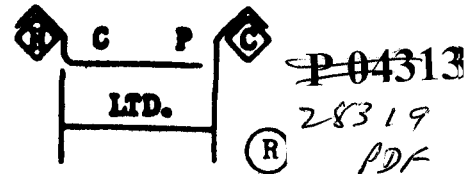


HARD CHROME PLATING CONSULTANTS, INC. ^{EMP 2001} ^{Plating}

Where the impossible usually doesn't take any longer to do.

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Feb. 1992

HARD CHROME FIXTURES II

Its been a few years ago that I left HARD CHROMIUM FIXTURES go out of print. The reason was purely economic as the cost of 80 color prints became prohibitive. Now with the advent of color copiers it has become practical again. The book CHROME PLATING SIMPLIFIED REVERSIBLE RACK 2 BUS BAR SYSTEM has 382 pages. It has pretty well filled its binder. It did start out in life with only 100 pages and like Topsy just grew.

There has been a lot more material written since the last page in the Hard Chrome Plater's Bible as its known by many chrome platers. Much of this material has appeared in my more or less frequent news letters. Because we did use several different mailing lists, you may not have received all of these mailings. Of course new shops start up all the time to take the place of shops that died. So its possible that some of you reading this have not had the opportunity to learn hard chrome plating the way it should be done. The only reason hard chrome shops die is they did not learn how to hard chrome plate correctly in the first place. Reversible rack 2 bus bar shops do not die, they keep expanding.

You will find the balance of my writings all in one place in this book. I have seen some of your books with news letters added and they look kind of messy. Just about all of you have not had access to the papers that I wrote for different plating Societies. These have some new material, pictures and insights that I am sure will be helpful. By the time this book is published there will be approximately 50 of these pages. It will be in a loose leaf binder again as I don't know just how long before the grim reaper shows up. Of course my heaven will be a reversible rack chrome tank. This time book buyers will receive any and all articles written after they buy HARD CHROME FIXTURES II, at no further charge.

There will be at least 80 pictures in full living color and possibly 40 in glorious black and white. Some of these are pictures of unusual or production job setups. At least the picture portion can be easily and quickly referred too. Besides the pictures will be some commentary explaining the finer points of the setup. I will try to bring some order to the rest of the articles but it won't be easy. The articles will be exactly the way they were first written. I have neither the time or inclination to re-edit them.

At this point I don't know just how much it will cost to produce this new book. It all depends on the final number of pictures and pages that are in it. To get some idea how many to print you might consider the following. You can get a 15% pre-publication discount if you order now. Deadline is March 31, 1992 which should be the publication date.

POWER SUPPLY

We have acquired several 5 volt, 330 ampere power supplies. They are regulated to within a few milliamps and do not have either a volt or ampere meter. These will operate our porous pot racks as normally they only draw about 210 amperes in the purification mode. Bright chrome platers usually cycle the voltage on their chrome tanks so could use a separate power supply for this application. If there is not enough room or available amperes in chrome or other tanks this would be a useful power supply also. These are a surplus market item and will only be available while limited quantities last. Input voltage can be either 120 or 240 volts AC. Most of these appear new and test OK and are sold as is. Price \$150.00 plus UPS shipping.

Yours for the best in hard chrome information. Clarence H.Peger

A PROBLEM SOLVING HARD CHROMIUM PLATING METHOD

Hard Chromium platers world wide are using plating methods that have been obsolete since 1935. This was the year Mr. Paul P. Hale invented the Reversible Rack and the 2 Bus Bar System of hard chromium plating began. Almost immediately, the rack and plating by constant voltage eliminated most of the problems plaguing platers using 3 bus bar tanks. By the end of the first year it was possible to eliminate all the problems they were having. The racks can hold and plate any piece configuration. The rack clamps both piece and anode so there is no shifting or miss-alignment of either. Holes and slots as small as .040 (1.02 mm) in diameter are easily plated. Pieces that weigh more than about 220 lbs. (100 kilo) are plated using 3 other standard fixtures if they are too big or heavy for reversible racks. The same basic principals apply which insures high quality plating. Whether pieces weigh less than a ounce (gram) or tons (MT), the system can plate them with a very even and concentric deposits. Plating rates are purposely limited to .006 (152 u) per hour but sometimes .012 (305 u) to .030 (762 u) can be used.

This system requires maintaining plating voltage at 4.5 volts for the reversible racks. 5.5 volts is used to plate large shafts, rollers and pistons in conforming tank anodes. You would use 6 to 9 volts to plate the same pieces at a slower rate using stick or bar anodes. Plating by figuring amperes is never used. This allows maximum use of the power source or space for work in the tank, whichever is used up first. There is no center cathode bar to hinder operations. Racked work can be put in, reversed, plated and pulled out without disturbing any other racks in the tank. There is no reversing switch needed as the racks and large piece cross over fixtures are reversible. All these features allow maximum production from a chromium tank. A reversible rack tank can produce more than 400% more work per day than can 3 bus bar tanks. Some of these 3 bus bar tanks have been modified into a cell configuration but that is not much of a improvement. You can also think of reversible racks as cells because each does its own thing but using the same power source. There is no need for more than one rectifier on each tank. In a 12 feet (3.6 meter) tank you would have between 15 to 20 of these reversible rack cells if you want to think of them that way.

The above is possible using the old 100 to 1 chromium, sulfate solution. No special so called high speed solution is necessary. If you cannot plate at the above plating rates, in this solution, it is because you are using too low a solution temperature. Your anodes are also too far away from the cathode. No stick anodes are ever used because you can't do fast, quality hard chromium plating when using them. The correct solution temperature is 140° F. (60° C.) and ½ inch (12.7 mm) anode to cathode spacing in the reversible racks. Very large pieces plated in the conforming tank anodes use between ¾ inch (19 mm) and never more than 2 inch (50.8 mm) anode to cathode spacing. That is why they are plated at 5.5 volts. Some times 6 volts is used but never higher than that. These same large pieces you are now using 7 to 9 volts to plate at a much slower rate. Of course there are other factors involved such as superior, lead anode material, copper and aluminum racks, etc.

The literature would have you believe, the old 100 to 1 chromium, sulfate solution is only 12% efficient The literature is wrong and the proof is plating speeds of .006 (152 u) to .030 (762 u) per hour are being used by many reversible rack shops. Chromium deposits .060 (1.5 mm) thick are routinely applied and practical due to the high plating rates. The deposits are at maximum brightness and hardness no matter what the deposit rate. Rough, burnt or milky colored soft deposits are eliminated by using this hard chromium system. The literature is wrong in many other ways. It advocates plating by figuring area amperes, cold tank temperatures, using stick or bar anodes. These are a source of your many problems. Bad masking materials and

methods, fixturing, anoding, preplate processing are all laborious, time consuming and a deterrent to quality hard chromium plating.

All of the above have been simplified to the point where a reversible rack, tank operator can produce, at least 100 % more work each day. The system is easily learned if one tank is converted to this system. There is a 382 page training manual and 10½ hour video tape course that explains everything in great, non-technical detail. Hundreds of photographs, line drawings and blue prints will instruct you on how to convert one of your tanks. The system is a closed loop without air or water pollution problems. There is even a porous pot rack, solution purifier that can purify the solution. It removes all metallic impurities and re-oxidizes trivalent chromium. This eliminates any need to discard the bath. Even chromium that plates on the fixtures is recycled. Racks and cross over fixtures have a 10 to 15 year life so rack cost per job is nil. All rack and fixture parts are interchangeable. Only a few are needed as each can plate any part you will ever be asked to plate. Most of you have hundreds of fixtures that can not be used for any other piece.

All of the following are other benefits of this plating method. At least 80 % of the work received by 5:00 P.M. should be ready for pickup or delivery by 8:00 A.M. the next morning. The rest is usually done by 5:00 P.M. that day. That is 24 hour service as practiced by reversible rack shops. More than 30 % of the work is held to size. This eliminates much grinding after plating. .005 +.000, -.001 (127 u +000, -25 u) is considered a commercial, hold to size plating job. The +, -, tolerance is held as to size, concentricity and linearity end to end. Even long shafts etc. plated plus grind do not vary more than .001 or .002 (25 u or 50 u) end to end. The actual cost of plating a piece can be 50 % less than it costs you now. If you maintain your present price structure, obscene profit levels will be yours.

This system of plating is over 50 years old. Many things were tried, some discarded. If they didn't measure up to the Simpler, Faster, Better, Cheaper Test, you will not find them in the training manual. The closer you go by the book the more successful you will become. There is very little that you are doing now that even comes close to the correct way. Even plating machines are out produced and of course the chromium deposit is far superior. You may find the above very hard to believe. It is all true which you can prove by trying it yourself.

There are about 40 hard chromium plating only shops in the Cleveland, Ohio, U.S.A. area. The largest concentration in the world! Each of these shops has 2 or more 12 feet long (3.6 meter) hard chrome tanks. Lets just say the average is 2 to make this easier to understand. $40 \times 2 = 80$ tanks that do produce 4 times more work than any of yours of equal length. The capacity is therefore the equivalent of 160 three bus bar tanks. How do they all survive? It is very simple as they can and do chromium plate a great deal of work you consider impossible. Each shop has at least one sales person. Over the years, they have educated their customers to hard chrome plate everything that would save them time and money. There is a great volume of work in your area that is not being plated. Using your present method of hard chromium plating, much work is impossible for you to do correctly. Remember the many jobs you tried and failed? Some of those failures have prevented you from getting other jobs. The reversible rack 2 bus bar system makes all of those impossible jobs simple.

One hundred of the most important pages in the book are also in Spanish. The 10½ hour video tape is also available in Spanish. The video is available in either NTSC or PAL, BETA or VHS. I have only pointed out a few things that make the Reversible Rack 2 Bus Bar System vastly superior to any other method or system of hard chromium plating. There are many more reasons why you too should convert your chromium tanks to this system. It isn't the old 100 to 1 solution that is the cause of your many problems. There is a better way that is simpler, better, faster and cheaper. The cost of converting can be recovered in a few months.

MICROSCOPE

At times a microscope or even a magnifying glass will come in handy to inspect defects. A great deal of magnification is usually not necessary. In fact blowing up something 500 or a 1,000 times usually only confuses the issue. A perfectly usable chrome deposit can look pretty horrible when magnified that much. It makes the surface look more like a file than a smooth surface. Generally samples are etched to show the crack pattern. This produces a un-realistic picture of the surface being viewed. It is true that there is less chrome at the grain boundaries. However the chrome that is etched out contributes to a flat surface and wear resistance.

Binocular microscopes only give a stereo view too X 20 or X 30 magnification at the most. This usually is adequate for most purposes. Single lens hand magnifiers come in a variety of shapes and sizes. Some of the more expensive have compound, color corrected lenses. A simple lens because of its curvature will distort colors and the view. You can find better magnifiers in most lapidary rock shops. A Jewelers loupe will give you a birds eye view of what you want to see. They also have binocular head band lenses which are nice for some hands free jobs. For those of you that wear glasses, there is a style that clips to your glasses. Some have two or three swing away lenses of different powers.

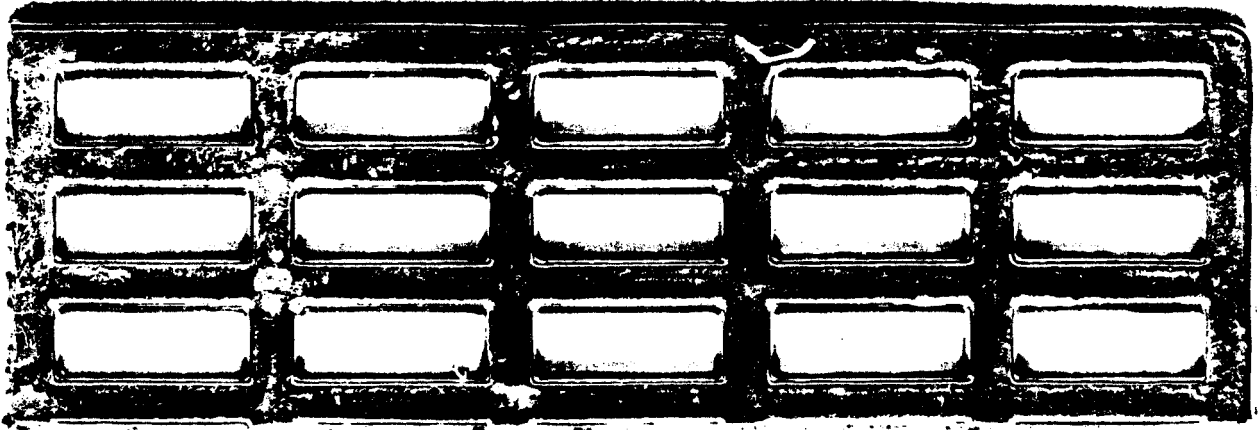
I have a ingenious, little device that allows one to look into and see the interior of your eye. You can see what a eye doctor sees when he looks in your eye. Its possible to see eye problems before you are aware of them. I used to show this to students in my class. A few of them decided it was time to see an eye doctor. I bought the Eye Scope from Edmund Scientific Co. quite a few years ago. They may still sell them although I have not noticed them in the catalog lately.

