

# SurTec® 716 SB

## Alkaline Zinc/Nickel Electroplating Process

### “Super Bendable”

#### Properties

- alkaline zinc/nickel process of the third generation with superior throwing power
- produces Zn/Ni alloy deposits containing 12-14 % nickel
- produces alloy layers with a very uniform composition in the current density range from 0.4 to 3 A/dm<sup>2</sup>
- produces a fine-grained, semi-bright and homogenous surface appearance
- the layers are very ductile and easy bendable, with no flake off from the layer up to max. 10 µm, after plating
- cyanide-free, alkaline process with high current efficiency (approx. 50 %)
- IMDS-number: 736126

#### Application

SurTec 716 is applied in rack process and includes the following products:

- SurTec 716 I Carrier controls the metal distribution and the alloy composition
- SurTec 700 L LCD Booster is used as a secondary brightener and works at low current density
- SurTec 716 Ni Nickel Solution contains 100 g/l nickel as well as complexing agent and is necessary to keep the nickel concentration constant
- SurTec 716 C Complexing Agent contains the complexing agent to produce the right composition of the alloy layer
- SurTec 716 CA Corrective Additive (see “trouble shooting” list)
- SurTec 716 CB Corrective Additive B (see “trouble shooting” list)
- SurTec 700 EN Sodium Zincate Electrolyte, 3x Concentrate is an electrolyte concentrate (containing 30 g/l Zn) for the initial bath make-up

make-up values:

SurTec 700 EN Sodium Zincate Concentrate	265 ml/l
SurTec 716 I Carrier	2-4 ml/l
SurTec 700 L LCD Booster	0.5-1 ml/l
SurTec 716 Ni Nickel Solution	20-35 ml/l
SurTec 716 C Complexing Agent	70 ml/l

analytical values:	zinc	8 g/l	(7-9 g/l)
	nickel	2-3.5 g/l	(2.0-3.5 g/l)
	sodium hydroxide (NaOH)	145 g/l	(140-160 g/l)
	sodium carbonate (Na <sub>2</sub> CO <sub>3</sub> )	max. 70 g/l	

make-up:

Steps for make-up:

1. Fill the calculated amount of SurTec 700 EN Sodium Zincate Electrolyte, 3x Concentrate into the clean plating tank.
2. Add additionally approx. 20 g/l sodium hydroxide.
3. Dilute with deionised water to approx. 80 % of the final volume, stir and mix very well. Before adding the additives, make sure that the temperature of the electrolyte is not higher than 30°C.
4. Slowly add the calculated amount of SurTec 716 C Complexing Agent at a well-mixed position. Because of the high viscosity of the additive, rinse the SurTec 716 C container thoroughly with deionised water for complete cleanout.
5. Mix the bath for at least 30 minutes (e.g. with filter pumps).
6. Slowly add approx. 20 ml/l SurTec 716 Ni Nickel Solution at a well-mixed position.
7. Mix and filter the bath for min. 6 hours with filter pumps.
8. Dummy plate at low current density:  
min. 1 Ah per litre electrolyte volume at 0.2 A/dm<sup>2</sup>.

example: 12,000 litre electrolyte volume  
20 m<sup>2</sup> = 2000 dm<sup>2</sup> cathode area  
1 Ah/l · 12000 l = 12000 Ah  
2000 dm<sup>2</sup> · 0.2 A/dm<sup>2</sup> = 400 A  
12000 Ah / 400 A = 30 h plating time

9. Add 4 ml/l SurTec 716 I Carrier and adjust by Hull cell to 11.4-12 % Ni content in the layer, by adding SurTec 716 Ni in steps of 2-5 ml/l.
10. Fill up to the final volume with deionised water.

temperature: 24°C (22-27°C)  
current density: 1.5 A/dm<sup>2</sup> (1.0-3.0 A/dm<sup>2</sup>)  
current efficiency: 45-55 %  
plating speed: 0.2 µm/min at 2.0 A/dm<sup>2</sup>  
anodes: pure nickel anodes  
agitation: rack movement with 1.5-4 m/min; optionally the rack movement can be additionally supported by flooding with venturi nozzles  
tank material: polypropylene or steel with PP, PVC or rubber coating  
filtration: continuously: 2-3 times the total bath volume per hour;  
pore size: 10-50 µm  
heating/ cooling: necessary: out of Teflon or stainless steel  
exhaust: required for worker's protection  
hints: Metal impurities can be removed by dummy plating at low current densities (0.1-0.2 A/dm<sup>2</sup>).  
Remove copper parts which have fallen into the bath immediately.

