

# SurTec® 877

## Etch Free Hard Chromium Process - PFOS free

### Properties

- high current efficiency, high deposition rate
- etch free process, due to the fluoride-free catalyst (brass is not attacked)
- deposits bright, hard and micro-cracked chromium layers (400-500 cracks/cm)
- the layer hardness will be about 1000 HV
- very active electrolyte with good metal distribution and high burning level
- works within wide concentration ranges
- easy to dose, easy to control liquid all-in-one product
- SurTec 877 V, the additive to maintain the bath, contains chromic acid, catalyst and anode protector in the correct ratio
- no need for pole changing during warming up the parts in the bath, they just can be left inside under protecting current (-> less metal contamination in the bath)
- bath system can be used with the PFOS-free fume suppressant SurTec 870 S K 4

### Application

SurTec 877 is suited for every hard chromium process. The following typical conditions might be modified according to specific requirements.

bath parameters:

chromic acid	250 g/l	(120-300 g/l)
chromium(III)	3 g/l	( 0.5 - 7.5 g/l)
sulfate	2.5 g/l	(approx. 1 % of the CrO <sub>3</sub> amount)
metal impurities (Fe, Cu, Ni)	< 10 g/l	

make-up: The new bath make-up is done by a SurTec assistant. He also will find out the optimum bath parameters for the specific plating line.

temperature: 60 °C (50-70 °C)

current density: 60 A/dm<sup>2</sup> (35-80 A/dm<sup>2</sup>)  
for higher current densities we recommend also higher values of chromic acid

current efficiency: 20 % (18-22 %)

deposition rate: 1.0-1.2 μm/min at 60 A/dm<sup>2</sup>

anodes: lead anodes (Pb/Sn 93/7) at chromic acid contents > 220 g/l;  
platinised titanium anodes are suitable for chromic acid contents < 220 g/l

tank material: steel with chromic acid resistant coating

heating: necessary; of acid resistant material

cooling: sometimes necessary; of acid resistant material

exhaust: required for worker's protection

## Maintenance and Analysis

Keep the bath parameters constant by adding SurTec 877 V Maintenance Concentrate, which contains all components in the correct ratio (chromic acid, catalyst and anode protector). Replenish evaporation losses with deionised water.

Measure the electrolyte density of the desired working concentration and correct with SurTec 877 V: increase of 10 g/l  $\text{CrO}_3$  = addition of 20 ml/l (26.7 g/l) SurTec 877 V Maintenance Concentrate.

The chromic acid concentration can also be analysed by titration.

Analyse and adjust the sulfate content regularly, trivalent chromium and metal impurities from time to time. If necessary, the catalyst component SurTec 877 can be analysed by Ion Chromatography.

To prevent the formation of chromic acid fume near the plating tank, the addition of SurTec 870 S K 4 Fume Suppressant is recommended, which forms a low foam layer on the electrolyte surface. Before adding SurTec 870 S K 4 for the first time to the bath, the plating tank, the anodes and the equipment have to be cleaned thoroughly. If not, the Fume Suppressant (a tenside) will do the cleaning step and the smut will float on top of the bath which may lead to plating faults.

### Sample Preparation

Take a sample at a homogeneously mixed position. Let it cool down to room temperature. If the sample is turbid, let the turbidity settle down and decant the solution.

### Sulfate ( $\text{SO}_4^{2-}$ ) – Analysis by Titration

reagents:                hydrochloric acid (conc.)  
                              ethanol  
                              barium chloride solution (3 %)  
                              ammonia (conc.)  
                              0.1 N EDTA  
                              indicator: Eriochrom Black T (1 % blend with NaCl)  
                              0.1 N zinc chloride solution

procedure:                1. Pipette 20 ml bath sample into a 250 ml beaker.  
                              2. Dilute with 150 ml deionised water.  
                              3. Acidify with 20 ml hydrochloric acid.  
                              4. Add 30 ml ethanol.  
                              5. Boil the solution for reduction of the chromic acid for 10 min.  
                              6. Add 10 ml barium chloride solution to the boiling solution.  
                              7. Allow the precipitate to settle (30 min) and filtrate with a very fine grained analytical filter (blue ribbon). Wash it chromium free and barium free with hot diluted hydrochloric acid.  
                              8. Prepare 200 ml solution of **exactly** 20 ml 0.1 N EDTA and 20 ml conc. ammonia in deionised water.  
                              9. Put the filter paper with the precipitation into this solution and boil it for 30 min.  
                              10. Let it cool down to room temperature.  
                              11. Add 20 ml conc. ammonia.  
                              12. Add a spatula tip indicator.  
                              13. Titrate back excessive EDTA with 0.1 N zinc chloride solution from blue to red.