One day when on a consulting call, I used the customers microscope to inspect the chrome crack pattern in proof coins. By not focusing my eyes on the coin, I could see into my eye just like looking in my Eye Scope. You can try this and it may do the same for you. Without the Eye Scope instruction book it will be difficult to know what your seeing. One thing for sure is that if both eyes don't look the same, you may have a problem.

This consulting call was to the Philadelphia Mint where a new chrome plating tank was installed by a company that shall be nameless. At start up, proof coin dies came out with the chrome crack pattern showing. As each coin is made in a 50 ton press the crack pattern was re-produced in the coins. They were plating the dies at 125° F. and taking 40 minutes to plate .0003 thick. The first thing I did was raise the temperature to 140° F. and increase the voltage in steps for several samples. The higher temperature did not change the crack pattern in the first sample. As each succeeding sample was plated at higher voltages, the results were as follows. Sample #2 showed gas bubble pitting. #3 a fainter crack pattern. #4 was plated at 4.5 volts and took 12 minutes to plate .0003 thick with the crummy stick anodes they were using. The crack pattern was no longer in evidence under a 20 power microscope. A decent anode and fixture could have cut that time to about 6 or 7 minutes.

They had put the rectifier 12 feet away and hooked it up with cable. There was about a volt drop between the rectifier and tank. Of course this changed with the load and cable temperature change. Their plant electrician brought out the hand book and showed me the table that said the cable should be adequate. I pointed out that the table was written for A.C. electricity and that D.C. was a horse of a deferent color. There was no disputing the one volt drop that increased with plating time. They had other problems with too much unnecessary equipment. A Ultra Sonic cleaner turned out to be a waste of money. All in all the installation cost too much and wouldn't work according to specifications. I told them they would have to junk the specs and make the necessary corrections to get the wanted results.

LEAD MATS AND OTHER THINGS



The lead mats shown above were the results of careful engineering by this company. The number and placement of the ribs were designed to provide the maximum current carrying capacity with the maximum surface area available. Slot size was also a consideration taken into account. If the holes are too big, you would see the mat pattern in the plated deposit. This is very important when using the 1/2 inch anode to cathode spacing of the Reversible Rack 2 Bus Bar System.

Because these mats are cast, they do not form hard, dead scales as is the case with rolled or extruded lead. They recover to plating condition usually in less than 1 minute if left dead in the tank. They do not usually warp but hold their shape until used to at least half size. The increased surface area contributes to higher plating rates and decreases trivalent chrome build up in the solution.

The Lead Industries Association sent out a flier that you might find interesting. It had a graph that was used to show the decline of lead blood levels over the last 55 years. The curve went down from 35 mg/dl to 5 mg/dl average level at this time. It seems some would have you believe that these low levels will reduce your intelligence.

I checked my lead level a couple of years back. It was 15 mg/dl in spite of all my years of lead burning, drinking water that comes in my house and factory in lead pipes, plus all the years of automobile exhaust. December 1, 1991 I will be 70 years old. I still have total recall of what is important besides much of what doesn't mean a hoot.

GREEN #GTS-2 or YELLOW ADHESIVE VINYL #YTS-1

6 mil yellow vinyl conforms around complex shaped parts.

No undercut or bleed through, holds a straight edge when masking parts for electroless nickel and hard chrome plating.

Chemically resistant adhesive won't contaminate plating solutions. Withstands temperatures to 210 degrees F.

Works well in chemical milling, painting, abrasive blast applications. Stock sizes: 3/4", 1", 2" and 3" by 66' rolls. Total thickness: 6 mil

NON-ADHESIVE YELLOW VINYL MASK OFF TAPE #YT01

Non-adhesive yellow vinyl masks off areas for plating, painting or abrasive blasting applications.

Adheres to itself, conforms to curves and hard to reach areas. Forms leak-proof bond if ends are properly fused or sealed.

PUSH PULL BLOWER SYSTEMS

I had a conversation with a customer that told me, they had just installed a push pull hood on one of their hard chrome tanks. I asked him if he had a copy of my book. He said no and that I have been telling him for years, in these news letters, that he should. So I told him some of the things he would have learned if he had. I have seen at least 12 push pull systems shut down because they didn't work. I have been exposed to a few that I knew were not working very well. If I can smell chrome fumes in a shop it has to be bad. After working on chrome tanks for 35 years, my nose is kind of insensitive to chrome fumes.

There is nothing wrong with my nose as to smelling other odors. As soon as my wife starts burning the food in the kitchen, I can smell it 3 rooms away. Usually the food is still salvageable. That be as it may, here are the facts. This poor customer has his shop in California and that tank will probably never pass in that configuration. He thinks that he had a better idea and it will. Its not impossible to make that type of system work if you don't mind throwing good money after bad.

The problem is that the push air stream hits the racks in the tank. This is bound to set up a turbulence with some of the mist going into the shop. The only way to prevent that is to use a woefully, oversized blower. In that case you are simply overpowering the push and might as well turn it off. If that was the end of it, that might not be so bad. You want bad? bad is what you get if you are so foolish.

The oversize blower is going to cost you a grand or two extra. Ditto the piping. Instead of using a 5 horse power motor or less, you will be feeding probably a 25 horse or more, forever? Hell that is not so bad you say? These systems use a upright hood on the back of the tank. Just where do you think the mist laden air stream is going to go. Do you know where? I will tell you where. Right past those beautiful copper bus bars. Just how long do you think they will stay intact? Not very long and that I can guarantee. I visited a shop in Texas that had one of these systems. There was plenty of mist floating around even with all the doors and windows open. I took the owner over to the back of one of the tanks. Sure enough the back bus was eaten half away.

Ready for more bad news? Invariably these systems with more than one tank are all hooked up to one blower. Some of these large engineering firms that claim they know how to engineer a plating installation are the worst offenders. I am sure they never go back and talk to the platers that have to work with their mistakes. Of course what they put in will cost the top dollar. Run up the cost runs up the profit. In one shop they proposed a 100 horsepower blower. This was for two small chrome tanks and included the cold rinse tank hoods? If you look at their ad in the trade magazine you will see about the same mistakes that were made in the 1920 to 1940 era. You ought to see some of the Military plating shops. Everything all crammed together and most tanks in the wrong place. I swear it looks like there is more piping than there is under the city of Cleveland. If everything even came close to working right, you might say, what the heck.

Never put anything but a double lateral hood on a chrome tank. With the exhaust lip on the tank rim, it takes the least amount of air to exhaust the mist. Each tank should have its own blower system. This is cheaper than having a common blower system in the short or long run. It is almost impossible to balance the draw on multiple tanks. In one navy shop, I was told that one man was steadily employed just changing exhaust slot sizes. He would change one and upset two or three others. Each chrome tank should have a centrifical mist separator either above or in back of the tank. The above is preferred as the mist will drain back in the tank by itself. I think its the height of folly to allow the mist to travel through long runs of pipe to a scrubber. Most of it will settle out in the duct. What reaches the scrubber creates too much chrome contaminated water and short scrubber life.

MIST SUPPRESSENTS

A flier crossed my desk touting the use of mist suppressents. A picture on the cover showed one of the major reasons they shouldn't be used. It showed a chrome foam blanket that reached the copper bus bars and anode hooks. That is a sure way to kiss the copper good bye. People that should know better are touting these as a cure for chrome mist problems. I have yet to see or hear mentioned that they can be downright dangerous.

That is Hydrogen in those foam bubbles which is explosive when hit by a spark or comes in contact with a hot bleeder wire or trees. It will go off like a cannon shot and throw chromic acid all over anyone in close vicinity. Even if that was the only problem, it is enough to keep us from selling the stuff. But there are more problems with their use so take your pick.

One of our customers is using a brand that costs \$90.00 a gallon and only lasts them about a week. I have not seen their shop but suspect that their blower system is either borderline or practically non-existent. Simple math shows $\$90.00 \times 52 \text{ weeks} = \$4,680.00$ a year. Depending on how bad their tank venting is, it could be corrected with possibly less than a one or two year pay back. He wanted us to find him a cheaper source for the suppressent. We could get and sell him one but that is not how this company is operated. If its a bad deal we don't sell it.

Some of the other minor problems are that in the past some of these have been blamed for causing pitting. This has been true for heavy chrome deposits. You wouldn't notice this when bright chrome plating. Their life has been very short at tank temperatures that allow fast plating rates. Some of the newer ones may be more stable at higher temperatures. At least that is one of the claims. The foam blanket does hold in tank heat and that is bad if your hard chrome plating the way you should be. Do you really need a cooling problem? It also reduces evaporation which could cause another problem. You might not have enough evaporation to accept all your rinse water.

You would have to be very conscientious about making additions at the proper time. Failure to do this carries a certain liability if mist gets out into the shop. Who needs that can of worms! A properly designed and installed hood and blower system will eliminate a lot of hassle and loss of sleep. There is no way that these mist suppressents will eliminate the need for one. If you think otherwise, your living in a dream world.

All chrome tanks should have a double, lateral hood and a mist eliminator section within 3 feet of the hood plenum chamber. These will remove at least 98% of the mist and return it to the tank. The most trouble free are the centrifical, for vertical runs and the chevron type for horizontal runs of duct. It makes no sense to send the mist through long runs of duct work. What happens if you do results in most or all of it being deposited in the duct work. The eliminators can be spliced into existing duct as close to the tank as possible without problems. These are essentially wide open and don't restrict the existing air flow much.

There is another type that uses mesh pads that are also effective when kept clean. This is an on-going problem as they can load up pretty quickly and restrict the air flow drastically. I just think simple is better particularly when the least amount of human maintenance is required. A retro-fit mesh pad mist separator may require replacing the existing fan as it does have a higher WC drop when new and in operation. The above two mist eliminators only require a one or two minute max wash down once or twice a month. This should be done with the fan off.

These are relatively low cost and will keep most of the chrome mist at and back in the chrome tank. We do sell these and the price is based on the size of the existing or planned duct if a new installation. You may still be required to have a scrubber but its best not to put any or as little chrome in it as possible.

SCIENTIFIC PAPERS AND ARTICLES

Every year sees an increase in the number of conventions and other gatherings where papers are presented and speakers lecture. Supposedly these papers and lectures are not to contain commercial material. Talk about Ostriches hiding their heads in the sand. When there were only a few of these affairs, this was relatively possible. The day of the lonely researcher working in a lab not connected with industry has been long gone. You do see some papers by people working in college labs. Chances are he is working on a grant from some large company. If he does come up with something new it will be patented. If you will look at most of these papers, there is a title and company mentioned. If you want more information about the subject matter its only as far away as your phone.

The plating magazines are guilty of the same thing. One of them excluded articles with a commercial slant for a long time. Of course this couldn't be kept up forever. It follows that most of what is written today is done by employees of plating suppliers, consultants and other parties with an ax to grind. The sheer volume of material dictates that much will be a rehash of previous articles. There is some wheat with the chaff and it gets increasingly harder to separate the wheat.

Some of the papers are pretty impressive but leave out good conclusions. You wade through a long article only to find that, you can't figure out if it will add to your bottom line. I am sure you read these things the same way I do. Whats in it for me? Will it improve my method of operation? You may have been salivating at the start of the article but only wind up with cotton mouth.

Don't quit reading these things for the following reason. You may be able to pick up a few grains of wheat in all those pages of chaff. Some thing said may set you off in an entirely new direction. The article may give you an insight to something that the writer was not even contemplating.

I have written a few papers that were accepted and published by various Societies. If you wanted to be picky, they could be construed as more than a little commercial. The subject material was the Reversible Rack 2 Bus Bar System. One asked that I include data from the original experiments. Hells Bells, I have no way of knowing what happened 60 years ago when Mr. Paul P. Hale was inventing the reversible rack. If any of you have that information, I would be most happy to receive it.

A paper is limited to a few pages and doesn't allow a full description of the worlds best plating method. Why write a paper that doesn't inform the reader that full instructions are available. Since publishing the first edition of my book in 1975 I have dedicated my life to spreading the good news world wide. I could have sold the system to a few shops and became a millionaire with very little effort. I am from the old school and believe in helping as many of my fellow men as possible. Sometimes it makes one wonder when there are so many out there that don't know which side of their bread is buttered.

There is a 382 page training manual, 11 hours of video tape and 7½ hours of audio tape available. We have cut the price to \$250.00 so those of you that thought \$400.00 was too much can consider leaving some of the moths out of your wallet. Its too bad by delaying your conversion to this superior method, you have left thousands of dollars slip through your fingers. People and shops that I have trained went from virtually nothing to over \$1,000,000.00 in billings in about 5 years*. They are still growing. Of course some of you may have over a million dollars in billings. The rub is that not much of it remains in your pocket. Your too inefficient, slow and have too much overhead. One of my customers bid on a job for \$10,000.00 and didn't have room to run it. He brought it to Cleveland, Ohio and got it done in a Reversible Rack shop there. Are you ready for this? he got it done for \$3,000.00. He said to me and I quote "Why did you put me in the hard chrome business when all I needed was a truck?" A word to the wise should be sufficient, hopefully.