recommended process sequence (for steel parts):

1. hot degreasing with SurTec 190 + SurTec 091
2. hydrochloric acid pickling with SurTec 424
3. anodic electrolytical cleaning with SurTec 190
4. neutralisation with SurTec 481
5. **Zn/Ni Electrolyte SurTec 716 SB**
6. activation in hydrochloric acid at pH 1.5-2.0
7. Chromiting SurTec 680
8. hot air drying

Between each step, there has to be rinsed. The rinsing methods have to be adapted to the plating line.

## Technical Specification

(at 20°C)	Appearance	Density (g/ml)	pH-value (conc.)
SurTec 716 I	liquid, colourless	1.018 (1.00-1.04)	ca. 10.5
SurTec 700 L	liquid, yellowish	1.052 (1.01-1.09)	13.4 (12-14)
SurTec 716 Ni	liquid, purple	1.263 (1.24-1.29)	9.0 (8-11)
SurTec 716 C	liquid, colourless	1.036 (1.00-1.08)	ca. 11.5
SurTec 716 CA	liquid, colourless to yellowish	1.001 (0.95-1.05)	> 13
SurTec 716 CB	liquid, colourless to yellowish	1.031 (1.01-1.05)	12.5 (10.5-14.5)
SurTec 700 EN	liquid, colourless	1.332 (1.31-1.35)	ca. 13

## Maintenance and Analysis

Analyse and adjust the content of zinc, nickel and potassium hydroxide regularly. Daily control analyses are recommended, in order to prevent large variations of the metal composition in the bath. Analyse the content of potassium carbonate from time to time. Additives can be dosed according to Ampere-hours.

Adjust the nickel concentration in the bath by addition of SurTec 716 Ni Nickel Solution. A dosage of 10 ml SurTec 716 Ni represents 1 g nickel. SurTec 716 Ni is dosed according to nickel analysis (per AAS or titration).

The zinc concentration can be adjusted and maintained by an external zinc generator.

## Sample Preparation

Take a sample at a homogeneously mixed position. If the sample is turbid, let the turbidity settle down and decant or filter the solution.

### Zinc – Analysis per AAS

equipment:	atomic absorption spectrometer (AAS): wave length 213.9 nm slit: 0.7 nm
reagents:	hydrochloric acid (1:1) p. a. zinc standard solutions: 1-5 ppm
procedure:	Prepare a 1:5000 dilution: <ol style="list-style-type: none"><li>1. Pipette 10 ml bath sample into a 100 ml volumetric flask.</li><li>2. Fill up with deionised water and mix well.</li><li>3. Pipette 1 ml from this dilution into a 500 ml volumetric flask.</li><li>4. Add 20 ml half conc. hydrochloric acid.</li><li>5. Fill up with deionised water and mix well.</li><li>6. Determinate this solution at 213.9 nm against the laboratory standards of 1 to 5 ppm zinc.</li></ol>
correction:	Adjust the circulation rate from the zinc generator to reach the correct zinc content.

### Zinc – Analysis per Titration

reagents:	0.1 mol/l EDTA solution (Titrplex III) buffer solution (100 g/l NaOH and 240 ml/l glacial acetic acid, 98 % in deionised water) dimethylglyoxime solution (2 % alcoholic solution) indicator: xylene orange tetra sodium salt (1 % in KNO <sub>3</sub> )
procedure:	Repeat determination: <ol style="list-style-type: none"><li>1. Pipette 5 ml bath sample into a 250 ml beaker.</li><li>2. Dilute with approx. 25 ml deionised water.</li><li>3. Add buffer solution, until the solution gets clear and the colour changes (approx. 20 ml).</li><li>4. Add approx. 20 ml dimethylglyoxime solution.</li><li>5. Heat up to 60°C while stirring.</li><li>6. After cooling down to room temperature filtrate the solution and wash the filter cake with some deionised water.</li><li>7. Add a spatula tip of indicator to the filtrate (inclusive the water from the washed filter cake).</li><li>8. Titrate with the 0.1 mol/l EDTA from purple to orange.</li></ol>
calculation:	consumption in ml = ml (A) ml (A) · 1.3074 = g/l zinc
hint:	The colour changes from purple to yellow-grey. It is not possible to describe the colour exactly; it depends on the matrix of the bath sample (e. g. metal impurities).
correction:	Adjust the circulation rate from the zinc generator to reach the correct zinc content.

