Hex - A - Gone is a decorative trivalent chromium electroplating system which produces a finish comparable in color to a hexavalent chromium deposit. Hex - A - Gone offers exceptional throwing power, ease of operation, and good tolerance to metallic impurities. Trivalent chromium plating solutions offer reduced waste treatment costs and less health and environmental concerns than hexavalent chromium solutions.

- Exceptional throwing power
- Environmentally friendly
- Higher bath efficiency reduces utility requirements
- Operates at low current densities
- Cheaper to operate than hexavalent chromium solutions
## Operating Parameters

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Optimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Chromium:</td>
<td>5 - 10 g/l</td>
<td>7 g/l</td>
</tr>
<tr>
<td>Hex - A - Gone Salts:</td>
<td>31 - 38 oz/gal</td>
<td>35 oz/gal</td>
</tr>
<tr>
<td></td>
<td>235 - 285 g/l</td>
<td>260 g/l</td>
</tr>
<tr>
<td>Hex-A-Gone Cr Maintenance:</td>
<td>6.3 - 11.4%</td>
<td>9%</td>
</tr>
<tr>
<td>Surface Tension:</td>
<td>&lt; 40 dynes/cm²</td>
<td></td>
</tr>
<tr>
<td>Current Density:</td>
<td>40 - 100 A/ft² (4 - 10 A/dm²)</td>
<td>70A/ft² (7 A/Dm²)</td>
</tr>
<tr>
<td>pH:</td>
<td>3.3 - 3.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Temperature:</td>
<td>110° - 130°F (43° - 54°C)</td>
<td>123°F (50°C)</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.18 - 1.22</td>
<td>1.20</td>
</tr>
</tbody>
</table>

## Equipment

**Tank:** A polypropylene, polypropylene, PVC, or Koroseal lined tank

**Anodes:** Inert anodes with special catalytic coatings are used for direct contact with plating solution. Pavco recommends a plastic mesh be put over the anodes to prevent scratching or mechanically damaging the catalytic coating. Contact Pavco technical department for availability of these anodes.

**Anode Bars:** Use copper anode bars, preferably shielded with plastic.

**pH meter:** Careful control of pH is critical to the successful operation of Hex-A-Gone. A good pH probe and frequent standardization of the meter are necessary.

**Filtration:** Use 5 - 15 micron polypropylene filters and activated carbon. Filtration speed should be at least 1 tank turnover per hour.

**Rectifier:** Up to 12 volts, less than 5% ripple

**Temperature Control:** A titanium heat exchanger is recommended.

**Ventilation:** Required, check local regulations

**Agitation:** Air agitation is required for dissolution of salt additions. Air agitation is not recommend when electroplating.

**Metallic Removal:** Electrowinning cell or Ion Exchange resin can be used.
**Bath Maintenance**

**Hex-A-Gone Cr Maintenance:** 1 gal/7,500 amp - hrs. (1 L / 1900 amp - hrs.)

**Hex-A-Gone BC Maintenance:** 1 gal/10,000 amp - hrs. (1 L / 2600 amp - hrs.)

**Hex-A-Gone Wetter:** 1 gal/25,000 amp - hrs. (1 L / 6300 amp - hrs.)

**Hex-A-Gone Salts:** Based on specific gravity (see chart)

**CAUTION:** Careful control of pH is required for successful operation of Hex-A-Gone. **DO NOT ALLOW THE pH TO EXCEED 3.8.**

### Addition of Hex-A-Gone Salts Required

<table>
<thead>
<tr>
<th>Specific Gravity</th>
<th>oz/gal</th>
<th>g/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.200</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1.190</td>
<td>1.7</td>
<td>13</td>
</tr>
<tr>
<td>1.180</td>
<td>3.5</td>
<td>26</td>
</tr>
<tr>
<td>1.170</td>
<td>6.9</td>
<td>52</td>
</tr>
<tr>
<td>1.160</td>
<td>13.9</td>
<td>104</td>
</tr>
</tbody>
</table>

