



PRODUCT INFORMATION

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MARTRON HCR Decorative Chrome Plating Process

Section 1: Product Description and Features

Martron HCR Chromium Plating Process is a bright, trouble-free, highly activating, stain-free system with exceptional covering power. The catalyst has been specifically formulated to activate the nickel-plated surface to accept bright chromium deposits over a wide current density range without low current density staining.

The **Martron HCR** Chromium Plating Process offers the user both higher cathode current efficiencies and higher operational current densities when compared to a conventional chromium plating process.

- Higher cathode current efficiencies and operational current densities
- Accepts chromium deposits over a wide range of current densities
- No low current density staining
- Exceptional covering power
- Economical and easy to use

This process consists of the following **Martron Inc.** products:

Martron HCR

Section 2: Safety Precautions

Always read and understand the Safety Data Sheet (SDS) for any chemical product prior to using the product to ensure familiarity with the methods of safe handling and health hazards associated with **Martron HCR**.

Section 3: Make Up and Maintenance of Martron HCR

Equipment

Tanks and any ancillary equipment should be constructed of Koroseal lined or PVC line steel, polyethylene or polypropylene. Rinse tanks after plating should also be lined. Fiberglass is not recommended because of the possible solubility of their bonding resins.

Agitation is only required for mixing purposes only. Air agitation supplied by a low-pressure blower is recommended. Compressed air should never be used. PVC pipe is suggested directly beneath the parts being plated. The volume of air should provide uniform movement of solution throughout the tank including the anode area.

A certain amount of heat will be generated during plating. Therefore, a means of cooling the bath is highly recommended using Teflon or Titanium coils or heat exchangers.

The anodes should have a composition of 7% tin and 93% lead. The anode current densities should be maintained high enough to form and keep a brownish colored scale formation. Anode hooks and anode bars should be cleaned periodically and checked for good contact. Burning and/or miss-plates can result from

excessive scaling of anodes. Anodes isolated from the plating circuit will tend to build excessive yellow scale.

Ensure adequate ventilation is provided to remove the chromium mist generated during plating.

Rectification should be maintained with a ripple below 5% for optimum plating results.

Solution Make Up

	Optimum	Range
Chromic Acid	32 oz/gal	24 – 40 oz/gal.
Sulfuric Acid 66°Be'	0.055 % (vol)	0.033 – 0.085 % (vol)
Martron HCR	1.00 % (vol)	0.75 – 1.25 % (vol)

Make Up Procedures

- Fill tank to 75% of its working volume with warm water (80°F)
- With continuous stirring add the required amount of chromic acid
- With continuous stirring add the required amount of sulfuric acid 66 °Be'
- With continuous stirring add the required amount of **Martron HCR**
- Add balance of water to fill tank
- Stir to mix uniformly
- Heat chromium solution to operating temperature
- Confirm solution composition by analysis and performing Hull Cell tests

Operating Conditions

	Optimum	Range
Chromic Acid	32 oz/gal	24 - 40 oz/gal
Sulfate	0.13 oz/gal	.08 – 0.20 oz/gal
Ration CrO ₃ :SO ₄ *	240:1	180 – 300:1
Martron HCR**	1.00 % (vol)	0.75 – 1.25 % (vol)
Fluoride Catalyst	400 ppm	350 – 450 ppm
Temperature	110°F	100 - 120°F
Cathode Current Density	175 ASF	30 – 600 ASF
Voltage		6 – 15 volts

***Note:** Adjust Sulfate concentration as needed to maintain required CrO₃:SO₄ Ratio.

****Note:** Catalyst level is recommended on an individual basis depending on plating conditions.

Conversion of an Existing Decorative Chrome Solution

Most decorative chrome conversions are a slide-in process. A sample should first be sent to **Martron Inc.** for analysis and conversion.

