



SILVERON™ GT-101 Bright Silver

Cyanide-Free Bright Electrolytic Silver

For Electronic, Decorative and Industrial Finishing Applications

Regional Product Availability

- North America
- Europe, Middle East and Africa
- Latin America
- Asia-Pacific

Description

SILVERON™ GT-101 Bright Silver is an alkaline non-cyanide pure silver electroplating electrolyte designed to produce bright silver deposits for various applications. The product can be used in conventional plating equipment and high speed reel-to-reel, jet or wire plating equipment. The silver deposits can be applied to both copper alloy and nickel alloy substrates.

Advantages

- Bright white pure silver deposit (> 99.9% Ag)
- Free of metallic grain refiners
- Stable plating solution and constant bath performance
- Micro-hardness of the deposit: 100-120 HV (no softening effect at 150°C/1h)

Bath Make-up for One Liter

Chemical Required	Low Speed (0.5 – 2 ASD)	High Speed (2 – 10 ASD)
SILVERON™ GT-101 Make Up Solution	400 ml/L	400 ml/L
SILVERON GT-101 Silver Concentrate	250 ml/L	500 ml/L
SILVERON GT-101 Brightener	10 ml/L	---
SILVERON GT-101 HS Brightener	---	20 ml/L
SILVERON GT-101 HS Additive	-----	40 ml/L
Deionized (D.I.) Water	Top to 1 liter	Top to 1 liter

Note: For decorative applications where highly bright deposits are required, it is recommended to use the low speed electrolyte.

Make-Up Procedure

- 1) Add SILVERON GT-101 Make Up Solution to a clean tank
- 2) Add SILVERON GT-101 Silver Concentrate and mix thoroughly
- 3) Add SILVERON GT-101 Brightener, (or SILVERON GT-101 HS Brightener for high speed applications) and mix thoroughly
- 4) For high speed applications, add SILVERON GT-101 HS Additive and mix thoroughly
- 5) Add Deionized Water to 95% of the final volume and mix thoroughly
- 6) Adjust the solution pH to 9.5 using KOH solution (500 g/L) or a solution of SILVERON GT-101 Acid Salt (100 g/L)
- 7) Add Deionized Water to the final volume and mix thoroughly

Operating Parameters

For Plating at Lower Current Densities (0.5 – 2 ASD)

Parameters	Range	Optimum
Silver	15 – 25 g/L	20 g/L
SILVERON™ GT-101 Brightener	8 – 16 ml/L	10 ml/L
Free Complexing Agent	70 – 80 g/L	75 g/L
pH	9.2 - 10	9.5
Temperature	45 – 60°C	50°C
Anode to Cathode Ratio	2:1 to 5:1; recommended 3:1	
Agitation	Moderate solution agitation and cathode movement	
Cathode Efficiency*	ca. 100% or 4.02 g/Ah	
Deposition Rate*	0.6 µm in 1 minute at 1.0 ASD	

* These properties are typical, should not be construed as specifications.

For Plating at Higher Current Densities (2 - 10 ASD)

Parameters	Range	Optimum
Silver	35 -45 g/L	40 g/L
SILVERON GT-101 HS Brightener	16 - 32 ml/L	20 ml/L
SILVERON GT-101 HS Additive	35 – 45 ml/L	40 ml/L
Free Complexing Agent	70 – 80 g/L	75 g/L
pH	9.2 - 10	9.5
Temperature	50 – 70°C	50°C
Anode to Cathode Ratio	2:1 to 5:1; recommended 3:1	
Agitation	Vigorous solution agitation with cathode movement	
Cathode Efficiency*	ca. 100% or 4.02 g/Ah	
Deposition Rate*	5 µm in 1 minute at 8 ASD	

* These properties are typical, should not be construed as specifications.

Process Sequence

For Plating over Copper Substrates

Step	Notes
Cleaning	
SILVERON™ GT-101 Bright Silver	
Hot Rinse (directly after silver plating)	80-90°C, 10 -30 seconds or 60-70°C, 1-2 minutes
Anti-tarnish	Optional
Hot Rinse	Optional, 60°C

For Plating over Nickel Substrates

Step	Notes
Cleaning	
Nickel Plating	
SILVERON™ GT-101 Silver Strike or Copper Strike or other activation method	No rinse required before silver plating Rinsing before silver plating
SILVERON GT-101 Bright Silver	
Hot Rinse (directly after plating)	80-90°C, 10 -30 seconds or 60-70°C, 1-2 minutes
Anti-tarnish	Optional
Hot Rinse	Optional, 60°C

Analysis Procedure

Analysis of Silver Concentration

I. Principle

The silver concentration is measured using a titrimetric analysis based on precipitation of silver as its thiocyanate compound. When all the silver is precipitated the free thiocyanate causes an indicator change (Ammonium Ferric (III) Sulphate).