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R103	1 1/2 inch rack with 3 bottoms	245.00	HMO3	HOOK MOLD	19.00
DR03	Double top rack with 3 "	278.00	FMO4	FLAT LEED MOLD	95.00
SB01	Side bars, 1 inch set of 2	20.50	BAUME	HYDROMETER	CALL
SB015	" " 1 1/2 inch set of 2	42.00	DOT	WELDER	\$1985.00
SB10	Offset Sidebars	25.75	DURA 60	(GAL) 4 GALLON MIN.	*25.95
SBL1	Extra long Sidebars	24.50	DURA 60	12 GALLONS OR MORE	23.95
BB01	Blank Bottoms 1 inch	7.50	STOP OFF	LACQUER (GAL)	CALL
BB05	Blank " 1/2 inch	6.50	WHITING		3.50 LB
BB15	Blank " 1 1/2 inch	9.75	GC01	GUARD COAT GALLON	25.95
A001	Angle bottoms, each	9.75	GC02	GUARD COAT II GALLON	36.50
V005	1/2 inch V bottom	22.50	SCR	RECTIFIER PRELOADER	220.00
V001	One " " "	22.50	LP01	8 INCH LEAD POT	56.85
V015	1 1/2 inch V bottom	37.75	RS01	THREE BAY RACK STAND	128.00
CB01	One inch clamping bottom	19.50		-4 SIZES NOW AVAILABLE-	
CB05	1/2 " " "	22.50		POROUS POT CHROME SOLUTION PURIFIER	
CB15	1 1/2 inch clamping bottom	23.50		PPS1 \$785.00 PPS2 450.00	
SP12	12 hole production spine	40.00		PPS3 \$420.00 PPS4 CALL	
PBO5	5 hole production bottom	31.00		For 6% TIN add \$21.00 per unit	
PB04	4 " " "	47.50		POROUS POT REPLACEMENT PIECES	
RT01	One inch rack top only	130.00		ANODE PPA-1 10 x 29"	55.00
RT15	1 1/2 " " " "	160.00		CATHODE PPA-1C 10 x 26"	50.50
DT05	Double top rack " "	195.00		ANODE PPA-2 5 x 23"	83.50
WH01	1" WORK HOLDER (COPPER)	19.50		CATHODE PPA-2C 3 1/2 x 19"	47.50
WH15	1 1/2" WORK HOLDER (ALUMINUM)	23.50		For 6% TIN add \$7.00 per piece	
IN01	Insulators for 1 " rack, set of 2	15.75		PLATINUM REPLACEMENT ANODES	CALL
IN015	" " 1 1/2 " rack, set of 2	13.25		GREEN FRAMEWORK PLF1 & PSF2	55.00
INW02	" " Dbl. top " " " "	16.25		GREY PVC TRAY GPT1 & GPT2	35.00
CH01	Cathode Hooks 1 inch	24.50		WHITE INSULATORS SET OF 3	5.00
CH15	" " 1 1/2 "	31.00		REPLACEMENT POTS	
CH002	" " Dbl. top	34.00		PPR-1 12 x 24 x 3" rectangle	295.00
MF01	Mold frame work	70.00		PPR-2 18 x 3 3/4" round	125.00
CAZ1	Copper Anode Z Bar 13 x 1 1/2 x 3/8"	31.00		PRC-8 8 5/8D x 25 1/2L x 1/4" Thick	
	CROSSOVER BARS - Price each			Replacement for COSMOS unit	335.00
CC01	one inch Cathode	34.50		OTHER SIZE POTS AVAILABLE	CALL
CC15	3/8 x 1 1/2 "	45.75		*****	
CCB1	2 x 13 x 3/8 " Crossbar	22.50		*SURPLUS RECTIFIER - LIMITED SUPPLY*	
CC55	1/2 x 1 1/2 "	57.50		*330 Amp./5V 110 or 220v input*	
CC52	1/2 x 2 "	70.00		*These won't last-order early 150.00*	
CA15	3/8 x 1 1/2 Anode	51.50		*****	
CA51	1/2 x 1 1/2 "	58.00		LM01 10"x15" LEAD MATS	
CA52	1/2 x 2 "	75.00		1 TO 49 EACH	\$ 14.00
DBA1	Double bar anode crossover	112.25		50 @ 13.50 "	675.00
MB01	MAGNET BOTTOMS	55.00		100 @ 12.50 "	1,250.00
ML01	MAGNETS LONG 7 1/4 x 11/16 x 1/4"	4.00		200 @ 11.50 "	2,300.00
MS02	MAGNETS SHORT 1 7/8 x 7/8 x 3/8"	3.00		LM26 26.5"x16.5" LEAD MATS	42.00
				LM26T " " 6% TIN	75.00
				SHEETLEAD 10.5"x18.5" 6% ANT	47.25
				CONFORMING & LARGE TANK ANODES	CALL

6% ANTIMONY LEAD WIRE - VARIOUS SIZES SHIPPED IN SMALL QUANTITIES

HARD CHROME PLATING CONSULTANTS Inc. Phone:(216) 631-9090, FAX LINE 216 631-9060
 PRICE LIST OF GOODS AND SERVICES EFFECTIVE March 1992 SHIPPING & SPECIAL CRATING EXTRA
 ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE
 TERMS *** 10 DAYS -2%...NET 30 DAYS FOR U.S. FIRMS WITH ESTABLISHED CREDIT ONLY.
 TO SAVE C.O.D CHARGES SEND CHECK WITH ORDER *** 2% INTEREST ON PAST DUE ITEMS
 - ALL ORDERS OUTSIDE OF THE U.S. MUST BE PRE-PAID IN U.S. FUNDS -

VC01	1,000 AMP. CENTER HOLE WORK HOLDER	145.50	LEAD WIRE in small quantities	4.15 LB.
VBO1	2,000 " V BLOCK " "	270.00	1/16" to 1/2" diameter in sizes	
VC02	2,000 " CENTER HOLE " "	220.00	50 LB. SPOOL	150.00
VBO3	3,000 " V BLOCK " "	398.00		
SF08	Set of Fixtures for a Tank Anode	2,780.00	REPLACEMENT SCRUBBER BALLS	
TT02	2 Reversing Tabs for Tank Anodes	30.00	5 CUBIC FT. per CARTON	85.00
LV01	LOW VOLTAGE REOSTAT BOARD	120.00		
AF40	ALUMINUM FOIL STICKY TAPE 1" CASE	120.00	AF01 ALUMINUM FOIL .0015 THICK	72.00
	2 & 3" WIDTHS CASE	135.00	SOLD IN 20 lb. DISPENSER BOX	
	BY THE ROLL: 1" 4.50; 2" 9.25; 3" 11.25			

Please call for the latest price before ordering.
 MANUFACTURERS WARRANTIES APPLY.

YT01 PVC YELLOW, non sticky tape
 in 1/2 to 3" widths 3.95 LB.
 A 1 inch roll weighs one pound.
 YT51 PVC YELLOW sticky available CALL

There are many items that you can buy from us at DISCOUNT PRICES. Following are only some of them.

RECTIFIERS - New or Rebuilt; both have the same one year warranty.	CALL
HEATING AND COOLING COILS, ELECTRIC HEATERS, CONTROLS.	CALL
LINED TANKS & EXHAUST HOOD.	CALL
COPPER BUS BARS, 2024 ALUMINUM in any quantity.	CALL
HORIZONTAL & VERTICAL MIST ELIMINATORS.	CALL

AMPERE HOUR METER - 180.00 This is something all platers will soon be required to have on each tank. They are connected to the rectifier shunt where the ampere meter leads are connected. Most shunts are rated at 50 millivolts and the number is usually stamped on the shunt. To order you must supply the shunt rating and the ampere capacity of the rectifier.

DHT1	HARDNESS TESTER	103.95	CR TRIVALENT TEST KIT	170.00
T280	TINSLEY THICKNESS GAGE	215.00	KSTS KOCOUR KIT	650.00

CPSR - The Hard Chrome Platers Bible:

CHROME PLATING SIMPLIFIED - REVERSIBLE RACK TWO BUS BAR SYSTEM. The latest edition is 380+ pages and comes with five 90 minute AUDIO TAPES. Due to copiable nature of book - THERE ARE NO REFUNDS ON BOOK OR VIDEO COURSE - please send check with order or it will be sent C.O.D./U.P.S. Within the U.S.A \$125.00
 FOREIGN orders sent U.S. Air Mail POST PAID 150.00
 AUDIO TAPES only 30.00

 11 HR VIDEO TAPE COURSE \$250.00

Included in course:

Technical BOOK 380+ pages
 11 Hours in VIDEO TAPE VHS or BETA
 5 AUDIO TAPES

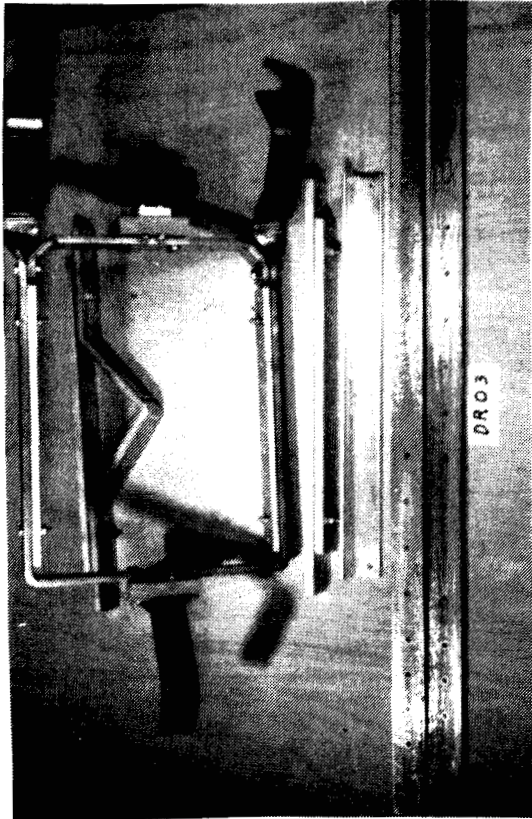
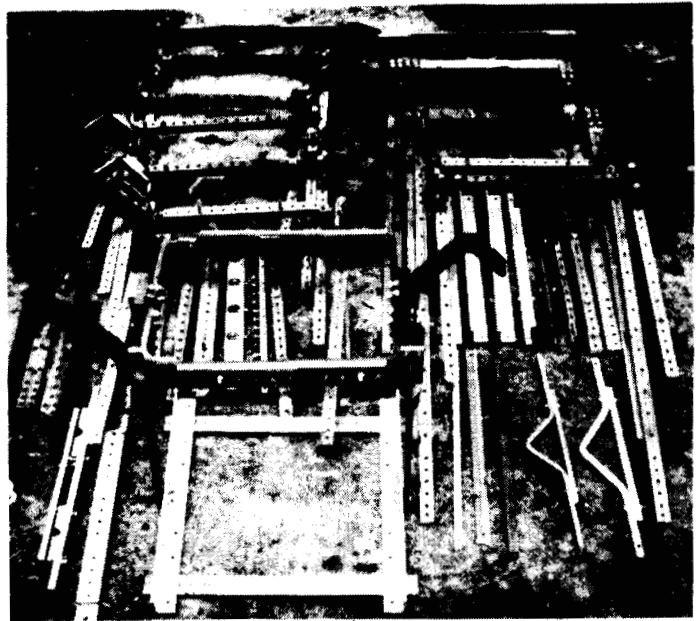
*** CLEARLY SPECIFY WHEN ORDERING ***

VTVA	USA/VHS	VTBA	USA/BETA
VTVP	PAL/VHS	VTBP	PAL/BETA
VTVS	SECAM/VHS	VTBS	SECAM/BETA

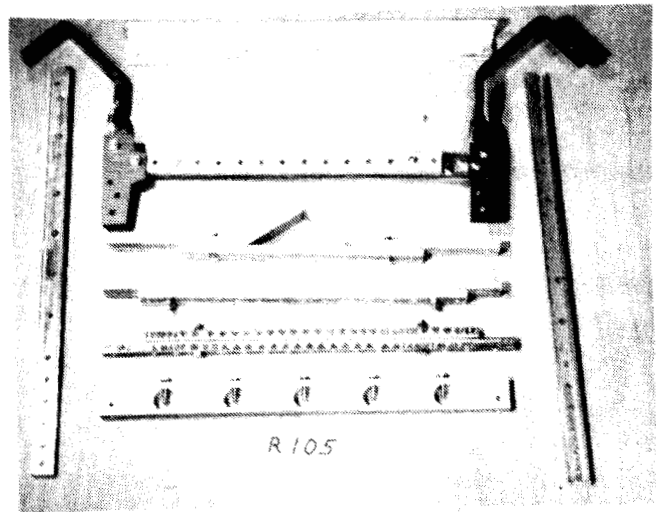
SPANISH EDITION - \$275.00 First 100 pages of Technical Book in Spanish
 11 Hours of Video Tape in Spanish

TELEPHONE CONSULTING FEE - for one year \$100.00

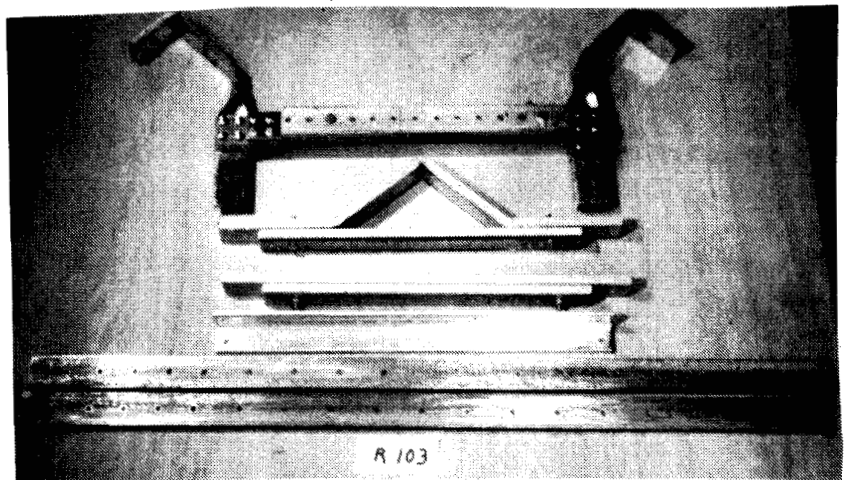
SA12 - Set of 12 racks and accessories consists of the following. Nine 1 inch and two 1½ inch racks plus one double top rack - Die and mold framework - five each 1 inch and ½ inch clamping bottoms - five angle - four V bottoms - three production bottoms - three 1½ inch clamping bottoms - three double bar anode crossovers - 6 blank bottoms - 12 hole production spine - three cathode crossovers - two reversing tabs.