Operating Notes

Chromic Acid to Sulfate Ratio

For optimum results, maintain the chromic acid-to-sulfate ratio in the 180 – 300:1 range. A low chromic acid to sulfate ratio (high sulfate – low ratio) can result in decreased covering power and narrowing of the bright plating range. An addition of 0.02 oz/gal of barium carbonate will reduce the sulfate content by 0.01 oz/gal. Excessive drag-in of acid dips can result in high sulfate concentrations. The drag-in of chloride can act in conjunction with the sulfate resulting in decreased covering power and narrowing of the bright plating range.

A high chromic acid-to-sulfate ratio (low sulfate – high ratio) can result in low current density staining, staining around stop-off areas, as well as dull, white blotchy chromium deposits. Sensitivity to high current density burning is also increased.

Anode Current Density

The anode current density should be maintained high enough to form and keep a brownish color scale formation on the anodes. Anode hooks and anode bars should be cleaned periodically and checked for good

contact. Burning and/or miss-plates can result from excessive scaling of anodes. Anodes isolated from the plating circuit will tend to build excessive yellow scale.

Trivalent Chromium

High concentrations of trivalent chromium are formed when the anode area is smaller than the cathode area. Other causes of trivalent chromium are poor anode electrical contact, when the anodes are heavily scaled with yellow chromate, excessive reverse etching of the parts dissolving iron and/or copper into the plating solution, and when organic soils are introduced into the plating solution.

The ideal trivalent chromium concentration is 1% of the chromic acid concentration. Any concentration above 1% should be considered an impurity. Extreme levels fall into the 4 – 5% range. Each percent of trivalent chromium will complex the chromic acid by a factor of about 2.4 oz/gal. This in turn will reduce the chromic acid-to-sulfate ratio considerably. High concentrations of trivalent chromium can be up to six times the negative effect than that of iron.

The trivalent chromium can be reduced in the plating solution by dummyming. During the dummyming operation, use a large anode area and a small cathode area in order for the oxygen generated at the anode to oxidize the trivalent chromium back into chromic acid.

Chloride

Chloride contamination performs as an additional catalyst that will interfere with the chromic acid-to-sulfate ratio. A concentration of 100 ppm will act like an additional 0.01 oz/gal sulfate in the chrome plating solution. For optimum plating results, the chloride concentration should be kept below 20 ppm. In reality, the upper chloride limit should be kept below 50 ppm.

The most common source of chloride contamination is the drag-in of hydrochloric acid used to strip chrome deposits. Other sources of chlorides are drag-in of nickel solution, the water supply, decomposition of PVC tank liners and piping. Therefore, DI water should be considered for the water source.

As with trivalent chromium, chlorides can be removed via dummyming the plating solution. While the trivalent chromium is being converted back to chromic acid, the chlorides will be driven off as a gas at the anode. A more rapid method of removing chloride contamination is the use of silver compounds, but this method is usually cost prohibitive.

Function of Solution Components

Chromic Acid

Chromic acid supplies the source of the chromium ions in the plating solution. For most decorative chrome applications, the bath will perform satisfactory at chromic acid concentrations in the range of 28 to 32 oz/gal. Chromic acid concentrations in the mid or upper region of the recommended range will help to compensate for low voltage conditions caused by inadequate power source.

For optimum performance, the ideal chromic acid concentration and chromic acid-to-sulfate ratio should be determined for a specific application. Once determined, the concentration and ratio must be maintained within the specified range required by the operation. Daily analysis of the chromic acid solution may be performed using a hydrometer. However, periodically more accurate analytical methods should be used. When large additions of chromic acid are made, the sulfate present in the chromic acid should be considered. Sulfate analysis should be performed and the sulfate adjusted if necessary.

Sulfate

The sulfate ion acts a partial catalyst to the decorative chrome process. The source for the sulfate ion is reagent grade sulfuric acid. The sulfate concentration should be analyzed frequently and adjusted to maintain the optimum chromic acid-to-sulfate ratio determined for the application.

