



## CHROMIC ANODIZE (MIL-A-8625)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS
<b>Minimum weight type I after sealing:</b> <u>Class 1</u> - 200 milligrams/sq. ft. <u>Class 2</u> - 5000 milligrams/sq. ft.	<b>Type 1A</b>	<b>0.00002"</b> <b>0.0003"</b>	Conventional chromic acid bath. Shall not be applied to aluminum alloys with over 5.0% copper, 7.0% silicon, or total alloying constituents over 7.5% (Note: alloys with higher than 8.0% silicon may be anodized subject to approval of acquiring activity if supplier shows coatings equivalent to that on lower silicon contents).
<b>Corrosion Resistance Requirements:</b> Salt spray requirement is 336 hours.	<b>Type 1B</b>	<b>0.00002"</b> <b>0.0003"</b>	Low voltage chromic acid anodizing (20V). Use Type 1B for 7000 series alloys. Heat treatable alloys which are to receive Type I coatings should be tempered (such as T4 or T6).
5% solution per method 811.1 of FED-STD-151 or ASTM B117 (surface inclined approximately 6 degrees from the vertical). The specimen panels or finished products shall show no more than a total of 15 isolated spots or parts, none larger than 1/32 inch in diameter, in a total of 150 sq. in. of test area grouped from 5 or more test pieces; or no more than 5 isolated spots or pits in a total of 30 sq. in. from one or more test pieces.	<b>Class 1</b> <b>Class 2</b>		Non-dyed (natural, including dichromate sealing) Dyed. Specify color on contract.

## HARD ANODIZE (MIL-A-8625)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
Color will vary from light tan to black depending on alloy and thickness. Can be dyed in darker colors depending on thickness. Coating PENETRATES base metal as much as builds up on the surface. The term THICKNESS includes both the build up and penetration. Provides very hard ceramic type coating. Abrasion resistance will vary with alloy and thickness of coating. Good dielectric properties. Does not seal coatings where main the function is to obtain maximum abrasion or wear resistance. When used for exterior applications requiring corrosion resistance but permitting reduced abrasion resistance, the coating shall be sealed (boiling deionized water or hot 5% sodium 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 milligrams.	<b>Type III</b> <b>Class 1</b> <b>Class 2</b>	<b>As specified on drawing.</b>  <b>If not specified nominal thickness shall be 0.002"</b>	Conventional chromic acid bath. Shall not be applied to aluminum alloys with over 5.0% copper, 7.0% silicon, or total alloying constituents over 7.5% (Note: alloys with higher than 8.0% silicon may be anodized subject to approval of acquiring activity if supplier shows coatings equivalent to that on lower silicon contents).  Low voltage chromic acid anodizing (20V). Use Type 1B for 7000 series alloys. Heat treatable alloys which are to receive Type I coatings should be tempered (such as T4 or T6).  Non-dyed (natural, including dichromate sealing) Dyed. Specify color on contract.

## BLACK OXIDE COATING (MIL-C-13924)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
A uniform black coating for ferrous metals. Mostly a decorative coating with very limited corrosion protection under mild corrosion conditions. Black oxide coatings should normally be given a supplementary treatment \i.e., oil displacement per Mil-C-6173 Grade 3 or protective treatments of Mil-C-16173).	<b>Class 4</b>	<b>No dimensional change</b>	For moving parts which cannot tolerate the dimensional change of a more corrosion resistant finish. For decorative applications and can be used to decrease light reflection. Alkaline oxidizing. For 300 series corrosion resistant steel alloys only.



## CHEMICAL FILMS (MIL-DTL-5541)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS
Materials qualified produce coatings that range in color from clear to iridescent yellow or brown, inspection difficulties may arise with clear coatings because visual inspection does not reveal the presence of a coating.	Class 1A		For maximum protection against corrosion, painted or unpainted
	Class 3 Type I only		For protection against corrosion where low electrical resistance is required