DR03 - Double top rack with 3 bottoms - angle, clamping and V bottom with 2 side bars.

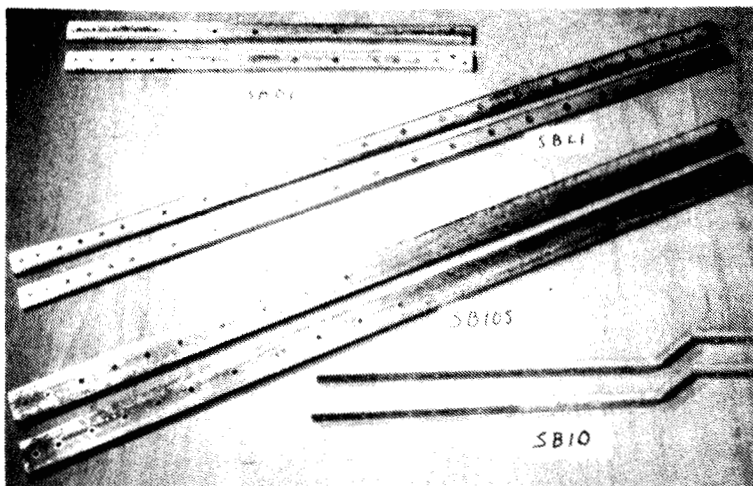


R105 - One inch rack with 5 bottoms - 1 inch and ½ inch clamping, V bottoms - 5 hole production and angle bottom not shown - 2 side bars.

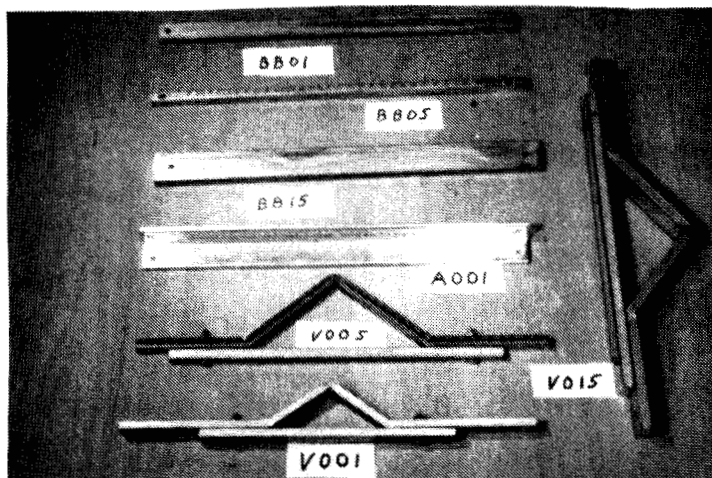


R103 - 1½ inch rack with 3 bottoms - angle, clamping, V bottoms and 2 side bars.

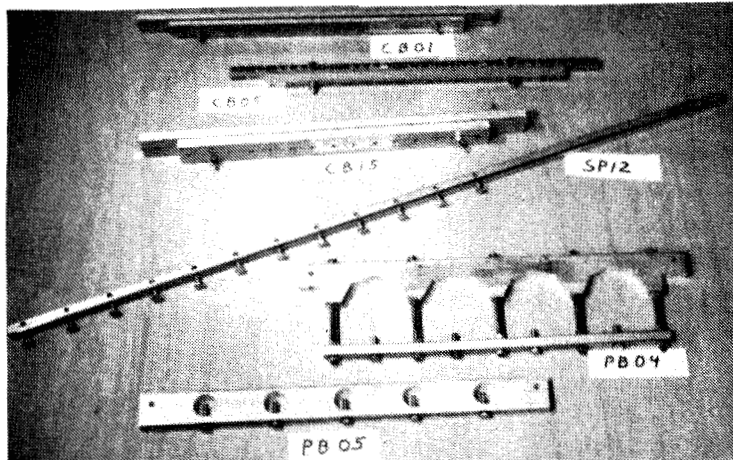
- SB01 - Side bars, 1 inch set of 2
- SBL1 - Side bars extra long
- SB105 - " " 1½ inch
- SB10 - Offset side bars
- SBS0 - Side bars length to order.



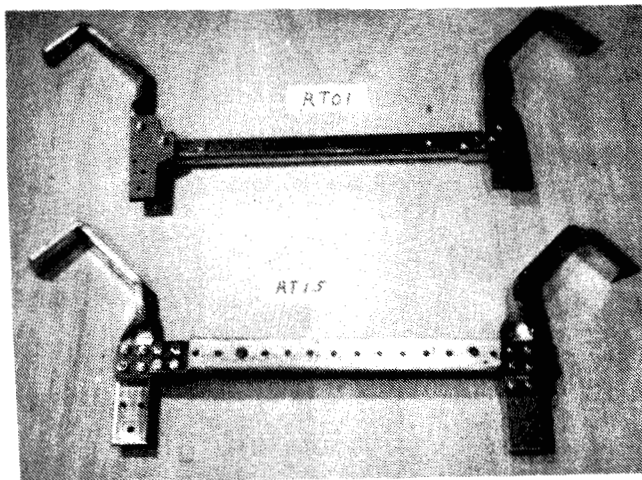
- BB01 - Blank bottom 1 inch
- BB05 - Blank " ½ "
- BB15 - Blank " 1½ "
- A001 - Angle "
- V005 - ½ inch V bottom
- V001 - one inch V bottom
- V015 - 1½ inch V bottom



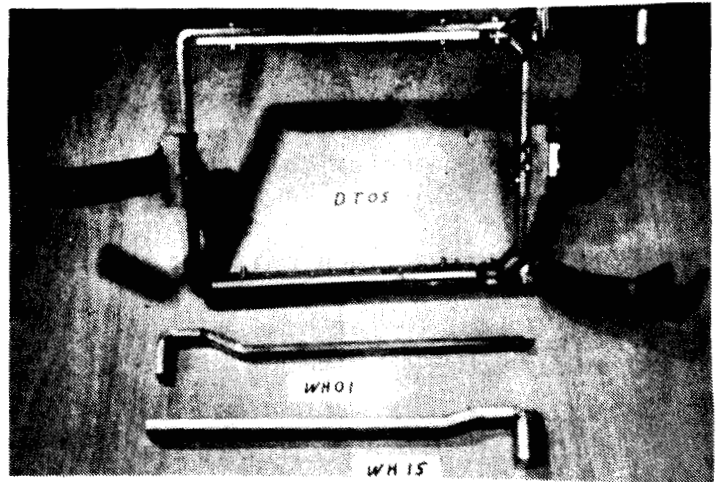
- CB01 - One inch clamping bottom
- CB05 - ½ inch clamping bottom
- CB15 - 1½ inch clamping bottom
- SP12 - 12 hole production spine
- PB05 - 5 hole production bottom
- PB04 - 4 " " "



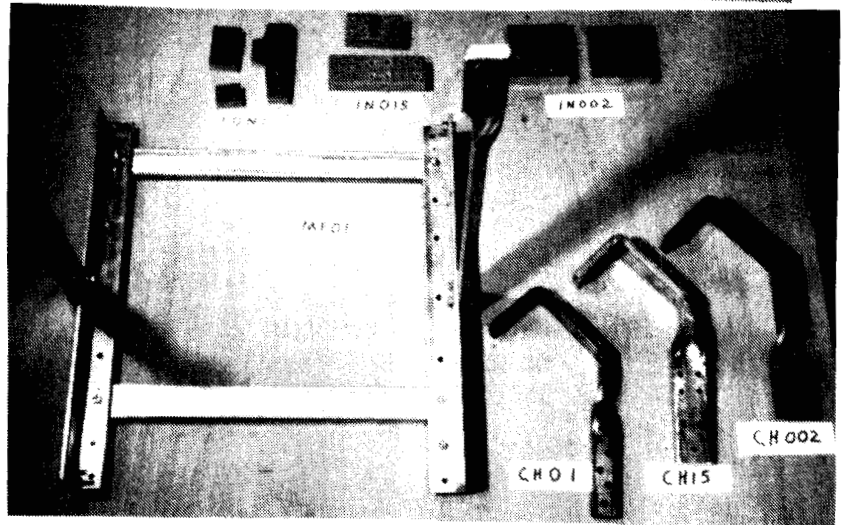
- RT01 - One inch rack top only with a anode clamping bar.
- RT15 - 1½ inch rack top only with a anode clamping bar.



DT05 - Double top rack, top only
 WH01 - Copper work holder 1 inch
 WH15 - Aluminum work holder 1½ inch
 Parts can be bolted to either end.

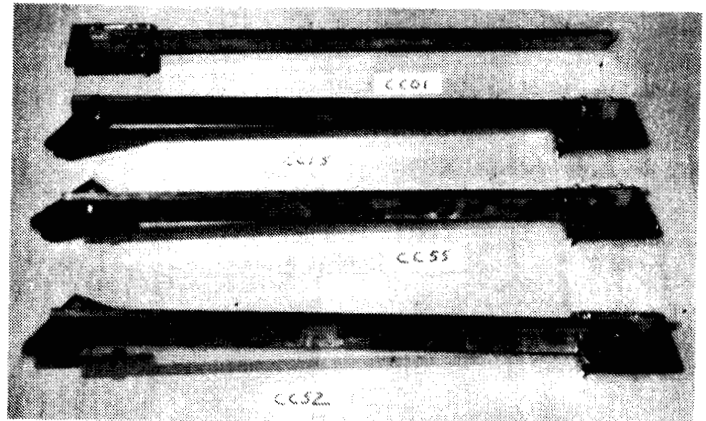


IN 01 - 1 inch rack insulators
 IN015 - 1½ inch rack insulators
 IN002 - Dbl. top rack insulators
 CH01 - Cathode hooks 1 inch
 CH15 - " " 1½ inch
 CH02 - " " dbl. top
 MF 01 - Mold frame work



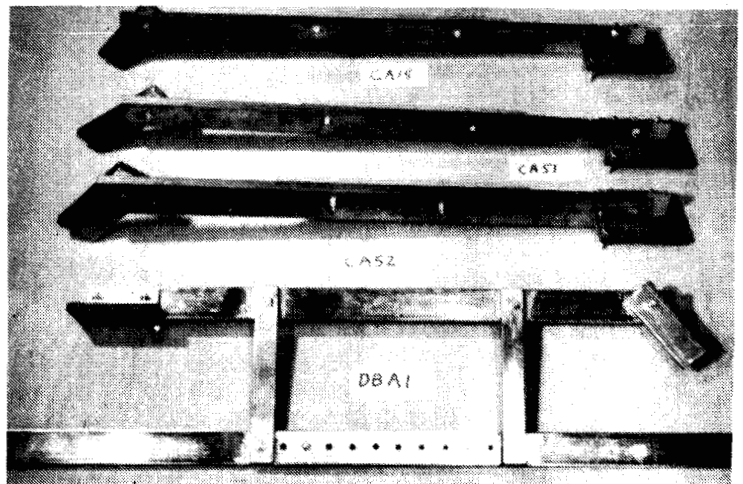
CROSSOVER BARS

CC01 - one inch	Cathode
CC15 - 3/8 x 1½ inch	"
CC55 - ½ x 1½ "	"
CC52 - ½ x 2 "	"