To raise the sulfate ion in the chrome plating bath, for each 0.01 oz/gal sulfate, add 0.0054 fl.oz./gal sulfuric acid 66 °Be'. High concentrations of sulfate ion can be reduced by adding barium carbonate to precipitate the sulfate ion as barium sulfate. For each 0.01 oz/gal sulfate to be reduced, add 0.02 oz/gal of barium carbonate. Note that this reaction is not instantaneous. For total reaction to take place, it requires approximately (4)

hours. It is best to add barium carbonate after plating, and let react overnight with light agitation.

Function of the Addition Agents

Martron HCR

The **Martron HCR** contains the second acid radical in the form of a fluoride complex used in a double catalyst process for decorative chrome plating. This mixed catalyst gives the advantages of improving cathode efficiency, covering power and ability to plate on bright nickel deposits when compared to the straight sulfate catalyst type.

To prepare and maintain the **Martron HCR** process, the user adds one gallon of **Martron HCR** for each 100 pounds of chromic acid used to prepare and maintain the solution. Sulfuric acid is added as required to adjust the chromic acid to sulfate ratio.

Process Control

Solution maintenance is a function of drag-out, contamination, current density, and varies by application. Daily visual inspection of the plated work is required to help maintain the plating solution. The chromic acid and sulfate need to be analyzed on a regular basis to maintain the quality of the chrome deposit.

Analytical Method

Determination of Hexavalent Chromium in Chromium Plating Solution

Equipment Required

- 2.0 ml pipet
- 10.0 ml pipet
- 100 ml volumetric flask
- 250 ml Erlenmeyer flask
- 25 ml graduated cylinder
- 50 ml buret with stand

Reagents Required

- Ammonium Bifluoride, Crystals
- Conc. Hydrochloric Acid, Reagent Grade
- 10% Potassium Iodide Solution
- 0.1 N Sodium Thiosulfate Solution
- Starch Indicator Solution

Procedure

- Pipet a 2.0 ml sample of the chromium solution into a 100 ml volumetric flask.
- Dilute to exactly 100 ml with deionized water and mix thoroughly.
- Pipet 10.0 ml of the diluted sample into a 250 ml Erlenmeyer flask.
- Add 100 ml of deionized water to the flask.
- Add 3 grs of Ammonium Bifluoride crystals and mix thoroughly.
- With a graduated cylinder, add 10 ml of Conc. Hydrochloric Acid.
- With a graduated cylinder, add 10 ml of 10% Potassium Iodide solution and mix.
- Titrate the brown solution to a straw color with 0.1 N Sodium Thiosulfate solution.
- Add 1 ml of Starch Indicator solution and continue titrating until the blue color disappears.
- Record ml of titrant used.
- Calculation:

$$(\text{oz/gal}) \text{ Chromic Acid} = \text{ml of } 0.1 \text{ N Na}_2\text{S}_2\text{O}_3 \times 2.22$$

Determination of Sulfate in Chromium Plating Solution

Equipment Required

- Centrifuge (manual or electric)

- Kocour Centrifuge Tubes – Graduated from 0.0 to 0.6 oz/gal Sulfate
- Stoppers for Centrifuge Tubes
- 10 ml Graduated Cylinder

Reagents Required

- 30% Barium Chloride Solution
- 5 N Hydrochloric Acid Solution

Procedure

- Allow Chrome Plating Sample to cool to room temperature.
- Place glass centrifuge tubes in aluminum shields.
- Using the 10 ml graduated cylinder, add 5 ml of 5 N Hydrochloric Acid solution to each tube.
- Pipet a 20.0 ml sample of Chrome Plating Solution into each tube.
- Stopper tubes, remove from shields and mix contents by shaking.
- Using the graduated cylinder, add 6 ml of deionized water to one of the centrifuge tubes.
- Using the graduated cylinder, add 5 ml of 30% Barium Chloride solution to the other centrifuge tube.
- Stopper tubes, remove from shields and shake vigorously for one minute.
- Replace tubes in shields and allow to stand for 5 minutes. (Time this.)
- Centrifuge the samples for 30 seconds.