II. Reagents

- Nitric Acid concentrated (65%)
- ~3.5 M Nitric Acid (25 % v/v of concentrated Nitric Acid)
- Saturated (~ 200 g/L) Ammonium Ferric (III) Sulphate, $\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 12 \text{H}_2\text{O}$ treated with conc Nitric Acid until colour turns from brown to clear yellow
- Ammonium Thiocyanate, NH_4SCN (0.1 M)
- Stirrer plate

III. Procedure

- Pipette 5 ml of silver bath into a 250 ml Erlenmeyer flask.
- Dilute to 100 ml with distilled or Deionised Water, add 20 ml of 3.5 M Nitric Acid and stir.
- Add approx.5 ml of Ammonium Ferric (III) Sulphate indicator and titrate using a stirrer with NH_4SCN (0.1 M) to orange/white colour endpoint.
- Record the number of Ammonium Thiocyanate titrated.

IV. Calculation

$$\text{Silver (g/L)} = 2.157 \times \text{ml NH}_4\text{SCN (0.1 M)}$$

Analysis of Complexing Agent

I. Principle

The Complexing Agent is measured using a titration method with Silver Nitrate.

II. Equipment

- a) Stirrer plate
- b) 250 ml Erlenmeyer flask
- c) 50 ml Burette
- d) 5 ml pipette
- e) pH meter

III. Reagents

- a) Silver Nitrate (0.1 M)
- b) Deionised Water
- c) Potassium Hydroxide solution (1 M)

IV. Procedure

- a) Pipette 5 ml of silver bath into a 250 ml Erlenmeyer flask.
- b) Dilute to 100 ml with distilled or Deionised Water.
- c) Set the pH with the Potassium Hydroxide solution (1 M) to 10.0. This is very important. If the pH is too low, the consumption of Silver Nitrate is too low, if the pH is too high, the consumption is too high
- d) Titrate with Silver Nitrate (0.1 M) to the first permanent turbidity.

V. Calculation

Complexing Agent (g/L) = 5.126 x ml Silver Nitrate (0.1 M)

Analysis of HS Additive

I. Principle

The SILVERON™ GT-101 HS Additive is measured by UV and calculated with a calibration curve. The absorbance is measured at 255nm. In the bath make up the peak is partially covered. Nevertheless the absorbance at 255 nm is proportional to the concentration.

II. Procedure

- a) Pipette 1 ml of sample to a 100 ml volumetric flask, fill with water to the mark and mix thoroughly.
- b) Pipette 10 ml from the flask to another 100 ml volumetric flask, fill with water to the mark and mix thoroughly.
- c) Measure absorbance at 255 nm.

III. Calibration curve

Prepare make ups with different SILVERON GT-101 HS Additive concentrations:

400 ml/L SILVERON GT-101 Make Up solution

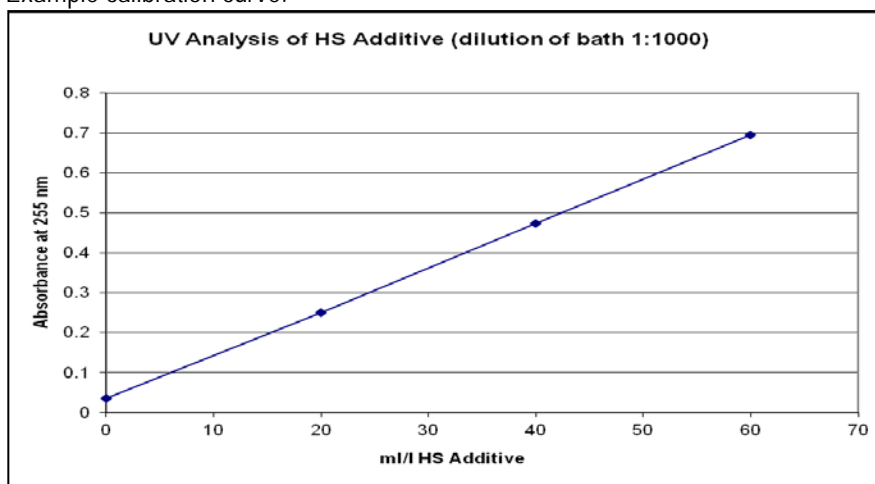
500 ml/L SILVERON GT-101 Silver Concentrate

10 ml/L SILVERON GT-101 Brightener

- without SILVERON™ GT-101 HS Additive
- 20 ml/L SILVERON GT-101 HS Additive
- 40 ml/L SILVERON GT-101 HS Additive
- 60 ml/L SILVERON GT-101 HS Additive

Measure absorbance like the above procedure.

Example calibration curve:



Bath Maintenance

Silver Concentration

The optimum silver concentration should be maintained based on analysis. To raise the silver concentration by 1.0 gram, add 12.5 ml SILVERON™ GT-101 Silver Concentrate.

pH

The solution pH should be maintained at the optimum using KOH solution (500 g/L) or a solution of SILVERON GT-101 Acid Salt (100 g/L).