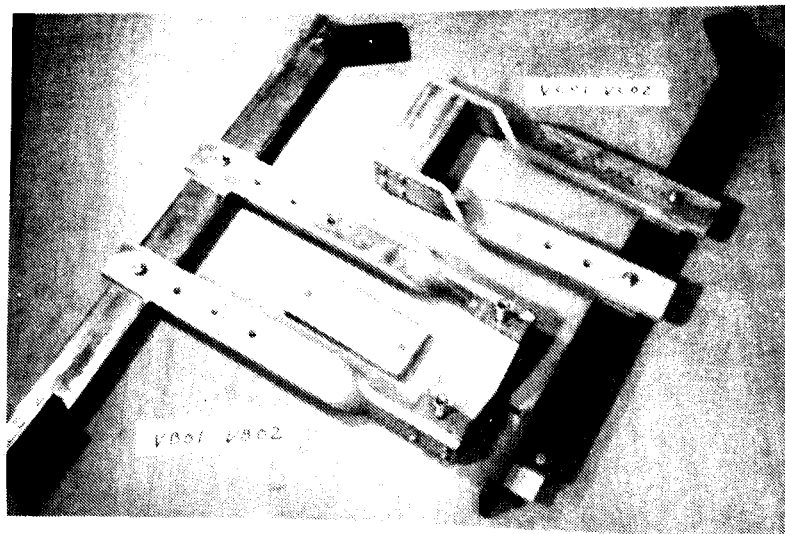


CA15 - 3/8 x 1½ inch	Anode
CA51 - ½ x 1½ inch	"
CA52 - ½ x 2 "	"
DBA1 - Double bar anode crossover	

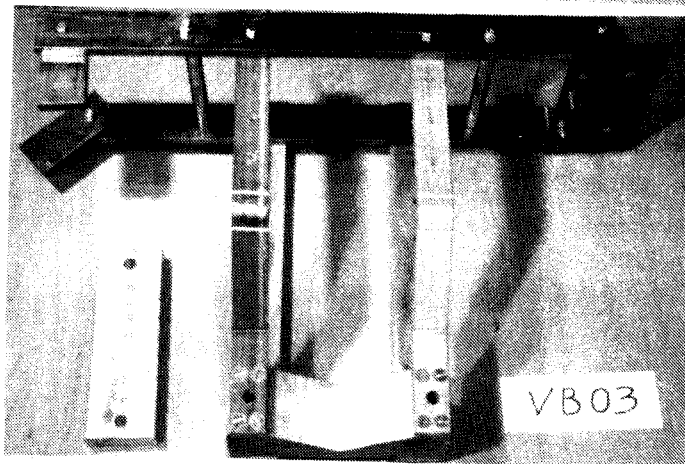
DBA1 can be used with either stick or sheet lead anodes.



- VB01 - 1,000 amp. V block holder
- VC01 - 1,000 amp. center hole cathode holder
- VB02 - 2,000 amp. V block holder
- VC02 - 2,000 amp. center hole cathode holder



- VB03 - 3,000 amp. V block holder



- SF08 - SET OF FIXTURES FOR A TANK ANODE TANK. Set consists of various quantities of CC01 to VB03 to suite the types of work to be plated.

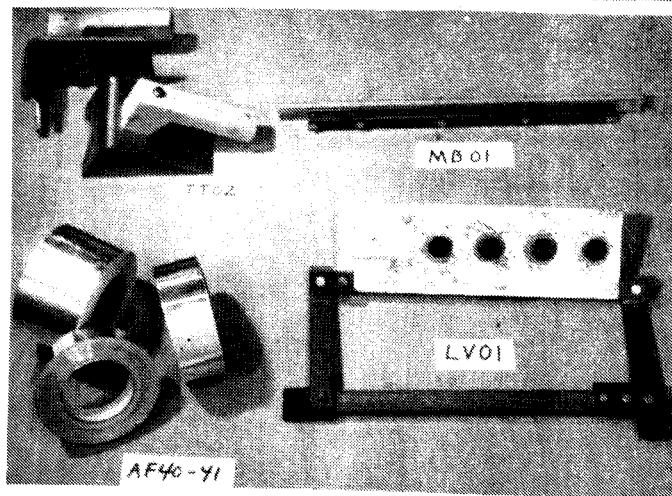
- TT02 - Reversing tabs for tank anodes.

- MB01 - Magnet bottom

- LV01 - Low Voltage Reostat Board

- AF 40 - Aluminum foil sticky tape 1 to 3 inch widths

- AF 41 - Aluminum foil tape mixed size case.

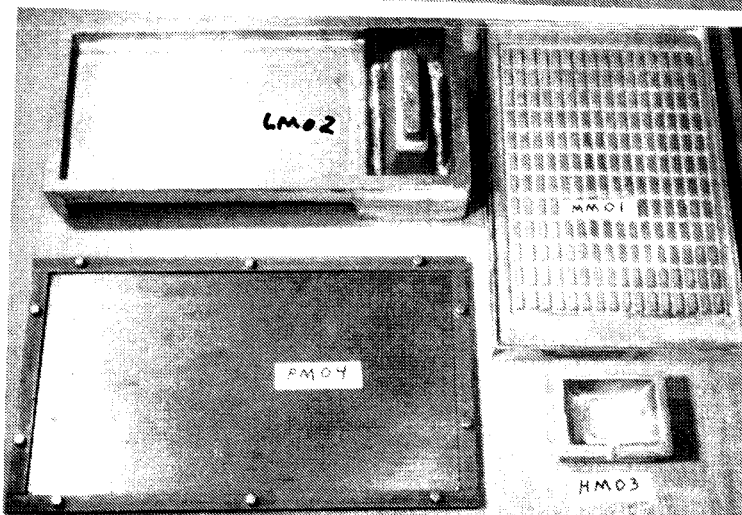


- MM01 - Mat Mold

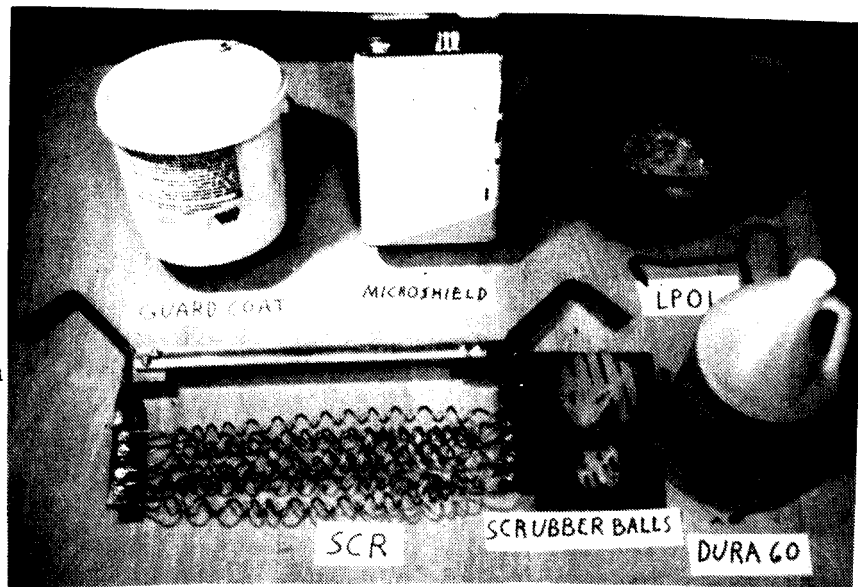
- IM02 - Lead Mold

- HMO3 - Hook Mold

- FM 04 - Flat Lead Mold



LP01 - Eight inch lead pot
 GUARD COAT - Vinyl floor or tank coating.
 MICROSHIELD - Stopoff lacquer
 SCR - Dummy load to remove spikes from a SCR rectifier output.
 SCRUBBER BALLS - For replacement or build your own scrubber.
 DURA 60 - Non etching chrome solution additive increases throwing power, easier rinsing, etc.



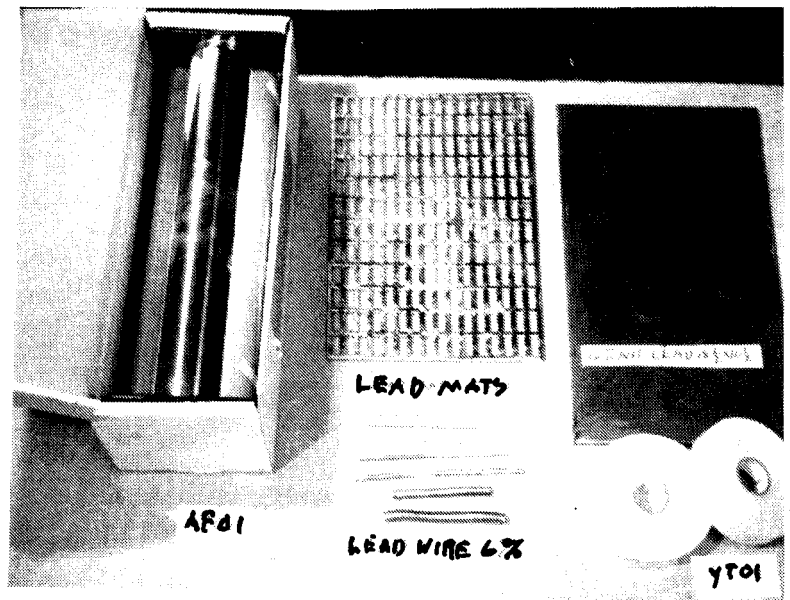
AF01 - Aluminum foil in 20 lb. rolls and is 18 inches wide.

Lead Mats - 10 x 15 inches long in either Antimony or Tin lead

SHEET LEAD - 6% antimony 18½ x 10½ ¼ inch thick.

LEAD WIRE - 6% antimony, sizes from 1/16 to 3/4 thick in any length. No need to buy 50 lb. spools.

YT01 - PVC yellow tape, non sticky and it really stretches, sold cheaper by the lb. A 1 inch roll weighs about a lb.

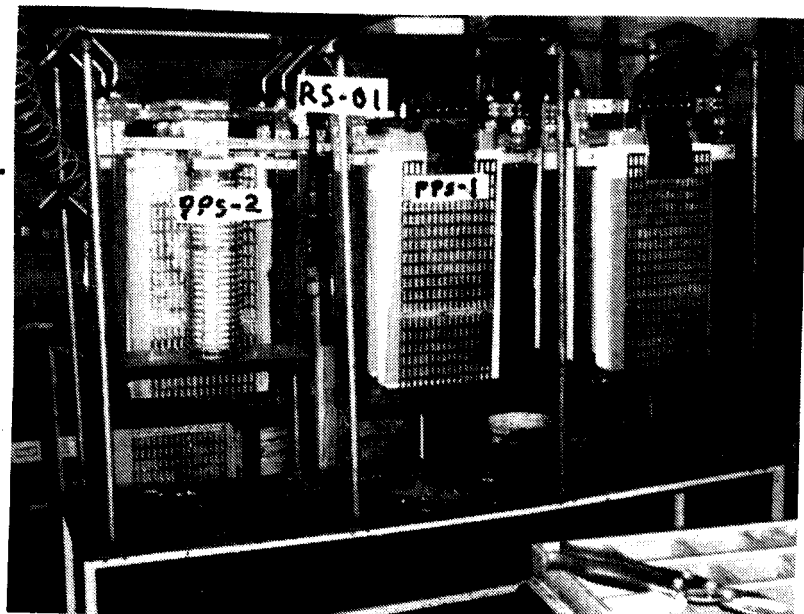


CHROME SOLUTION PURIFIERS

PPS1 - Recommended for shops with more than 700 gallons of solution.
 PPS2 - For shops with less than 700 Gal.
 PPS3 - For shallow tanks and machines.

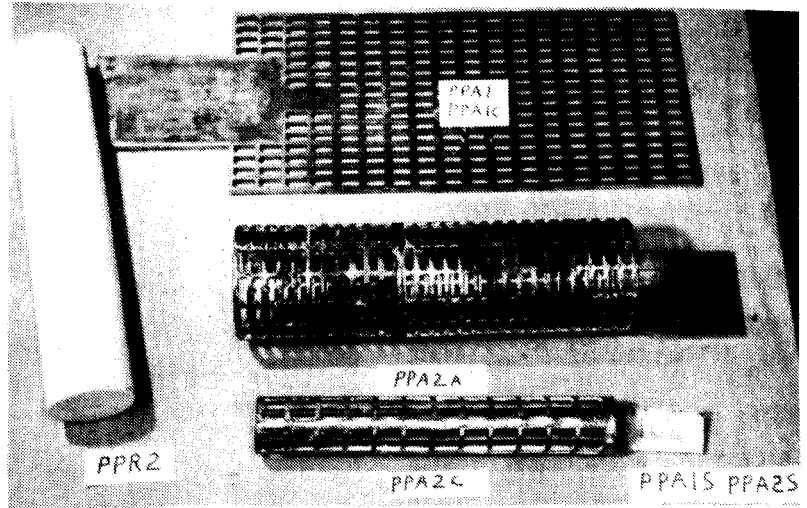
The same units will remove chrome from rinse water.

RS01 - 3 Bay rack stand as shown.