## COPPER (MIL-C-14550)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS
Copper in color and matte to very shiny finish. Good corrosion resistance when used as undercoat. A number of copper processes are available, each designed for a specific purpose. Brightness (to eliminate the need for bung; High speed (for electroforming); Fine grain (to prevent case hardening); etc. Stress relief steel parts, cold straightened or suspected of having residual tensile stresses (350°F ± 25°F-3hours). Parts with tensile strength over 210 Ksi bake 24 hours within 4 hours after plating.	Class 0	Unless otherwise specified .001-.005	For heat treatment stop-o. For carburizing and decarburizing shield, also plated through printed circuit boards.
	Class 1	.001"	As an undercoat for nickel and other platings.
	Class 2	.0005"	To prevent basis metal migration into tin (prevents poisoning solderability).
	Class 3	.0002"	
	Class 4	.0001"	

## ELECTROLESS NICKEL (MIL-C-26074)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS	
Similar to stainless steel in color. Plates uniformly in recesses 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 shapes (where assembly tolerances need uniformity provided by "electroless" process). Precoating and postcoating procedures: -Class 1- below RC40. Baking at 375°F ± 25°F at user's 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 RC4 0. Shot penned parts designed for unlimited life prior to plating. Post plating bake 3 hours min. 350°F. Class 2 coating. Shall have minimum hardness of 850 knoop (100gm load) Class 3. Post bake 1-1½ hours at 375°F ± 25°F Class 4. Post bake heat treatable alloys 1-1½ hours at 240°F-260"		Unless otherwise specified .001-.005	*The minimum thickness of the nickel coating shall be 0.0005 inch (grade B) for copper-, nickel-, and cobalt-based titanium and beryllium alloys.	
	Class 1 Class 2 Class 3 Class 4			As plated, no subsequent heat treatment. A bake for hydrogen embrittlement relief is not considered a treatment.
	Grade A	0.001"		Heat treated to obtain required hardness. May be used on all metals not acted by heating to 500°F and above.
	Grade B	0.0005"min		
	Grade C	0.0015"min		Aluminum alloys non-heat treatable, and beryllium alloys processed to improve adhesion of the nickel deposit.
				Aluminum alloy, heat treatable, processed to improve adhesion of the nickel deposit.



## ELECTROPOLISHING (NO MIL-SPEC NO.)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS
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 both		<b>Typical Thickness Loss .0002"</b>	Typical dimensional change. Process is not recommended for close tolerance surfaces.

## GOLD (MIL-DTL-45204)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS	
Yellow to orange color depending on proprietary process used. 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 solderability. If the hardness grade for the gold coating is not specified, Type I shall be furnished at hardness Grade A, and type II shall be furnished at hardness Grade C. For soldering, a thin purity soft gold coating is preferred. A minimum thickness of 0.000050 inch and a maximum thickness of 0.00010 inch shall be plated.	<b>Type I</b>		99.7 gold minimum Grades A, B, C.	
	<b>Type II</b>		99.0 gold minimum Grades A, B, C .	
	<b>Type III</b>		99.9 gold minimum Grades A, B, C .	
	<b>Grade A</b>		90 Knoop maximum.	
	<b>Grade B</b>		91-129 Knoop maximum.	
	<b>Grade C</b>		130-200 Knoop maximum.	
	<b>Grade D</b>		201 Knoop and over.	
	<b>Class 00</b>	<b>.00002" min.</b>		
	<b>Class 0</b>	<b>.00003" min.</b>		
	<b>Class 1</b>	<b>.00005" min.</b>		
<b>Class 2</b>	<b>.00010" min.</b>			
<b>Class 3</b>	<b>.00020" min.</b>			
<b>Class 4</b>	<b>.00030" min.</b>			
<b>Class 5</b>	<b>.00050" min.</b>			
<b>Class 6</b>	<b>.00150" min.</b>			

## SULFAMATE NICKEL (MIL-P-27418 (USAF))

PROCESS	TYPE CLASS	THICKNESS	COMMENTS
Soft Gray ductile nickel plate. Additives may be used to harden.		<b>.000010 to .200+"</b>	Electroforms, molds, electronic leads for ductility. Flexible circuits, soldering, brazing, PC boards, diusion barrier in between Gold over Copper.