**Bath Makeup per 1000 gallons - 3785 liters**

1. Add 800 gallons (3000 liters) of de-ionized water to a clean tank.
2. Heat the water to 110°F (50°C)
4. Add 100 gallons (380 l) of Hex-A-Gone Cr Make up.
5. After the salts and make-up are thoroughly dissolved and mixed raise the solution level to the proper operating volume with de-ionized water. Then lower the pH of the solution to 1.8 with 50% sulfuric acid. Agitate the bath for 12 hours minimum to establish the proper chromium complex. After the 12 hour period, raise the pH over a two hour period to operating range with 45% potassium hydroxide.
7. Add D.I. water to the final volume.
8. Electrolyze the bath for a total of 10 amp-hours/gallon (2.5 amp-hours/liter) before use.
Operating Tips

• Use routine additions of HAG BC Maintenance to maintain good coverage, color, and thickness of the chromium deposit
• Use routine additions of HAG CR Maintenance to maintain chromium levels. HAG CR Make-up is only used for a new bath make-up or when significant solution loss occurs
• Higher chromium levels will improve the high current density but will cut the coverage in the low current density
• Nickel in excess of 150 ppm or zinc in excess of 10 ppm can reduce the bath efficiency (slow down the rate of deposition) as well as darken the deposit. Electrolyze the solution at 10 amps/ft² (1 amp/dm²) to remove zinc, 15 amps/ft² (1.5 amps/dm²) to remove nickel
• Iron in excess of 50 ppm can darken the deposit. Electrolyze the solution at 15 amps/ft² (1.5 amps/dm²) to remove iron
• Use of waste treatment grade caustic is not recommended. Use caustic with a specification of less than 50 ppm chloride (<0.005%) to avoid chloride contamination issues
• When the rate of metallic contamination is high, Pavco recommends ion exchange or an electrowinning cell for continuous electrolyzing
• Carbon filtration is recommended to maintain good color and efficiency. Use 2 - 4 pounds of granular activated carbon (1 - 1.5 kg) per 1000 gallons (4000 liters) of solution. Replace the carbon every two weeks
• Inspect the anode coating every three months. The anodes will require periodic recoating. Thin anode coating will result in poor chromium coverage
• Routinely check for hex chrome to confirm proper anode coating and addition rates. Hexavalent chrome formation can be due to poor anode coating, Low BC Maintenance, or bath contaminants
• Keep the specific gravity below 1.25 for optimal high current density performance

Contaminant Limits

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Upper limits</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>&lt;10 ppm</td>
<td>Poor color, poor efficiency</td>
</tr>
<tr>
<td>Nickel</td>
<td>&lt;150 ppm</td>
<td>Poor color, poor efficiency, streaks</td>
</tr>
<tr>
<td>Zinc</td>
<td>&lt;10 ppm</td>
<td>Poor efficiency, haze in deposit</td>
</tr>
<tr>
<td>Iron</td>
<td>&lt;50 ppm</td>
<td>Darkens deposit</td>
</tr>
<tr>
<td>Chloride</td>
<td>&lt;200 ppm</td>
<td>Degrades anode coating</td>
</tr>
<tr>
<td>Fluoride</td>
<td>&lt;50 ppm</td>
<td>Degrades anodes</td>
</tr>
</tbody>
</table>
Hex-A-Gone Components

Function of Additives

**Hex-A-Gone Cr Make-up (HG 106) (used only in makeup)**
Provides the chromium salts necessary for a solution make-up.

**Hex-A-Gone BC Make-up (HG 108) (used only in makeup)**
Provides the grain refiners and brighteners necessary for a solution makeup.