10½ hour video tape course in both English and Spanish versions. There may be two, three, or four video cassetts furnished depending on which format is ordered. The total viewing time will be the same. 5 audio tapes are a supplement to the 322 page training manual. The manual can be ordered separately as part number CPSR. If the tapes are ordered later the book price will be deducted unless you want another book. German and French versions will soon be available also. ---call-----

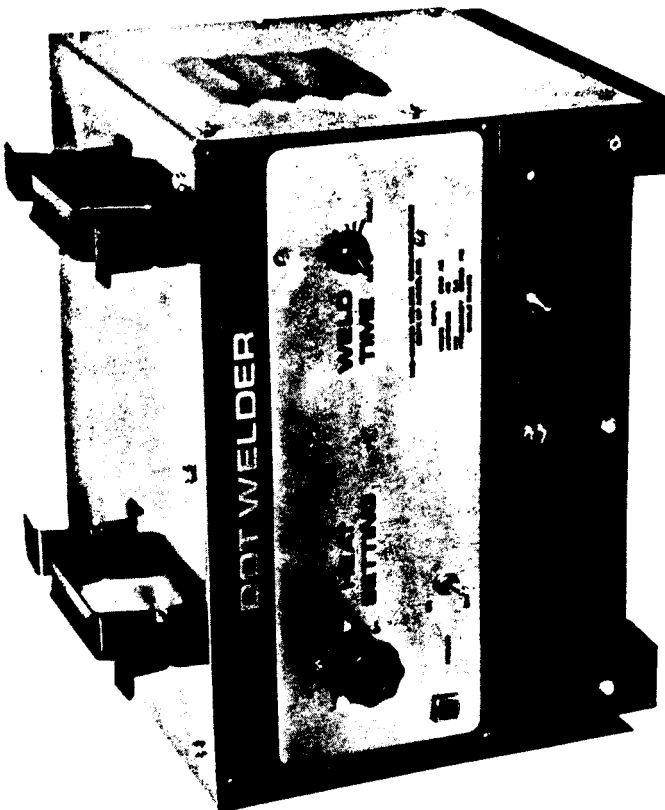


PPR2 is a replacement pot for both the PPS2 and PPS3 racks. PPA1 is a replacement anode for the PPS1 rack. The listed price is for one only, you will need to order two. PPA1C is the cathode for a PPS1 rack. PPA2A and PPA2C are a anode and cathode for PPS2.

PPS3 is a porous pot assembly that is used in shallow tanks or where space is limited. The overall dimensions are 5½ x 5½ x 18 inches long. PPA1S is the anode and PPA2S the cathode for a PPS3 assembly.

PPS2 and PPS3 are useful for tanks up to 700 gallons of solution. PPS1 is four times faster and is useful for up to 3,000 gallons.

The DOT WELDER is a highly useful welder and can do things other types can't. There is no spatter to mar highly finished surfaces. It can repair hardened steel molds that are cold without cracking them. Many platers use them to fill in pits before and after plating. Chrome noduals can be welded into a CHROME PLATED surface and it makes an invisiable repair.



LEAD LINED CHROME TANKS ----- CALL -
 STEEL DOUBLE LATERAL HOODS ----- CALL -
 SCRUBBERS, MIST SEPARATORS ----- CALL -
 RECTIFIERS, SATURABLE REACTORS ---- CALL -

ADVANCED MATERIALS

Guardcote® provides a world of protective coatings for Industrial users.

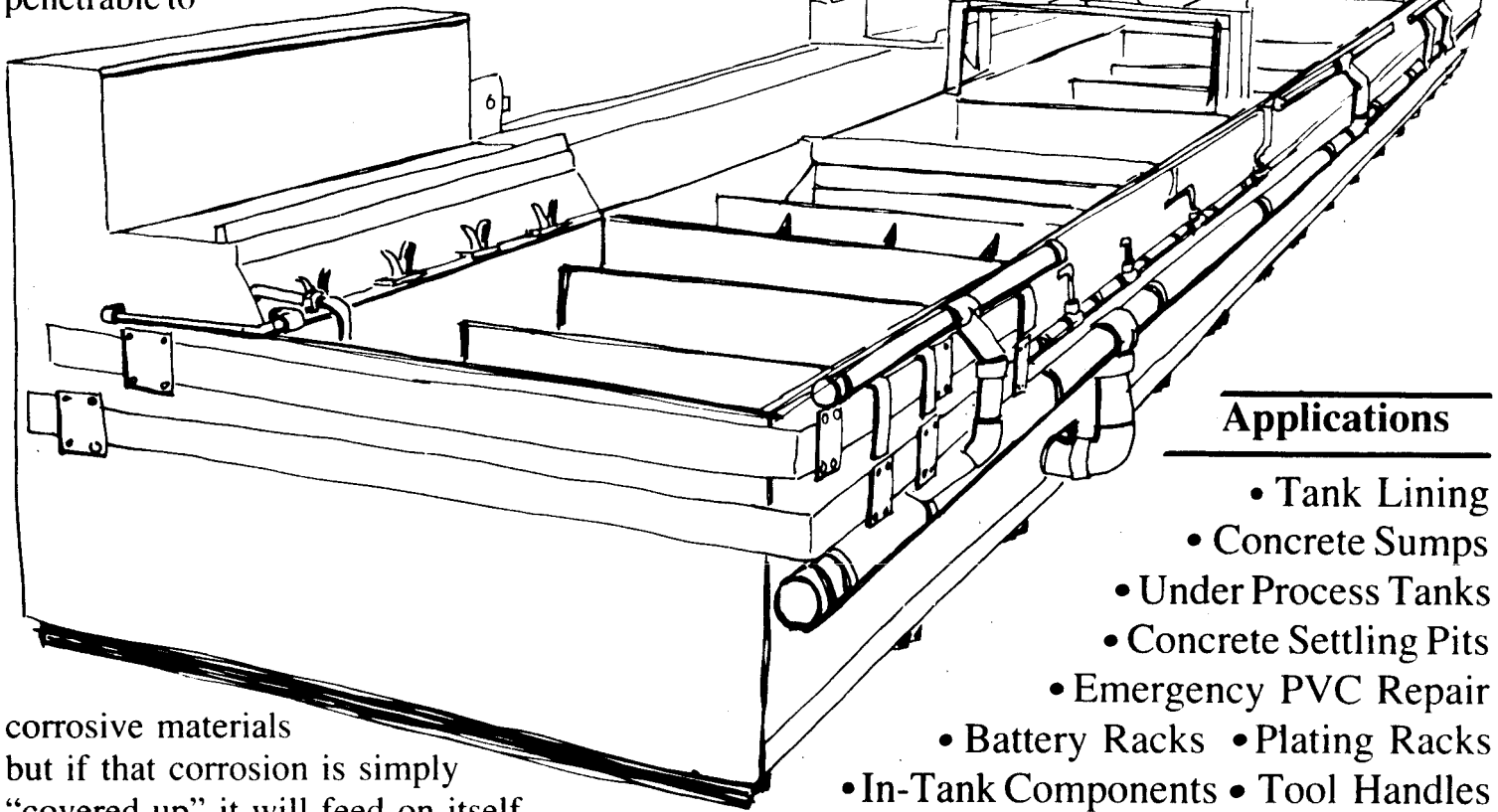


General

Advanced Material's revolutionary product, Guardcote, has been developed to meet the challenge of corrosive atmospheres which make it ideal for industrial use. Guardcote is an air dry plastic material that is acid and alkali resistant. It is ideally suited for surfaces that are exposed to corrosive liquids or fumes. Inaccessible areas and complicated fabrication designs can be protected quickly and easily by brushing, rolling or spraying on Guardcote.

Guardcote® Surface Preparation

Before covering a surface with Guardcote be sure any corrosion or rust problems are properly treated. Guardcote forms a barrier that is impenetrable to



corrosive materials but if that corrosion is simply "covered up" it will feed on itself underneath the topcoat. Rusty surfaces must be thoroughly cleaned by sandblasting or with a wirebrush. Captain Guardcote further recommends that any bare metal areas be acid etched and phosphate coated to completely neutralize residual corrosion and oils. For ex-

trême conditions, a zinc-rich primer should be applied prior to Guardcote. This will completely inhibit rust formation on bare metal.

Guardcote will adhere to any primed or painted surface and can be applied to ferrous or non-ferrous metals, plastic or concrete.

Industries

- Electroplating
- Enameling
- Pulp and Paper
- Soft Drink
- Chemical Processing
- Printed Circuit Boards
- Anodizing
- Electronics
- Breweries
- Food Processors
- Waste Treatment

Applications

- Tank Lining
- Concrete Sumps
- Under Process Tanks
- Concrete Settling Pits
- Emergency PVC Repair
- Battery Racks
- Plating Racks
- In-Tank Components
- Tool Handles
- Metal Pipe Lining
- Exhaust Systems
- Metal Roof Panels and Joists
- Food Processing Machinery
- Plus Hundreds Of Other Uses!

Catalog No. 280280 Thickness Gauge

The Biddle Cat. No. 280280 Thickness Gauge consists of a special lightweight magnet attached to a spring and contained within a pencil-like tube. To take a measurement, the exploring head or magnet is placed on the surface and the body of the gauge is drawn away, thus extending the spring. The spring extension, the amount of which is observed on the scale, is proportional to the force required to detach the magnet from the surface. The reading is taken at the point when the magnet breaks away from the surface, and the thickness is read directly from the scale.

The standard scale for non-magnetic coatings on mild steel also applies to coatings on cast iron and low-alloy steels, without appreciable error and to coatings on high alloy steels with a small correction for thickness of less than 0.001 inch.

When used on bases other than mild steel the gauge will still give repeatable results, but for accurate work a separate calibration is advisable for each particular application. This can normally be carried out by the customer and a correction chart made. Blank charts are supplied for this purpose.

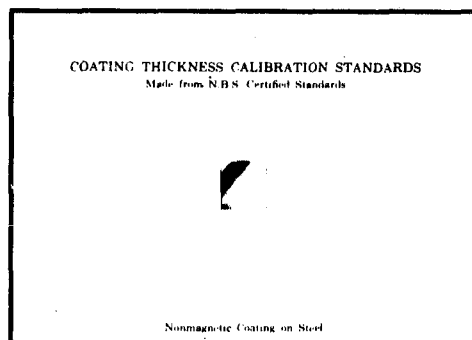


Reverse side of gauge showing linear scale in 0 to 10 units; carrying case with pocket clip is shown in the background.

Thickness Standards

For checking the accuracy of the gauge, we recommend that one or more thickness standards be purchased within the thickness ranges you are measuring. We carry in stock the following National Bureau of Standards samples consisting of a copper coating electroplated on a one-half inch square piece of steel, with a thin protective layer of chromium over the copper. The sample is glued to a piece of thick white cardboard and packaged in a clear plastic bag having a zipper closure:

Cat. No.	Inch	Mils	Cat. No.	Inch	Mils
281302	0.00025	0.25	281310	0.0032	3.2
281303	0.00050	0.50	281311	0.0055	5.5
281304	0.00075	0.75	281312	0.008	8.0
281305	0.0010	1.0	281313	0.010	10.0
281306	0.0015	1.5	281314	0.015	15.0
281307	0.0020	2.0			



Typical Standard Sample Card.

HARD CHROME PLATING CONSULTANTS Inc. Phone:(216) 631-9090, FAX LINE 216 631-9060
 TERMS.....10 DAYS -2%.....NET 30 DAYS.....1 1/2% INTEREST ON PAST DUE ITEMS
 PRICE LIST OF GOODS AND SERVICES EFFECTIVE January 1989 F.O.B. CLEVELAND OHIO US FUNDS
 CONSULTING SERVICE YOUR PLANT \$400.00 per day plus reasonable expenses.

REVERSIBLE RACKS - COMPLETE SETS - REPLACEMENT PARTS - SINGLE RACKS

SA12	SET OF 12 RACKS AND ACCESSORIES	\$2,856.00
RI05	One inch rack with 5 bottoms	199.00
RI03	1 1/2 inch rack with 3 bottoms	226.00
DR03	Double top rack with 3 "	266.00
SB01	Side bars, 1 inch set of 2	19.50
SB015	" " 1 1/2 inch set of 2	40.00
SB10	Offset Sidebars	24.50
SBL1	Extra long Sidebars	23.50
BB01	Blank Bottoms 1 inch	7.25
BB05	Blank " 1/2 inch	6.25
BB15	Blank " 1 1/2 inch	9.25
AO01	Angle bottoms, each	9.25
VO05	1/2 inch V bottom	19.50
VO01	One " " "	21.50
VO15	1 1/2 inch V bottom	34.00
CB01	One inch clamping bottom	18.50
CB05	1/2 " " "	21.50
CB15	1 1/2 inch clamping bottom	21.50
SP12	12 hole production spine	38.00
PB05	5 hole production bottom	29.00
PB04	4 " " "	45.00
RT01	One inch rack top only	123.50
RT15	1 1/2 " " " "	152.00
DT05	Double top rack " "	187.00
WHO1	1" WORK HOLDER (COPPER)	18.50
WH15	1 1/2" WORK HOLDER (ALUMINUM)	22.50
IN01	Insulators for 1 " rack, set of 2	10.50
IN015	" " 1 1/2 " rack, set of 2	12.50
IN002	" " Dbl. top " " " "	15.50
CH01	Cathode Hooks 1 inch	23.50
CH15	" " 1 1/2 "	30.00
CH002	" " Dbl. top	33.00
MF01	Mold frame work	68.50

MM01	MAT MOLD	\$170.00
LMO2	LEAD MOLD	195.00
HMO3	HOOK MOLD	17.00
FMO4	FLAT LEAD MOLD	85.00
***** Prices F.O.B. Cleveland ****		
DOT	WELDER	\$1935.00
DURA 60	(GAL) 4 GALLON MIN.	*25.95
DURA 60	12 GALLONS OR MORE	23.95
MICROSHIELD	(GALLON)	60.10
WHITING		2.50 LB
GC01	GUARD COAT GALLON	25.95
SCR	RECTIFIER PRELOADER	210.00
LP01	8 INCH LEAD POT	47.00
RS01	THREE BAY RACK STAND	122.00

-3 SIZES NOW AVAILABLE-

POROUS POT	CHROME SOLUTION PURIFIER
PPS1 \$700.00
PPS2 400.00
PPS3 \$375.00

REPLACEMENT PIECES

ANODES	PPA-1	92.00	PPA-2A	72.00
CATHODE	PPALC	43.00	PPA-2C	40.00
POTS	PPR1	245.00	PPR2	97.00
10 1/2 HR VIDEO TAPE COURSE \$400.00				
4 VIDEO TAPES, 5 AUDIO TAPES PLUS A				
CPSR 320 PAGE BOOK INCLUDED.				