Free Complexing Agent

Replenish complexing agent based on analysis. To raise complexing agent by 1.0 g/L add 5.3 ml/L SILVERON GT-101 Make Up Solution. The complexing agent is consumed primarily through solution drag-out. Typical consumption is 2.0 - 10.0 litres per 1000 Ah.

SILVERON GT-101 Brightener and SILVERON GT-101 HS Brightener

Replenish SILVERON GT-101 Brightener, or SILVERON GT-101 HS Brightener, based on hull cell tests. Consumption of SILVERON GT-101 Brightener is 1,500 – 2,500 ml per 1,000 Ah. For high speed applications, consumption of SILVERON GT-101 HS Brightener is 3500 - 4500 ml per 1000 Ahr.

SILVERON GT-101 HS Additive

The consumption of SILVERON GT-101 HS Additive is mainly due to solution drag-out. Replenish SILVERON GT-101 HS Additive based on analysis (UV). Typical consumption 200 - 1000 ml per 1000 Ah dependent on operation.

General Notes

Bath Temperature

It is recommended to operate SILVERON™ GT-101 Bright Silver at the elevated temperature (50°C) for both low speed and high speed plating, in order to achieve the optimum brightness of deposits. For high speed applications, increasing the bath temperature is more effective than varying any other parameters in extending the applicable current density range.

Rinsing After Silver Plating

1. Hot rinsing directly after SILVERON GT-101 Bright Silver is critical to maintain the fine grain structure of the silver deposit during the storage at high temperatures (> 150°C) and to prevent yellowish silver deposit.
2. Generally most silver anti-tarnish chemistry works better when using hot rinsing after silver plating as well as after anti-tarnish process.

Anode to Cathode Ratio

High anode to cathode ratio (prefer 3:1 to 5:1) is critical to reduce particles formed on the anodes and to prevent silver anode passivation.

Equipment

Tanks: Temperature-stabilised translucent white polypropylene; or rigid tanks coated with an equivalent material capable of withstanding temperatures up to 60°C.

Anodes: Silver anode (99.99%). The use of polypropylene anode bags is highly recommended.

Heaters: PVDF-clad panel heaters or titanium with thermostatic control. PTFE

Filtration: Preferably continuous using 5 microns woven polypropylene cartridges with a flow rate at least three times tank volume/hour.

Equipment Preparation

All items of equipment that come into contact with the SILVERON™ GT-101 Bright Silver electrolyte must be cleaned thoroughly prior to use. The recommended procedure must be applied to new as well as with previously used for other plating processes, for example, cyanide-based systems.

Cleaning Solution

Solution of Potassium Hydroxide 100 g/L

Leaching Solution

Solution of SILVERON GT-101 Acid Salt 30 g/L

or

SOLDERON™ Acid HC 10% (v/v)

Procedure

- 1) The tank and related equipment should be scrubbed to remove any visible debris and then flushed with Deionised Water to remove any visible residues.
- 2) Discard rinse water.
- 3) Fill the tank with 100 g/L Potassium Hydroxide solution and heat to approximately 55°C, and then circulate this solution through the system for at least 12 hours.
- 4) Discard the Potassium Hydroxide solution.
- 5) Flush the equipment with Deionised Water for 1 hour.
- 6) Discard the Deionised Water.
- 7) Fill the equipment with a solution of 30 g/l SILVERON™ GT-101 Acid Salt or with a solution of SOLDERON™ Acid HC and circulate for approximately 12 hours at 40°C.
- 8) Discard the acid solution.
- 9) Flush the equipment with Deionised Water for 1 hour. The final pH should be around 6-8.
- 10) Discard the Deionised Water. The equipment is now ready for use.

Note. The plating tank must be totally free of any residues of metals deriving from other processes as well as from trace of cyanide, prior to make up.

Associated Products

SILVERON™ GT-101 Make Up Solution
SILVERON GT-101 Silver Concentrate
SILVERON GT-101 Brightener
SILVERON GT-101 HS Brightener
SILVERON GT-101 HS Additive
SILVERON GT-101 Acid Salt

Handling Precautions

Before using this product, associated generic chemicals or the analytical reagents required for its control, consult the supplier's Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on material hazards, recommended handling precautions and product storage.

CAUTION! Keep combustible and/or flammable products and their vapors away from heat, sparks, flames and other sources of ignition including static discharge. Processing or operating at temperatures near or above product flashpoint may pose a fire hazard. Use appropriate grounding and bonding techniques to manage static discharge hazards.

CAUTION! Failure to maintain proper volume level when using immersion heaters can expose tank and solution to excessive heat resulting in a possible combustion hazard, particularly when plastic tanks are used.

Storage

Store products in tightly closed original containers at temperatures recommended on the product label.

Disposal Considerations

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Electronic Materials Technical Representative for more information.

Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

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886-00033-0612-EN
06/2012, Rev. 2