**Hex-A-Gone Salts (HG 116)**
Provides the salts required to operate the system. HAG salts are depleted when operating the bath. Regular analysis and additions of this product are required. Do not add salts if the specific gravity exceeds 1.22 g/l

**Hex-A-Gone Cr Maintenance (HG 100)**
Provides the correct balance of chromium metal and complexors to maintain the bath. HAG Cr Maintenance must be added on an amp-hour basis.

**Hex-A-Gone BC Maintenance (HG 102)**
Provides the correct balance of grain refiners and brighteners to maintain the bath. HAG BC Maintenance must be added on an amp-hour basis.

**Hex-A-Gone Wetter (HG 104)**
Reduces surface tension and prevents gas streaks. HAG Wetter must be added on an amp-hour basis.

**Hex-A-Gone Brightener (HG 112)**
HAG Brightener is contained in BC Maintenance. HAG Brightener should only be added at the direction of Pavco technical personnel.

**Hex-A-Gone Whitener (HG 110)**
HAG Whitener is contained in BC Maintenance. It helps to maintain the characteristic color of the deposit. HAG Whitener should only be added at the direction of Pavco technical personnel.

**Hex-A-Gone Catalyst (HG 114)**
HAG Catalyst is contained in BC Maintenance. HAG Catalyst should only be added at the direction of Pavco technical personnel. Typical addition is 0.1-0.2%.

**Hex-A-Gone Extender (HG 101)**
HAG Extender should only be added at the direction of Pavco technical personnel. This additive will improve LCD coverage of the chrome. It will tend to darken the deposit, so use minimally in 0.1% increments.

**Hex-A-Gone Complexor (HG 115)**
HAG Complexor should only be added at the direction of Pavco technical personnel. Low Complexor can lead to poor throwing power. High complexor will cause reduced efficiency.
Analytical Procedures

Hex-A-Gone Salts

Reagents
1. Mannitol
2. 1N sodium hydroxide

Procedure
1. Pipette a 5 ml bath sample into a 150 ml beaker
2. Add 20 mls de-ionized water.
3. Add a Teflon-coated magnetic stir bar & mix solution on stir plate throughout the analysis.
4. Using a pH meter, adjust pH solution to 6.0-6.5 using either 1 N sodium hydroxide or 1 N sulfuric acid. Record final pH.
5. Add 2 g Mannitol (Excess Mannitol is necessary at all times)
6. Slowly titrate the solution with 1N sodium hydroxide until the recorded pH is reached

Calculation:

\[
\frac{\text{[ } \text{ml (NaOH)} \times \text{[ } \text{N (NaOH)} \times 245]}{\text{[ } \text{ml sample x 7.5 (g/l)/(oz/gal)]}} = \text{oz/gal Hex-A-Gone Salts}
\]

CAUTION: DO NOT ADD SALTS IF THE SPECIFIC GRAVITY EXCEEDS 1.22 g/l. IF THE SALT ANALYSIS IS LOW AND THE SPECIFIC GRAVITY IS HIGH, ADD BORIC ACID IN 1 oz/gal (7.5 g/l) increments
Analytical Procedures

Chrome Metal

Reagents
1. Sodium hydroxide
2. 30% hydrogen peroxide
3. 1:1 sulfuric acid
4. 10% potassium iodide
5. Starch solution
6. 0.1N sodium thiosulfate

Procedure
1. Pipette a 5 ml bath sample into a 250 ml Erlenmeyer flask
2. Add 100 mls de-ionized water.
3. Add 2 grams of sodium hydroxide to the flask and swirl to dissolve
4. Add 2 mls of 30% hydrogen peroxide.
5. Boil the solution until all the peroxide is gone, at least 15 minutes.
6. Cool the solution to room temperature.
7. Add 10 mls of 1:1 sulfuric acid
8. Add 5 mls of 10% potassium iodide.
9. Titrate with 0.1 N thiosulfate to a straw color.
10. Add 2 mls of starch indicator.
11. Continue the titration to the absence of a blue color which persists for 30 seconds.