***CLEARLY SPECIFY WHEN ORDERING**

NO REFUNDS ON VIDEO COURSE

USA	VHS (VTVA)	BETA (VTBA)
PAL	VHS (VTVP)	BETA (VTBP)
SECAM	VHS (VTVS)	BETA (VTBS)

** CHECK WITH ORDER OR C.O.D. ONLY**
 CPSR - The Hard Chrome Platers Bible
 CHROME PLATING SIMPLIFIED REVERSIBLE
 RACK TWO BUS BAR SYSTEM+five 90 min.
 AUDIO TAPES UPS PAID \$100.00 ** AIR
 POST PAID FOREIGN \$120.00 *** (AUDIO
 TAPES \$25.00 SEPARATELY)

LM01	10"x15" LEAD MATS
1 TO 30 @ 11.50 each..... \$345.00	
50 @	10.50 " 525.00
100 @	10.00 " 1,000.00
200 @	9.00 " 1,800.00
SHEETLEAD 10.5" x 18.5" x 1/4 40.00	
TELEPHONE, FAX CONSULTING \$100.00	

SCRUBBER BALLS FOR REPLACEMENT - or
 build your own Scrubber.....
 80.00 per 5 CUBIC FT.

NEWS LETTER \$35.00
 6% ANTIMONY LEAD WIRE - 1/16 to 3/4"
 various sizes, shipped in small quan-
 tities. You don't have to buy 50 c
 100 LB. spools \$3.95 a L

CROSSOVER BARS - Price each		
CC01	one inch Cathode	33.00
CC15	3/8 x 1 1/2 "	44.00
CC55	1/2 x 1 1/2 "	51.00
CC52	1/2 x 2 "	66.50
CA15	3/8 x 1 1/2 Anode	49.00
CA51	1/2 x 1 1/2 "	56.50
CA52	1/2 x 2 "	71.50
DBA1	Double bar anode crossover	107.25
VB01	1,000 amp. V block cathode holder	143.00
VC01	1,000 " center hole cathode holder	137.75
VB02	2,000 " V block cathode holder	260.00
VC02	2,000 " center hole cathode holder	209.00
VB03	3,000 " V block cathode holder	392.75
SF08	SET OF FIXTURES FOR A TANK ANODE TANK	2652.00
TT02	2 Reversing Tabs for tank anodes	29.00
MB01	MAGNET bottom	53.00
LV01	LOW VOLTAGE REOSTAT BOARD	115.50
AF40	Aluminum Foil Sticky Tape 1", 1 1/2", 2", 2 1/2", 3" AND MIXED CASES.....	80.00

ALUMINUM FOIL STICKY TAPE SOLD BY THE CASE ONLY

AF01	ALUMINUM FOIL 3.60 LB.
YT01	Tape non sticky PVC..	3.60 LB.

Here is a little quiz for hard chrome shop owners and platers that really care about quality plating. Just how good is the plating your sending to customers? Incidentally having the right answers will have a very poitive effect on your bottom line.

1 - When plating shafts and rollers is the deposit uniform end to end? ()Y ()N Hourglass depoits don't qualify as being uniform.

2 - Is the required plating only where specified and not slopped over on other areas? ()Y ()N Optional areas are not always optional and could cause your customer additional grinding time.

3 - Depoits are always bright or reasonably so? ()Y ()N Milky chrome is too soft while dull grey or burnt is too brittle for some applications.

4 - Your shop is neat and clean and a joy to work in. ()Y ()N If your answer is not a 100% yes, you have problems. Unfortunatley they are hitting you in your wallet.

5 - Are your plating methods BAT? (Best available technology)? ()Y ()N Why in the world are you satisfied with less? Contrary to the long, difficult time its taken you to get where you are today, there is a simple system that is easily learned in a few days, weeks for slow learners.

6 - Are your plating rates only about .001 or less? ()Y ()N This can cause you a great many problems besides poor quality plating. Nothing should be plated at less than .002 per hour while a great many should be plated at a .006 per hour rate.

7 - Can you mix all types and sizes of pieces together in your chrome tank using a single rectifier? ()Y ()N Using our system the name of the game is, keep the tank full of work and or use all available amperes constantly.

8 - Is your average plating time for the average plus grind parts 2½ to 3 hours? ()Y ()N Most of the work in a tank should be turned over at least 3 or 4 times in a 24 hour day! To put it another way, one tank converted to this method will outproduce more than 4 tanks using stick anodes and the three bus bar system.

9 - Do you think a new so called high speed solution will solve your problems? ()Y ()N If you answered yes, wrong again. The old 100 to 1 chrome sulfate solution is being used to plate wire at a .030 per hour rate. The characteristics of the deposit, by any test, is exactly the same as if plated properly at any other rate.

10 - Just changing to one of the so called high speed solutions will increase my plating rates drastically. ()Y ()N These new solutions only claim about a 25% increase in efficiency. This means using only your present methods, to plate .001 per hour, it will give you a plating rate of .00125 per hour. WHOOP DE DOO! Regardless of what solution you use, you will have to change your plating methods to allow plating .006 or more per hour. Please don't panic, the fact is you can only achieve truly quality plating and higher profits by using these faster rates.

11 - You already know all you need to know about hard chrome plating. ()Y ()N There is a old saying that ignorance is bliss. It isn't very blissful for platers using obsolete technology.

Unfortunately, most of the existing literature was written by people with very limited or nonexistent experience on a working hard chrome tank. How else can you explain that recent books and

articles are only a rehash of obsolete methods. They keep repeating the same old mistakes. Yes, the old timers got chrome on pieces just as you do. THAT IS NOT THE POINT! The point is that there is a simple, cut and dried, 50 year old system that conservatively will increase your platers output by at least 100%. It will increase production out of a tank 400%, cut your costs at least one or two thirds. The video tape course and book will give you all the short cuts and information you need. There are blue prints, in the book, that tell you how to make racks. I don't think you should for the following reasons.

Our company now can make and sell racks cheaper and better than you can make them yourself. Buying them will allow you to start saving and increasing your profits several months sooner. This can offset the entire cost of the racks and additional equipment you need. You will find everything needed to set up a new shop or convert a tank in the price list. Please remember that we dicount everything. I am here to help you in every way I can. It really pains me to see platers turn down or lose work because they don't know how to do it, do not have the tools or skills to do it. There are millions of dollars worth of work looking for platers with all the answers. THE REVERSIBLE RACK 2 BUS BAR SYSTEM makes what you think is impossible or difficult very simple indeed.

We have moved to larger and better quarters. The video tapes take you through our former shop and class room therefore we have discontinued the school. The system of hard chrome plating that I teach is so fantastic that there are many of you that will not believe much of what you have just read.

For you doubters and others that want to improve their shops, the following is for your benefit. I will give up my Saturdays if you will give up one of yours. I am going to hold a series of one day classes on Saturdays only. I will show and teach you as much as possible about the worlds best hard chrome plating system. While time for hands on training will be limited much can be learned from the demonstrations. Lead burning will be hands on. Interaction with the other attendees and answers to any questions you may have will be a definite plus. As we are very busy during the week, visits to the plant will be limited to Saturdays or by attending the class.

How many classes per month will be established by the interest in this offer. To maximize what you will learn, class size will only be 6 people. Paid reservations are a must and the fee \$100.00 You can fly or drive in Friday evening. Be ready to start 8:00 AM leave 4:30 PM. Lunch will be served. If you are still a doubter at class end your fee will be cheerfully refunded. As my former students would tell you thats not about to happen. What will happen is that you will go home and throw rocks at the miserable way your plating. If you can't find time to attend its because your plating the hard way so you really need this. The tenitive schedul is the first Saturday of the month starting March 4, 1989. Call 216 631 9090 or Fax 631 9060 for reservations.

A paper was presented at the 10th AESF/EPA CONFERENCE trying to claim, membrane chrome solution purifiers are better than porous pots. For a test they used a contrived solution instead of a real world, working chrome tank solution. This only shows a rigged test can prove almost anything. They used our PPS2 at 70 amps to compare their 130 amp. unit. FOUL!! Why didn't they use our PPS1 which is 4

times faster?

Under actual plating bath conditions our smaller PPS2 has removed 1 lb. dry weight of contaminates on the cathode. A indeterminate weight of sludge, possibly another lb. was also in the pot. This was a 16 hour run but its possible that not much was happening after the first 8 hours. We recommend the pot should not be run more than 8 hours the first time. The pot had so much contaminating material in that it was difficult to remove the cathode.

In the paper, they infered that disassembly was a chore and took a lot of time. Removing 2 nuts is a chore? Our present PPS1 has been modified so only one nut is loosened to pull the cathode. The sludge can be pumped out with a small pump. Let it stand until the chrome separates from the sludge. You can then pour the separated chrome back in the pot. I am working on a method to separate the metalics from the sludge. The metal can be sold as scrap and there should be nothing to go to waste treatment. To make a long story shorter, the real kicker is that their unit costs \$14,000.00 while our PPS1 is only \$700.00! To separate chrome from rinse water they reccomend using a Ion Exchange unit. In their table 4 they have Ion Exchange units listed at \$35,000.00. Have they no mercy for the little guy? Our porous pot racks can remove impurities from any type of chrome solution. The same pot racks can also remove chrome from rinse water and caustic electric strip solutions. This not only conserves chrome but can reduce the need for waste treatment to zero or nearly so. I should be mad at seeing published such a biased and erroneous paper but I can't stop laughing.

There are other porous pot units that use separate tanks, pumps, rectifiers and need expensive installation. These also sell for about \$20,000.00 plus. Being outboard there is always danger of leaks on the floor. A PPS1 can easily handel 2,000 gallon tanks and you should not have to run it all the time. One of my customers reported that he took a unworkable solution back to the wine red of a brand new solution. He shouldn't need to run the pot again until about 3/4 of the time elapses, it took to contaminate the solution in the first place.

By popular request I am publishing my NEWS LETTER again. This is published monthly and will be combined with my phone consulting service. You can either order the News Letter at \$36.00 or Phone Consulting and the News Letter at \$100.00. Besides what is new in the hard chrome industry, there will be how to articles, hints and answers to questions. The phone or Fax consulting service allows you to call anytime you have a problem. Fax has the advantage in that you can send pictures and drawings when necessary to solve a problem. Send in your tax deductible check and put a Hard Chrome Plating Consultant on your payroll. Holy Smoke I am practicaly giving my service away!

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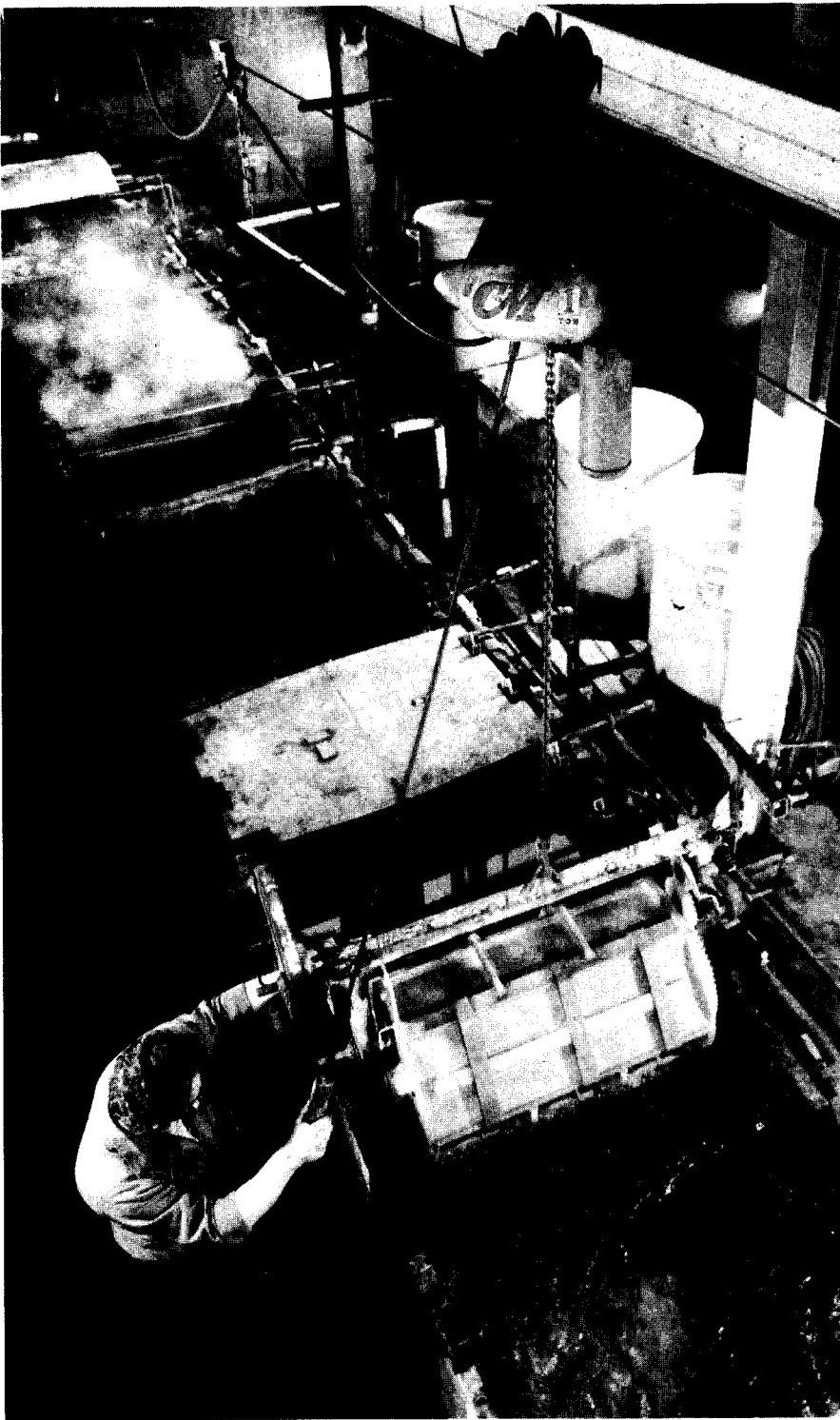
- **Is control station reliability a problem?** Lodestar control stations are rated NEMA-4 and impact resistant, with positive snap-action control — all standard