Note: If a hand centrifuge is used, turn the handle at a rate of 60 rpm. Be careful to keep all parts of the body and clothing away from the revolving tubes.

If an electric centrifuge is used, set the rotation speed at 900 to 1200 rpm (usually #1 setting).

- Remove the tubes, tap the stems until precipitate has a flat surface, and note the level of the precipitate.
- Centrifuge for 15 seconds more, and again read the level of precipitate.
- If the level of precipitate has fallen, repeat the centrifuging until the precipitate maintains a constant level.
- Record the readings for each tube.
- Calculation:

If any residue was found in the tube of Step 6, subtract from tube in Step 7.
(oz/gal) Sulfate = Level of Precipitate in Step 14

Note: If the precipitate exceeds 0.6 oz/gal in the graduated centrifuge tube, repeat analysis using 10.0 ml sample of the Chromium Plating solution, and multiply the final results by 2.

Determination of Fluoride Catalyst in Chromium Plating Solution

Equipment Required

- Specific Ion Meter or pH Meter with expanded Milli-Volt Scale
- Fluoride Ion Activity Electrode
- Sleeve Type Calomel Reference Electrode
- 3 – 5.0 ml Pipets
- 3 – 100 ml Plastic Beakers
- 100 ml Graduated Cylinder

Reagents Required

- 0.1200 M Sodium Fluoride Standard Solution
- 30 oz/gal Chromic Acid Solution
- 304 ppm Fluoride Standard - Pipet 80.0 ml of 0.1200 M Sodium Fluoride Standard Solution into a 500 ml volumetric flask. Dilute to mark with 30 oz/gal Chromic Acid solution.
- 608 ppm Fluoride Standard - Pipet 160.0 ml of 0.1200M Sodium Fluoride Standard into a 500 ml volumetric flask. Dilute to mark with 30 oz/gal Chromic Acid solution.
- TISAB II

Procedure

- Prepare the working Standards by pipetting 5.0 ml of the 304 and 608 ppm Fluoride Standards into two plastic 100

ml beakers.

- With a graduated cylinder, add 50 ml of TISAB II to each beaker.
- Calibrate instrument according to instruction manual.
- Stir Standards and Sample for one to two minutes before taking the readings.
- When using an expanded scale pH meter, prepare a calibration curve using semi-logarithmic graph paper. Use the linear axis for milli-volt readings and logarithmic axis for Fluoride concentrations.

Note: If standard graph paper is used, milli-volts should be plotted versus the logarithm of the fluoride concentration. In either case, a nearly straight line should be obtained through the points.

- Pipet a 5.0 ml sample of the chromium solution to be tested into a plastic 100 ml beaker.
- With a graduate cylinder, add 50 ml of TISAB II to the beaker.
- Stir for one to two minutes and determine reading.
- Calculation:
Compare meter reading with calibration curve or read direct from specific ion meter

Note: To raise the fluoride catalyst 100 ppm, add 0.143% by volume **Martron HCR**

Section 4: Waste Treatment

Consult appropriate Federal, State, and local regulatory agencies to ascertain proper disposal procedures. Do not discharge into waterways or sewer systems. Disposal will depend on the nature of waste material.

Section 5: Storage

Avoid freezing of **Martron HCR**. Store **Martron HCR** component in an appropriate area with compatible materials. All chemicals should be stored in compliance with all applicable federal, state or local requirements.

Section 6: Non-Warranty and Disclaimer

The data contained in this bulletin is believed by **Martron Inc.** to be true, accurate and complete. Since the final methods of use of this product are in the hands of the customer, and beyond **Martron Inc.'s** control, **Martron Inc.** cannot guarantee that the customer will obtain any specific result. Accordingly, **Martron Inc.** does not assume any responsibility for the use of this product by the customer, the results obtained, nor the infringement of any patents of third parties.

Section 7: Order Information

For ordering information, Technical Service Issues or for other customer assistance, please contact **Martron Inc.** at 704-289-1934.