEL** MIL-P-27418 (USAF)

.00002" min

.000010 to

.200 +

.00003" min .00005" min 00010" min. .00020" min.

**PROCESS SILVER** 

White matte to very bright in appearance. Good corrosion resistance, depending on base metal. Will tarnish easily.

Hardness varies from about 90 Brinnell to about 135 Brinnell depending on process and plating conditions. Solderability is excellent, but decreases with age. Best electrical conductor.

Type III Grade A Has excellent lubricity and smear characteristics for anti-galling uses on static seals, bushing,

Type I

Type II

Type I

.0001-.00025"

.0002-.0004

.0003" min.

.0002-.0006

etc. Stress relief steel parts at a Grade B minimum 375°F ± 25°F or more prior to cleaning and plating if they contain or are suspected of having damaging residual tensile stresses. Embittlement relief all steel parts

RC40 and above at 375°F ±

after plating.

TIN

25°F for 3 hours within 4 hours

Color is gray-white in a plated

condition. Has very high luster

applications (changes structure

exposed to temperatures below

and loses adhesion when

40°C). Customer to specify

Corrosion 1995 Requirements Test Period hr.

96 12

BERYLLIUM OXIDE

BERYLLIUM

BRASS

**BRONZE** 

COPPER

COPPER

bright or dull.

ZINC

ALBeMet

ALUMINUM

ALUMINUM

SILICONE

CARBIDE

ALSiC

**TIN LEAD** 

in fused condition. Soft, but is very ductile. Corrosion resistance is good. (Coated items should meet 24 hour 5% salt spray requirement). Soderability is excellent. Tin is not good for low temperature

Excellent solderability. Either a matte or bright luster is acceptable. For electronic components use only parts with

60/40 90/10 a matte or flow brightened finish.

Type I

Type II

Type III

COPPER / MOLY /

/TUNGSTEN

COPPER

**COPPER** 

INCONEL

INVAR

Unless otherwise specified .0003"

.0005"

0.0003" max

**METALS** 

KOVAR

MONEL

**NICKEL** 

NIOBIUM

MAGNESIUM

MOLYBDENUM

Flash for soldering To prevent galling and seizing Where corrosion resistance is important. To prevent formation of case during nitriding.

.0005" min engineering fields, including electrical unless and electronic fields otherwise specified Matte

QQ-S-365 Increasing use in both decorative and

**COMMENTS & SPEC NO.** 

Semi-bright Bright Chromate post-treatment to improve tarnish resistance.

No supplementary treatment.

MIL-T-10727 Electrodeposited

MIL-P-81728

Tin 50 to 70% by weight Lead remainder

(Unless otherwise specified). ASTM-B633 As plated With colored chromate conversion

coatings.

With colorless chromate conversion **SUBSTRATES Materials And Substrates** We regularly pass 300 degrees Celsius and in some cases as high as 450 degrees Celsius after plating depending on the base material. This allows for high temperature soldering, brazing, or post machining operations after plating. Please inquire about

any special applications that you may require. If you do not see your substrate material listed, please call and speak with us. We welcome the opportunity to research plating on new materials and are always willing to do samples for customer approval.

NON METALLICS **PHOSPHER** BRONZE PLASTICS SILVER

TELLURIUM COPPER THERMKON TITANIUM TUNGSTEN

STAINLESS STEEL appreciate our relationships for many years to follow. Thank you from all of us here at Aerospace Metals, Inc.

Aerospace Metals also plates to numerous AMS and ASTM specifications. Please visit our website, www.AerospaceMetalsUSA.com for our online Plating Data Sheet, more information and contacts. Aerospace Metals has enjoyed spending the last 25 years working and solving the numerous complex projects presented to us by our long list of loyal customers and we will continue to greatly

QQ-P-416