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LEAD POISONING

As a hard chrome plater, I have burned lead conforming anodes together since 1942. I would make or repair anodes almost every day. Burning time could be from a few minutes to several hours. Now 47 years later, I have had a blood test for lead, more about that later. Incidentally, I still do a fair amount of lead burning.

The first time I knew anything about lead testing was in 1975. One of the shops had a lab investigate, whether their platers were exposed to harmful levels of lead fumes. The test was conducted at the anode lead bench without a local blower system of any kind. The results proved negative.

The next time I ran into a problem was with Navy safety people. At the time, I was converting their hard chrome tanks to the Reversible Rack 2 Bus Bar System. The first problem was they wanted the weld shop people to do the lead burning. I had to fight the union and the safety people that lead burning and anode making were really a hard chrome platers job classification. The fact that in one Navy ship yard, the weld shop was over a ½ mile away was not too swift. If the platers didn't do it, there would be lengthy delays between needing a anode and getting it. Of course we will not mention the horrendous amount of paper work a request would entail.

The next argument was that the lead burner had to wear a helmet with a remote air supply. I told them they should check the air quality while lead was being burned. The result was that the helmet was not necessary. They didn't pick up much more than if they had sampled the air any place else. Even so they insisted on a exhaust hood over the lead bench. When one of the engineers suggested a 5,000 cfm blower I balked. How in the hell were we supposed to keep the torch lit? Another thing they wanted was a dust collector on the lead cutting band saw. For cutting new lead it shouldn't be necessary. Cutting dry, used anodes its not a bad idea at all. The shops I have worked in never gave this a thought.

Of the 67 years I have inhabited this planet, there are 60 years my drinking water has been coming through a LEAD pipe from the street to my house! This and my lead burning plus being exposed to leaded gasoline all these years, should make me a lead pipe cinch to have high lead levels of blood killing me. However, I am in pretty good shape for the shape I am in. My blood test came back 19 mcg/dl while OSHA normal limit is 40 mcg/dl. Normal for children is 0 - 25 mcg/dl so I guess I am in my second childhood.

All kidding aside, there are several things that you can do to limit your exposure. Do not burn lead with a oxidizing flame. It should be a nice baby blue and not a harsh blue white. Do not clean used anodes on a wire wheel. To get the oxide off, hand brush them while still wet. Anode cleaning solutions that I tried turned me off. They took too much time, shortened anode life and are just another hazardous waste to contend with. A blower hood over the lead bench may not be necessary but it will keep some people off your back. So to will a dust collector attached to your lead cutting band saw. I would also hang a dust mask there even if it doesn't get used. It is also prudent to have anyone you hire have a lead blood test before they pick up a torch. Another caution, don't carry a lead pencil in your shirt pocket. One of my older brothers did quite a few years ago. Some how it punctured him and that gave him a bad time for a while but he is still among the living.

Regarding the lead pipe to my house, over 1/2 the homes in Cleveland, Ohio have these lead pipes. A while back our water department sent everyone a notice to that fact. I don't have a copy of it on front of me. I do remember thinking it was a very clever snow job. They did gloss over the fact they would replace it if asked. Also missing was what that would cost and who would pay for it. As far as I am concerned, I would not let them dig up my front lawn. My lead blood level results speak for themselves.

Many of you are now melting your scrap lead and making mats to make new anodes. You should have an exhaust hood over the lead melting stove. This is to primarily remove the smoke and odors produced by dirty lead. I use automobile wheel weights to harden soft lead. These come from the junk yard and do have bits of rubber which when burnt is obnoxious.

Never put damp or wet lead in melted lead. When burning lead or melting lead always wear eye protection. Under some conditions, water can form near where you are burning. If a drop of molten lead hits the water the lead will explode. You may lose an eye! Always use an approved lead pot with a bail handle in good condition. There is no way you can control melted lead in a frying pan or other flat pan. I should know, it will end up on the floor and on you! We are talking about 675° F. lead and don't forget it.

TESTING CHROME THICKNESS ON SUPER CONDUCTOR WIRE

It is very difficult to determine plating thickness on small irregular objects and fine wire. The problem is even more difficult if the coatings are in thicknesses of millionths of an inch. The method we used to determine chrome thickness on super conductor wire on past orders was to cut transit time in the chrome tank. We are plating nickel wire .001 on the diameter at a particular voltage and current. When switching the machine to super conductor wire, it was only necessary to speed up the machine for thinner deposits. We knew what we were doing but the customer couldn't check the wire for quality control.

I came up with an acid test that can tell you how thick the plating is. I used plated wire samples with .0005 and .001 chrome on the O.D. Stripping the chrome with 20° baume Muriatic acid produced a stripping rate of 2.2 seconds per .000001. The variation between tests was less than 10%. This figure was very close to our estimated thickness on the super conductor wire.

The procedure used - fill a test tube 3/4 full of 20° baume muriatic acid. Degrease a sample piece of wire 2 inches longer than the test tube. Have a stop watch ready and drop the wire in the acid. Time the interval between the first and last bubble seen coming off the wire. Convert the time to seconds and divide by 2.2 which will give you millionths of an inch on the O.D.

This is a poor man's test but you know me. If it isn't cheaper, faster and better I don't want anything to do with it. There are always easy answers to complex problems but most people just try to make them more complicated.

THIS IS A SAMPLE OF THE ARTICLES YOU WILL RECEIVE IN THE NEWS LETTER.

POROUS POT OPERATING INSTRUCTIONS

You can use this porous pot rack to remove impurities from any type of chrome solution. It can also be used to remove chrome from rinse water and caustic electric strips. It will not reduce the chrome in rinse water enough to put it in a sewer. The water will be clean enough to keep using it for rinsing, in most applications. For those that can't use it this way, it will reduce the load on waste treatment and recover chrome solution.

On receiving the rack, check the pot and rack for hidden damage. If it is damaged contact us and the carrier. It is the carriers responsibility. Make sure the pot isn't cracked as they are fragile. The anode may be bent a little but this is easily corrected. If you have a PPS2 or 3, the anode can be made round again by straightening it on a pipe of suitable size. There should be about $\frac{1}{2}$ inch spacing between the anode and the pot.

If you need to increase PPS1's output do the following. When you replace the outside anode make the front anode a U shape. By burning the mats together in the other direction, you can add anode strips to the side. There are notches on the pot holding plastic to help keep the strips in place. Using a full anode like this will increase the pots speed by about 20%. Sorry, we don't make them this way because it would cause a shipping problem.

Replacement anodes and cathodes bought from us will be the same as shipped. If you want to make your own, you can buy from us either, the lead mats or a mold to cast them yourself. If you use sheet lead for replacements, you will reduce the removal capacity by about 40%. The lead mats have about 90% more surface area, therefore more throwing power, than flat sheet lead. This is also true if the mats are used for anodes in hard or bright chrome plating.

Flouride baths shorten anode life and you should specify tin lead anodes. The HEEF 25 bath produces extremely short anode life and will require special 7% tin lead anodes. This bath must be hot for porous pot operation. If used cold there will be a lot of crystals formed on the anodes and in the bottom of the tank. Other baths can be treated when cold. Even if anode life is shorter than if used in chrome or chrome sulfate baths, the benefits are well worth the extra cost.

The anodes on the outside are normally positive. If you trace the electrical path, it leads to the anode hook which is the + hook. If the rack is connected in reverse it will collect clean water in the pot. If the pot seems clogged reversing it for 10 minutes will clean out the pores. The holes in the pot are $\frac{1}{2}$ to 1 micron in size and the pot is 40% holes.

The racks are made to fit in a Reversible Rack 2 Bus Bar hard chrome tank. Anodizers, bright dip users, bright chrome platers, etc. will have to rig up some supports to suspend the rack in the tank. If because of lack of tank space this is not possible, You can use a 55 gallon plastic drum outboard of the tank. A small pump will be needed to pump the solution in it and let the solution return by gravity. It is in some instances necessary to batch treat scrubber water. Do whatever is necessary as the pot racks are portable. Cables can be used for connection to the bus bars or a separate power supply. For bright chrome platers that cycle the power to the chrome tank, it can be connected to the cleaner tank.

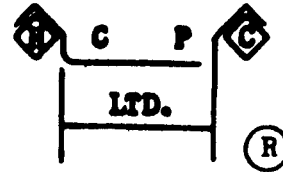
You can use 4.5 to 6 volts for removing impurities. You need 24 to 27 volts for removing chrome from rinse water. Lower voltage is used to remove chrome from the electric caustic strip and Stainless steel acid pickles. Limiting factors of what voltage to use is the solution temperature and how high solution rises in the pot.

The solution will get higher in the pot than the solution outside. The pot lip must be at least 1 inch out of the solution at all times. The solution inside will be

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hotter than the outside. The contaminated solution must not flow over the top. In a chrome tank, PPS1 will draw about 210 amps. at 4.5 volts while PPS2 and 3 draw 70 amps. There is a wide variation, in current drawn, depending on the type and concentration of the solution. That is some of the reason I can't give you hard numbers as to what to expect in your tanks. PPS1 rack is designed to handle 1,000 amps. maximum and PPS2's limit is 600 amps. While the pots will not allow that much amperage, for fastest removal use as much as you can.

To start the pot fill it with chrome solution or in the case of the electric strip, chrome contaminated caustic. For rinse water operation add a little chrome to rinse water in the pot.

PURIFICATION OPERATION - Do not run the pot more than 8 hours the first time. This is very important for PPS2 and 3. They may get so much contaminated material in that you might not be able to remove the cathode without breaking the pot. As the contaminates in the bath fall the allowable running time will increase. I have reports of these pots bringing the solution to the wine red of a new solution. A unworkable solution usually shows signs of life after a few days run. As the contaminates concentrate the amperage drawn will fall off. It could go to zero but its suggested the pot be cleaned when it falls off 75%. How conscientious you are about cleaning and running the pot rack has a great bearing on its performance. You can remove the cathode without removing the rack. Loosen or take off the two nuts on the side bars. Pump the solution and sludge out into a plastic container. Allow the chrome solution to separate from the sludge. This will happen in a few minutes. Pour off the chrome solution and return it to the pot. Replace the cathode and fill the pot to the correct level. Hopefully you remembered to brush off the cathode. Brushing the anode is usually not necessary. If you use this in tank cleaning method lift the rack from time to time to check on the anodes. They do get thinner with use. We are working on a method of recovering the metallics from the sludge so there will be no waste treatment needed. The metallics could be sold for scrap.

To separate chrome from rinse water collect the chrome in the pot. The hose inlet from a pump can be fastened 3 or 4 inches in the pot. At intervals you can pump some chrome back in the chrome tank. I have had a report that a PPS1 can remove several pounds of dissolved metallic chrome out of a caustic strip in 24 hours. This rejuvenated the strip and will save on hazardous waste treatment.

You may have to buy and use more than one pot if you have several or very large tanks. PPS1 is recommended for 2,000 gallons of solution or more. PPS2 and 3 up to 700 gallons. These are only guidelines as your requirements will depend on the degree of contamination and rate of introducing contaminates to the bath. You may not have to run the pots all of the time. As one tank cleans up it is easily moved to another. contaminating materials come out of solution at different rates. Iron is the slowest and copper the fastest. Nickel, aluminum, zinc, etc. are somewhere inbetween. You may even find reconstituted oil and grease that was dissolved in the chrome solution.