### Nickel – Analysis by AAS

equipment:	atomic absorption spectrometer (AAS): wave length: 232.0 nm slit: 0.2 nm
reagent:	hydrochloric acid (1:1) p. a. barium chloride solution (15 % p. a. in deionised water) nickel standard solutions: 5-10 ppm
procedure:	<ol style="list-style-type: none"><li>1. Pipette 5 ml bath sample into a 100 ml beaker.</li><li>2. Cautiously add 10 ml half conc. hydrochloric acid. Attention: gas evolution (CO<sub>2</sub>)!</li><li>3. Fill 20 ml barium chloride solution into a second beaker.</li><li>4. Warm up both beakers to approx. 70°C.</li><li>5. Add the barium chloride solution to the bath sample, a precipitation is formed.</li><li>6. Let the solution cool down.</li><li>7. Fill the solution together with the precipitation quantitatively into a 50 ml volumetric flask.</li><li>8. Fill up to the final volume with deionised water, mix well and let the precipitate settle down. This is the pre-dilution of 1:10.</li><li>9. From the clear solution from top of the flask, pipette 5 ml into a 100 ml volumetric flask.</li><li>10. Add 5 ml half conc. hydrochloric acid.</li><li>11. Fill up with deionised water and mix well. This is the final dilution of 1:200 (in summary).</li><li>12. Determinate this solution at 232.0 nm against laboratory standards of 5 to 10 ppm nickel.</li></ol>
correction:	rise by 1 g/l nickel = addition of 10 ml/l SurTec 716 Ni

### Nickel – Analysis per Titration

reagents:	0.1 mol/l EDTA solution (Titrplex III) buffer solution (100 g/l NaOH and 240 ml/l glacial acetic acid, 98 % in deionised water) indicator: xylenole orange tetra sodium salt (1 % in KNO <sub>3</sub> )
procedure:	Repeat determination: <ol style="list-style-type: none"><li>1. Pipette 5 ml bath sample into a 250 ml beaker.</li><li>2. Dilute with approx. 100 ml deionised water.</li><li>3. Add approx. 20 ml buffer solution, until the solution gets clear.</li><li>4. Heat up to 80°C while stirring.</li><li>5. Add a spatula tip of indicator.</li><li>6. Titrate at 80°C with 0.1 mol/l EDTA solution from purple to red-orange.</li></ol>
calculation:	consumption in ml = ml ( <b>B</b> ) [ml ( <b>B</b> ) - ml ( <b>A</b> )] · 1.1742 = g/l nickel
correction:	rise by 1 g/l nickel = addition of 10 ml/l SurTec 716 Ni

### Sodium Hydroxide – Analysis per Titration

reagents:	1 N sulfuric acid barium chloride solution (15 % p. a. in deionised water) indicator: thymolphthalein
procedure:	1. Pipette 5 ml bath sample into a 250 ml Erlenmeyer flask. 2. Add 15 ml of the barium chloride solution. 3. Dilute with 50 ml of deionised water. 4. Add 3 drops of indicator. 5. Titrate with 1 N sulfuric acid from blue to colourless.
calculation:	consumption in ml · 7.98 = g/l sodium hydroxide
hint:	For the dosage of NaOH, the quality (concentration) of the raw material has to be considered.

### Sodium Carbonate – Analysis per Titration

reagents:	barium nitrate solution (5 %) 1 N hydrochloric acid 1 N sodium hydroxide solution indicator: methyl orange solution (0.04 %)
procedure:	1. Pipette 10 ml bath sample into a 250 ml Erlenmeyer flask. 2. Add 50 ml deionised water. 3. Boil the solution. 4. Add 75 ml barium nitrate solution. 5. After settling down of the precipitate, filtrate with a fine-grained filter paper and wash with hot deionised water. 6. Put the filter into a new 250 ml Erlenmeyer flask. 7. Add 100 ml deionised water. 8. Add 20 ml 1 N hydrochloric acid. 9. Boil the solution shortly. 10. After cooling down, add 3 drops of indicator. 11. Titrate excessive hydrochloric acid with 1 N sodium hydroxide from red to orange-yellow.
calculation:	(20 - consumption in ml) · 5.3 = g/l sodium carbonate
correction:	Carbonate can be removed by chilling equipment at 3-5°C.

