# A Primer on Chromium Plating

The actual chromium plating process is a long one to describe. I will start with a little known fact about Chromium itself, then a brief on Decorative Chrome and finally Hard Chrome.

Chromium


Chrome plating has a 'cracked' structure. Not porous but, a fine lattice of cracks with no definite pattern. Because of this fine crack structure it is a highly stressed deposit and must have this fine cracking to obtain its hardness. Thinner coatings (i.e. less than .001") should be protected with light oil or wax for long life.

Decorative Chrome

Decorative Chrome Plating is actually a thicker (.0008/.0012") Nickel plating followed by a thinner (.00001") Chrome plating to protect the Nickel plating from pitting and peeling. Do not ever 'polish' Decorative Chrome…just protect it with wax or light oil. The thin layer of chrome can be removed and will allow the nickel plating to be attacked (pitting & peeling). Also, the 'cracked' structure as explained above will eventually allow moisture and/or contaminants through to attack the Nickel. Most people do not understand this and ruin their chrome plated items by trying to polish. It

is as shiny as it is going to get. You may get a little bit better shine but it will be short lived. Keep wax or light oil on it and it will outlast you.

## Hard Chrome

Hard Chromium plating is somewhat different as it is used primarily in industry. (Some call it "Industrial Chrome" or "Functional Chrome") It is put on in thicknesses from .00001 up to .065" (It is possible to buildup a diameter by .125" or 1/8") with the most common thicknesses being .0002/.0006" for anti-galling purposes and .001 to .002" minimum for wear applications. Thicker deposits as mentioned are utilized for buildup of mismachined or worn parts. Also, thicker deposits are used in applications for harsh environments.

## Hardness & Lubricity

On a Knoop Hardness scale, a diamond is a '10' and Chromium is a '9'. Few metals can even come close to compare. A chromium plated part is a better part and will last longer due to this main property (hardness) of Chromium. It also has a very low coefficient of friction…almost nothing will stick to it. Another excellent property.

## Adding 'True' Hardness to a Surface:

With a minimum of .001" thickness on a part…you can take a file to it & you will dull the file and not cut through the chrome. Anything less than .001" thick and you can cut through it rather easily.

## Thin Deposits

Thinner deposits are utilized for Appearance, Anti-galling, and Lubricity. They should never be specified for a wear application unless special conditions dictate. (i.e. Need added life but can not tolerate a larger amount of chrome due to size restrictions or an impact zone on the plated surface.)

## Thin 'Dense' Deposits

Thin Dense Chrome may be dense but it is still thin. Take a file to any of these trade named products and you will cut right through it. And the Hardness claims…have it tested…we did. It is no harder and in most cases softer than any regular (no trade name) Hard Chrome. Any good (i.e. has been in business a long time) Hard Chrome shop can

provide thin dense chrome plating that is comparable and probably better…at a much less expensive price. Why pay extra for a trade name?

## 'Crack Free' Deposits


These deposits are of the same genre as the Thin Dense Deposits described above. These deposits yield a greater degree of corrosion resistance due to their 'Crack Free' structure. However, in order to accomplish these structures they do not have the same high hardness as regular deposits and consequently will not last as long in wear applications.

## Other Types of Deposits

Other types of deposits are Porous Chrome and Channel Chromium used mainly for oil retention in cylinders and on crankshafts. Black Chromium is used mainly for its appearance.

## Engineering Proper Thickness

Engineering the proper thickness for a new part can be tricky. Consultation with an expert is recommended. Sometimes 'trial and error' must be performed to reach optimum performance/cost ratios. An expert can help avoid any mistakes and expedite your experimental stage.

On worn or mismachined parts the thickness is normally determined by the amount of damage to be removed before plating or the amount that the part is undersize (OD - outside diameter) or oversize (ID - inside diameter).

When specifying thickness for a part that will require grinding after plating…always specify .005" total under (or .0025" on a side) size Before Plating ('BP'). This will help insure that you have the minimum of .001" thick for wear in case the part is setup slightly off center when grinding. Also, there is a tremendous amount of heat generated

at the 'grinding zone' even with plenty of coolant. Thinner deposits can 'lift' during grinding because of this heat. If it should be necessary to grind a thinner deposit…great care must be taken.

## Grinding Chrome Deposits

When grinding chrome deposits, certain precautions and instructions are imperative. Only use an Aluminum Oxide wheel. (Manufacturer's can offer recommendations – Norton Company is a good source and in our opinion, makes the best wheels.) Always grind with plenty of coolant. Never dry.

Chrome plating does not apply evenly on most surfaces, especially in thicker deposits, requiring grinding after plating (AP). Find the 'high spots' (around keyways and edges see: Table of Characteristics of Chrome Deposits) and remove them first with a hand grinder or with the machine wheel very carefully. It is important to use an indicator and micrometer on the part to find the high spots on the part's main area of plating…in order to not 'burn' the chromium and loose its properties and adhesion. When finally grinding on the main body of the part, depth of cut should not exceed .0002". The slower the better.

Grinding chrome is very unlike grinding steel and other metals and coatings. There should be no 'sparks'. Find and use a waterproof marker to apply to the chrome surface to be ground. Because there is no spark, this will aid you in determining when and where the wheel is touching the plating. Grinding chrome is a very slow and tedious process. On average it will take 2 to 3 times longer to grind chrome compared to steel.

## The Chromium Plating Process

Chrome Plating is not as simple as 'just dipping it' in the solution. It is actually very complex as you can see from the picture. Learning how to do this properly takes years. However, it is very interesting and the journey from Apprentice to Platers Helper to HCP status is quite rewarding.