Calculation:

\[
g/l \text{ Total Cr} = \frac{\text{ml. of Na}_2\text{S}_2\text{O}_3 \times \text{N of Na}_2\text{S}_2\text{O}_3 (17.3)}}{\text{mls of sample}}
\]

% Cr Maintenance = g/l total Cr x 1.25
**Analytical Procedures**

**Hexavalent Chrome Test for Hex-A-Gone**

**Trivalent Chrome Solution (Qualitative)**

**Equipment required**
- 250 ml Erlenmeyer flask
- 1 ml pipette
- 50 ml graduated cylinder

**Reagents**
- Diphenylcarbazide, 0.5% in acetone
- Sulfuric acid, 50%
- Distilled or Deionized water (DI)

**Procedure**

1. Add 90 mls DI water to a 250 ml Erlenmeyer flask.
2. Add 10 mls Sulfuric acid, 50%, with a graduated cylinder.
3. Add 1 ml diphenyl carbazide indicator solution. Observe for pink color. If solution is pink, discard and wash all glassware before returning to step 1.
4. If solution is not pink after Step 3, pipette 1 ml of trivalent chrome solution into the flask.
5. Observe for the development of a pink color. Pink indicates presence of hexavalent chrome.

A barely distinguishable pink color indicates 20-50 ppm hexavalent chrome
Opaque pink/red indicates in excess of 500 ppm hexavalent chrome

**Notes:**

- Take care not to contaminate diphenylcarbazide indicator solution with chromium solution. Discard the indicator if contaminated. A colorless solution after step 3 demonstrates clean indicator, glassware and reagents.

- Test the trivalent chrome plating bath immediately after sampling the bath. Any hexavalent chrome generated at the anodes will rapidly react with bath additives and give false negative results if sample is allowed to sit idle.

- Check the bath after 1, 4, and 8 hrs of production. Positive hex chrome tests can indicate a defective anode coating. Consult your Pavco representative.
## Troubleshooting Chart

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>White to gray haze or streaks</td>
<td>Low wetting agent</td>
<td>Add up to 0.3% Hex-A-Gone Wetter</td>
</tr>
<tr>
<td></td>
<td>Organic contamination</td>
<td>Filter continuously through activated carbon</td>
</tr>
<tr>
<td>Thin white bands or darkened deposits</td>
<td>Excess Hex-A-Gone BC Maintenance</td>
<td>Withhold adds of Hex-A-Gone BC Maintenance</td>
</tr>
<tr>
<td></td>
<td>pH not in range</td>
<td>Adjust pH with potassium hydroxide or sulfuric acid</td>
</tr>
<tr>
<td>Poor coverage or brown, colored streaked deposits</td>
<td>Temperature out of range</td>
<td>Adjust temperature to 110° - 130 °F (43° - 54°C)</td>
</tr>
<tr>
<td></td>
<td>Low chrome Metal</td>
<td>Add 0.5 - 2.0% Hex-A-Gone Cr Maintenance</td>
</tr>
<tr>
<td></td>
<td>Low Hex-A-Gone Salts</td>
<td>Analyze and adjust the Hex-A-Gone Salts concentration</td>
</tr>
<tr>
<td></td>
<td>Low Hexagon Complexor</td>
<td>Send sample to Pavco Laboratory for analysis. Add 2 g/l increments at pH 2</td>
</tr>
<tr>
<td>Dark LCD or overall streaky or dark deposit</td>
<td>Metallic contamination</td>
<td>Electrolyze the bath at 5 - 10 ASF to remove copper or nickel</td>
</tr>
<tr>
<td>White haze in LCD (strips in 10% sulfuric)</td>
<td>Zinc contamination</td>
<td>Check for dropped parts, electrolyze at 5-10 ASF or regenerate IX resin</td>
</tr>
<tr>
<td>Thin or no chromium deposit</td>
<td>Poor bath efficiency</td>
<td>Heat bath to 120°F (49°C ). Lower the pH to 2 with sulfuric acid and maintain for 12 hours. Slowly raise the pH to 3.3 - 3.8 with liquid KOH. Electrolyze for 2 amp hours/gal</td>
</tr>
<tr>
<td></td>
<td>Metallic contamination</td>
<td>Check for metals and treat per above</td>
</tr>
<tr>
<td></td>
<td>Hexavalent chrome</td>
<td>Run hex chrome test. Check anode coatings. Treat with hydrogen peroxide or sodium metabisulfite. Consult your Pavco representative for details.</td>
</tr>
<tr>
<td></td>
<td>contamination</td>
<td></td>
</tr>
<tr>
<td>Lightened deposit color</td>
<td>Low Hex-A-Gone BC</td>
<td>Add 3 - 6 fl oz./100 gal Hex-A-Gone BC Maintenance</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td></td>
</tr>
</tbody>
</table>