calculation:                 $(20 - \text{consumption in ml}) \cdot 0.4805 = \text{g/l SO}_4^{2-}$

correction:                precipitation of 0.1 g/l  $\text{SO}_4^{2-}$  = addition of 0.205 g/l  $\text{BaCO}_3$

### Chromic Acid – Analysis by Bath Density

(all values at 25 °C)

bath density in g/ml	chromic acid in g/l	bath density in g/ml	chromic acid in g/l
1.0709	100	1.1778	255
1.0745	105	1.1812	260
1.0780	110	1.1846	265
1.0815	115	1.1880	270
1.0850	120	1.1914	275
1.0885	125	1.1947	280
1.0919	130	1.1981	285
1.0954	135	1.2015	290
1.0989	140	1.2048	295
1.1024	145	1.2082	300
1.1059	150	1.2116	305
1.1093	155	1.2149	310
1.1128	160	1.2183	315
1.1162	165	1.2216	320
1.1197	170	1.2250	325
1.1231	175	1.2283	330
1.1266	180	1.2316	335
1.1300	185	1.2350	340
1.1335	190	1.2383	345
1.1369	195	1.2416	350
1.1403	200	1.2450	355
1.1438	205	1.2483	360
1.1472	210	1.2516	365
1.1506	215	1.2549	370
1.1540	220	1.2583	375
1.1574	225	1.2616	380
1.1608	230	1.2649	385
1.1642	235	1.2682	390
1.1677	240	1.2715	395
1.1710	245	1.2748	400
1.1744	250		

### Chromic Acid (CrO<sub>3</sub>) – Analysis by Titration

reagents:	hydrochloric acid (conc.) potassium iodide 0.1 N sodium thiosulfate solution starch solution (1 %)
procedure:	<ol style="list-style-type: none"><li>1. Pipette 10 ml bath sample into a 500 ml volumetric flask.</li><li>2. Fill up with deionised water.</li><li>3. Pipette 10 ml of this dilution into a 250 ml Erlenmeyer flask.</li><li>4. Dilute with 100 ml deionised water.</li><li>5. Add 10 ml conc. hydrochloric acid.</li><li>6. Add 2 g potassium iodide.</li><li>7. Titrate with 0.1 N sodium thiosulfate solution until the solution becomes yellow.</li><li>8. Add 3 drops of starch solution (solution becomes blue).</li><li>9. Continue titrating until discolouring of the solution.</li></ol>
calculation:	consumption in ml · 16.67 = g/l CrO <sub>3</sub>
correction:	rise of 10 g/l CrO <sub>3</sub> = addition of 20 ml/l SurTec 877 V (= 26.7 g/l SurTec 877 V Maintenance Concentrate)

### Metal Impurities (Iron, Copper, Nickel, Zinc)

Take the bath sample and prepare a dilution of 1:1000.  
Therefore, pipette 10 ml bath solution into a 100 ml volumetric flask. Fill up with deionised water and mix well. From this solution, pipette 1 ml into a 100 ml volumetric flask. Add 20 ml HCl (1:1) p.a. Fill up with deionised water and mix well. Measure this solution with the atomic absorption spectrometer (AAS) at the corresponding wave length against adequate laboratory standards.

### Technical Specification

(at 20 °C)	Appearance	Density (g/ml)	pH-value (conc.)
SurTec 877 V	liquid, orange-brown, clear	1.334 (1.28-1.38)	< 1

### Ingredients

- chromic acid
- fluoride-free catalysts
- anode protector

### Consumption and Stock Keeping

The consumption depends heavily on the drag-out. To determine the exact amounts of drag-out, see [SurTec Technical Letter 11](#).

In order to prevent delays in the production process, per 1,000 l bath, the following amount should be kept in stock:

SurTec 877 V Maintenance Concentrate	500-1000 kg
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## Product Safety and Ecology

The safety instructions and the instructions for environmental protection have to be followed in order to avoid hazards for people and environment. The Material Safety Data Sheets (according to European legislation) contain explicit details for this.

The following hazard designations and classifications into water hazard classes (WHC) have to be taken into account:

<u>product</u>	<u>hazard designation</u>	<u>water hazard class</u>
SurTec 877 V	T - Toxic	WHC 3
(contains chromic acid)	N - Dangerous for the environment	

## Warranty

We are responsible for our products in the context of the valid legal regulations. The warranty exclusively accesses for the delivered state of a product. Warranties and claims for damages after the subsequent treatment of our products do not exist. For details please consider our [general terms and conditions](#).

## Further Information and Contact

In our forum, you can discuss topics of the surface technology:

<http://forum.SurTec.com/>

If you have any questions concerning the process, please contact your local technical department: <http://SurTec.com/International.html>

24 August 2009/DK, SV