The process of electrolysis accomplishes chromium plating. Utilizing DC current at a specified voltage and amperage you have a Cathode, which is negative (the part to be plated) and an Anode, which is Positive. The Cathode is placed at a predetermined distance from the anode in the electrolyte (the solution) and current is applied. The amount of time the Cathode (part) is left in this condition will determine the thickness.

Various different types of masking are utilized for stop off on areas that do not require plating. Tapes, plugs, shields, special lacquers, etc. A good plater knows what to use and they will probably not tell you what or where, so just tell them what you do not want plated. Or just tell them what is to be plated. They will figure out the rest. If not, they will contact you for clarification.

So now, lets Chrome Plate something: After a part arrives in the plating plant it goes through Incoming Inspection. Verifying count, condition of material and figuring out where and how much plating is to be applied are some of the areas covered.

Once this is determined, it will be masked off for abrasive blasting to insure the area to be plated is very, very clean. After blasting the area is kept protected so as to not form any oxides on the surface…it must not be touched by anything from this point onward.

The part is then masked and racked for plating. Very expensive tapes (some costing as much as $50 a roll at this writing), lacquers, shields, plugs, etc. are used. Knowing what and where to apply takes years of knowledge to master.

After masking an electrode (anode - Positive in the tank remember?) has to found or fabricated to conform to the configuration of what you are plating. This is also a crucial step in the process and requires years of knowledge to fabricate properly.

The part must now be 'racked' for introduction into the plating bath. Again, this takes years to learn properly in order to obtain the desired results.

Efficient accomplishment of all these tasks is imperative in order to make a profit on what you are doing.

We are now ready to place the part in the plating solution. In-Process Inspection is required at this time. The Plating Bath 'make up' (ingredients) are verified, as well as temperature, voltage, amperage and anode to cathode spacing. All electrical contacts are cleaned to insure proper transfer of current. Knowing how all these things are adjusted also takes years to learn.

The part is now 'reverse current' etched for final cleaning and activation of the surface. This insures proper adhesion in that you not only have a mechanical bond but a molecular bond as well. Knowing how long and at what current valuation is critical.

After proper 'reverse' the part is placed in plating position and the actual plating commences. The proper voltage and amperage is adjusted on the DC power supply.

The plating 'rate' is now determined and the part is allowed to remain in the solution for the proper duration to obtain the required 'build up' of chromium. Plating rates are very slow for Hard Chrome plating. Generally, in the neighborhood of .001" per hour.
Now you have some idea as to why it takes so long for you to get your parts back from your plater?

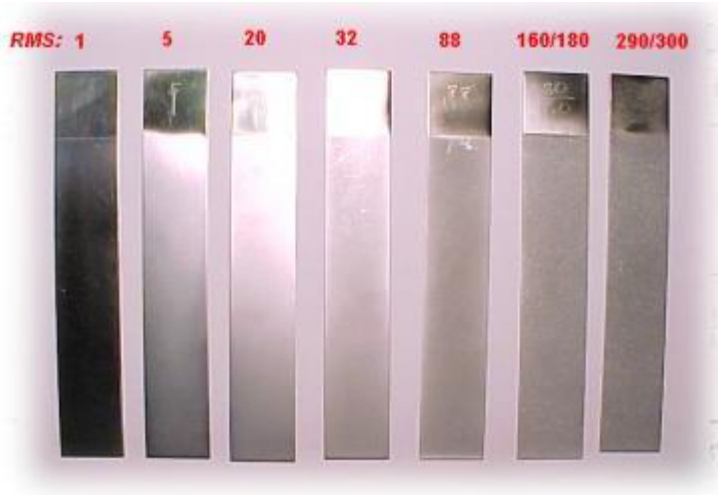
The part must be attended to during the plating process. 'Trees', solution level and monitoring of all values previously mentioned are very important. One small detail left unattended and you will have to strip the part and start all over again. (This is one reason it is difficult for your plater to give you a delivery date...things sometimes do go wrong and the delivery date has to pushed back due to reprocessing.)

After plating the part must be unracked, checked, the masking removed and then rinsed and cleaned. This also can take considerable time, as the 'masks' are very durable, being able to withstand an acid solution at high temperature. They sometimes must endure plating cycles of 48 hours or more for heavy build-ups.

After cleaning, Final Inspection is made to verify plating thickness, visual on the chrome and part condition, proper cleaning, etc.

The above is actually a simplification of what actually transpires. One possible example to give you an idea of what all can be involved. Obviously, this is not a simple or easy process as stated previously. If you obtain a reference book on plating and look through it, you will find a page or 2 on most plating processes. On Hard Chrome you will find many pages and after reading them, you will still not completely understand all the complexities of this process. ASM Metals Handbook Vol. 2 : Heat Treating, Cleaning and Finishing is one such reference.

Surface Roughness




The Surface roughness of the 'as plated' deposit is very dependent upon the surface condition before plating. Chromium plating will magnify the surface. It does not go on like 'body putty'. Small imperfections will not cover up and actually will become larger & more visible. The thicker the plating the larger the magnification. For example, a 32 RMS finish will end up as a 32 with thinner deposits but will magnify to a 36 or 40 if over .003" thickness is applied. As a general rule: Supply (or specify) a surface BP that is as good as or better than you would like to end up with AP.

Trying to obtain a specific RMS that is 'rough' after parts are ground to size is very difficult. Sometimes it can be obtained by using rough Al Oxide grit. Chrome is easy to obtain a good finish on. A 16 RMS is as ground and can be polished rather easily down to a 4 or even 1 RMS. Again, Al Oxide belts in very fine grits are utilized to obtain this.