## NICKEL (QQ-N-290)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS	
<p>There is a nickel finish for almost any need. Nickel can be deposited soft or hard-dull or bright, depending on process used and conditioned employed in plating. Thus, hardness can range from 150-500 Vickers. Can be similar to stainless steel in color, or can be a dull grey or light grey (almost white) color. 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°F ± 25°F for 3 hours.</p>	<b>Class 1</b>	.0016"	<b>NOTE:</b> All steel parts having a tensile strength of 220,000 or greater shall not be nickel plated without specific approval of procuring agency.	
	<b>Grade A</b>			
	<b>Grade B</b>		.0012"	For corrosion protection. Plating shall be applied over an underplating of copper or yellow brass on zinc and zinc based alloys. In no case, shall the copper underplate be substituted for any part of the specified nickel thickness.
	<b>Grade C</b>			
	<b>Grade D</b>			
	<b>Grade E</b>			
	<b>Grade F</b>			
<b>Grade G</b>	.0004"	For engineering applications.		

## PASSIVATE (QQ-P-35)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
<p>Specifications covers standard recommendation practice for cleaning and descaling stainless steel parts, equipment and systems. Cleaning includes all operations necessary for the removal of surface contaminates from metals to ensure (1) maximum corrosion resistance of the metal; (2) prevention of product contamination; and (3) achievement of desired appearance.</p>	<b>Type II</b>	<b>No dimensional change</b>	Medium temperature nitric acid solution with sodium dichromate additive.
	<b>Type VI</b>		Low temperature nitric acid solution.
	<b>Type VII</b>		Medium temperature nitric acid solution.
	<b>Type VII</b>		Medium temperature high concentrate nitric acid solution.

## RHODIUM (MIL-R-46085)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
<p>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 3 hours.</p>	<b>Type I</b>	.000002" min.	Over nickel, silver, gold, or platinum.
	<b>Type II</b>		Over other metals, requires nickel undercoat.
	<b>Class 1</b>		Used on silver for tarnish resistance.
			Applications range from electronic to nose cones, wherever wear, corrosion, resist solderability, and reflectivity are important.



## SILVER (QQ-S-365)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS
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. Has excellent lubricity and smear characteristics for anti-galling uses on static seals, bushings, etc. Stress relief steel parts at a minimum 375°F ± 25°F or more prior to cleaning and plating if they contain or are suspected of having damaging, residual tensile stresses. Embrittlement relief on all steel parts RC40 and above at 375°F ± 25°F for 3 hours within 4 hours after plating.	<b>Type I</b> <b>Type II</b> <b>Type III</b> <b>Grade A</b> <b>Grade B</b>	<b>Typical Thickness Loss .0002"</b>	Increasing use in both decorative and engineering fields, including electrical and electronic fields  Matte Semi-bright Bright  Chromate post-treatment to improve tarnish resistance.  No supplementary treatment.

## TIN (MIL-T-10727)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
Color is gray-white in a plated condition. Has very high luster in fused condition. Soft, but is very ductile. Corrosion resistance is good. (Coated items should meet 24-hour 5% salt spray requirement). Solderability is excellent. Tin is not good for low temperature applications (changes structure and loses adhesion when exposed to temperatures below 40°C). Customer to specify bright or dull.	<b>Type I</b>	<b>.0001- .00025" .0002- .0004" .0003" min. 0002- 0006"</b>	Electrodeposited  Flash for soldering To prevent galling and seizing Where corrosion resistance is important. To prevent formation of case during nitriding.

## TIN LEAD (MIL-P-81728)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
Excellent solderability. Either a matte or bright luster is acceptable. For electronic components use only parts with a matte or flow brightened finish.	<b>60/40</b> <b>90/10</b>	<b>Unless otherwise specified .0003" .0005" 0.0003" max</b>	Electroforms, molds, electronic leads for ductility. Flexible circuits, soldering, brazing, PC boards, diusion barrier in between Gold over Copper.

## ZINC (ASTM-B633)

PROCESS	TYPE CLASS	THICKNESS	COMMENTS & SPEC NO.
Corrosion Resistance Requirements Types Test Period hr. II 96 III 12	<b>Type I</b> <b>Type II</b> <b>Type III</b>		As plated  With colored chromate conversion coatings.  With colorless chromate conversion coatings