### Hull Cell Test

Perform all tests in a standard 250 ml Hull cell. Before plating, prepare well the Hull cell panel (pickling and anodic cleaning), it has to be free of zinc and without oil. Plate the freshly cleaned panel in the Hull cell at 1 A for 15 min. Rinse the panel with tap water and dry it with hot or compressed air. An ideal panel is bright and has equal nickel content over the whole current density area, measurable by X-ray. Because of the high current applied (1 A, 15 min), it is recommended to use fresh electrolyte samples for each variation in the Hull cell test.

Due to the high viscosity of SurTec 716 C we recommend the preparation of a pre-dilution of 1:1 with deionised water in order to ease the pipette handling in the Hull cell test.

## 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](#).

The following values per 10,000 Ah can be taken as estimated average consumption:

SurTec 716 I	0.5-1.0 l
SurTec 700 L	0.1-0.5 l
SurTec 716 Ni	6.0-9.0 l
SurTec 716 C	0.7-2.3 l

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

SurTec 716 I	25 kg
SurTec 700 L	25 kg
SurTec 716 Ni	50 kg
SurTec 716 C	25 kg
SurTec 716 CA	25 kg
SurTec 716 CB	25 kg

## 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 716 I	Xi - Irritant	WHC 2
	N - Dangerous for the environment	
SurTec 700 L	C - Corrosive	WHC 1
SurTec 716 C	C - Corrosive	WHC 2
SurTec 716 Ni	T - Toxic	WHC 2
	Xn - Harmful	
	N - Dangerous for the environment	
SurTec 716 CA	C - Corrosive	WHC 2
SurTec 716 CB	-	WHC 1
SurTec 700 EN	C - Corrosive	WHC 1
	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>

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## Trouble Shooting

Before consulting the following list, it should be verified that temperature, current density and analytical values stay within the above limit values.

Then start Hull cell tests in a 250 ml Hull cell at 1 A, 15 min, on thoroughly pretreated (pickled and anodal cleaned) steel panels. Rinse the plated Hull cell with tap water and dry with hot air.

Confirm each step of replenishment by Hull cell test before adding to the bath.

problem	possible cause	remedy
bright uniform layer within the whole current density range	electrolyte is o.k.	none
bad throwing power	a) lack of SurTec 716 I Carrier	add SurTec 716 I in steps of 0.5 ml/l; (confirm each step by Hull cell test)
	b) lack of SurTec 716 C Complexing Agent	add SurTec 716 C in steps of 2 ml/l; (confirm each step by Hull cell test)
matt grey deposition in the low current density area	a) lack of SurTec 716 CB Corrective Additive B	add SurTec 716 CB in steps of 1 ml/l; (confirm each step by Hull cell test)
	b) overdosage of SurTec 716 CA Corrective Additive	dilute the bath 20 % and re-adjust the basic values (Zn, Ni, NaOH)
	c) after new make-up: incomplete work-in of the electrolyte	work-in the electrolyte with 0.2 A/dm <sup>2</sup>
	d) lack of SurTec 700 L LCD Booster	add SurTec 700 L in steps of 0.2 ml/l; (confirm each step by Hull cell test)
dark brown or bluish deposition in the low current density area (back side of the Hull cell panel)	lack of complexing agent or the ratio of complexing agent is not balanced	add SurTec 716 CA in steps of 2 ml/l; if bad throwing power occurs too: add SurTec 716 C in steps of 5 ml/l (confirm each step by Hull cell test)
oil film on the baths surface	a) pretreatment inefficient – drag-in of oil	improve the pretreatment
	b) content of carbonate and/or total organic is too high	chill out the carbonate at 3-5°C; if necessary, dilute the bath 20 % and re-adjust the basic values (Zn, Ni, NaOH)