---

**Plating Systems**

**Hex-A-Gone**

---

**Pavco Hex-A-Gone**

Page 9
**Warranty and Disclaimer**

Technical information and recommendations contained herein are believed to be reliable, however, the accuracy or completeness thereof is not guaranteed. No statement or recommendation shall constitute a representation unless set forth in an agreement in writing by the seller and manufacturer. NO WARRANTY OR MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS MADE.

The following warranty is made in lieu of any other warranties, express, implied, or statutory. Products are warranted to be free from defects in material and workmanship at the time sold. The sole obligation of the seller and manufacturer under this warranty shall be to replace any product defective at the time sold. Under no circumstances shall the manufacturer or seller be liable for any loss, damage, expense, direct or consequential, arising out of the use of or inability to use the product. Materials shall not be returned to the seller or manufacturer without express written permission. No information or suggestions given by us shall be deemed to be a recommendation to use any product in conflict with any existing patent rights.

---

**Waste Treatment**

Dispose of the concentrates or solutions thereof according to local waste treatment regulations. Recommended treatment procedures are available from your Pavco representative.

**Safety**

Handling – Pavco mandates that the following safety equipment be used when handling chemicals in an electroplating environment: safety glasses, face shield, plastic or rubber apron, rubber gloves and safety shoes. Chemicals should only be handled by trained and experienced personnel.

Storage – Store Pavco products in a clean, well ventilated room which temperature remains above 45°F (7°C). Pavco products should remain in their original container with the lid or cap tightened. Drum pumps or pails must be clean prior to dispensing Pavco products to prevent contamination. If any Hex-A-Gone product freezes during shipment or storage, warm the product and mix it well before use.

Emergency Procedures – Refer to the MSDS for detailed emergency procedures

Eye Contact – Seek immediate medical attention. Flush the eyes with water for 15 minutes.

Skin Contact – Remove all contaminated clothing. Wash the skin with soap and water. Seek medical attention

Inhalation – Remove the person to an area with fresh air. Seek medical attention if necessary

Ingestion – Seek immediate medical attention

Spill – Dike the area to contain the spill. Refer to the MSDS for clean-up. Notify the proper authorities if required.

*Note: Refer to the MSDS for detailed emergency procedures

---

**Product Description & Shipping**

Hex-A-Gone Salts (HG 116) is a white powder

Hex-A-Gone BC Make-up (HG 108) is a pale yellow liquid with a specific gravity between 1.0 and 1.3 with a pH greater than 12

Hex-A-Gone CR Make-up (HG 106) is a dark blue green liquid with a specific gravity between 1.1 and 1.3 with a pH less than 3

Hex-A-Gone BC Maintenance (HG 102) is a pale yellow liquid with a specific gravity between 1.0 and 1.3 with a pH greater than 12

Hex-A-Gone CR Maintenance (HG 100) is a dark blue green liquid with a specific gravity between 1.2 and 1.3 with a pH less than 3

All products are available in in 5 gallon containers and 55 gallon drums.

Revision Date: 4/19/10    Revision Number: 11