

Sterling Silver

Sterling Metallic Solderability Preservative

Product Code: 175097

DESCRIPTION: **Sterling Silver** is an immersion process for plating a silver deposit on copper, designed to be used as a final finish for printed circuit boards.

FEATURES & BENEFITS:

Features

High stability
Uniform bright deposit
Wide operating window
Replenishable

Benefits

Long solution life
Improved cosmetics
Process control simplicity
Reduced make-up costs

PHYSICAL & CHEMICAL PROPERTIES:

	<u>Sterling Silver Part A</u>	<u>Sterling Silver Part B</u>
Appearance	Colorless, clear to slight opaque liquid	Light to dark orange liquid
Odor	Odorless	Odorless
Flash Point	Non-flammable	Non-flammable
Freezing Temperature	<0°C (32°F)	<0°C (32°F)
Min. Storage Temperature	3°C (37°F)	3°C (37°F)



EQUIPMENT:**For both the Sterling Predip and Sterling Silver Baths**

Tanks	CPVC, polypropylene, polyethylene.
Agitation	Work rod agitation and solution movement at 3 to 5 turnovers/hour are required. <i>Air agitation is detrimental.</i>
Vibration	In vertical mode, vibration is required for parts with plated through holes of 5:1 and larger aspect ratios, or boards 0.125”(3.2mm) and thicker, or via holes 0.008”(0.2mm) and smaller in diameter.
Filtration	Required. Continuous, through 20-micron polypropylene filter cartridges, at 3 to 5 turnovers/hour.
Ventilation	Required. 50 FPM (15 MPM) face velocity is recommended.
Heaters	Teflon, Teflon coated stainless steel (316), Quartz.

NOTE: No exposed metal is permitted in these tanks

**MAKE-UP
PROCEDURE ⁽¹⁾:****Sterling Predip**

DI Water	93.4% by volume
Sterling Silver Part B (175098)	5% by volume
Concentrated Nitric Acid, 70% reagent grade	1.6% by volume ⁽²⁾

Sterling Silver

DI Water	85.5% by volume
Sterling Silver Part B (175098)	10% by volume
Concentrated Nitric Acid, 70% reagent grade	2.0% by volume ⁽²⁾
Sterling Silver Part A (175097)	2.5% by volume

(1) Add components in the order listed; mix thoroughly before adding next component. Analyze to confirm concentrations before using the bath.

(2) Adjust the actual acid volume used if lower concentration acid is used.



**OPERATING
CONDITIONS ⁽³⁾:**

	Acid Normality	Chelator Molarity	Silver g/L	Copper mg/L	Temperature⁽⁴⁾	Contact time seconds⁽⁵⁾
Sterling PreDip bath	0.15 (0.1 - 0.2)	0.015 (0.01 - 0.02)	N/A	1000 max.	38 (32 - 43)°C 100 (90 - 110)°F	20 - 45
Sterling Silver bath	0.17 (0.12 - 0.22)	0.03 (0.02 - 0.04)	0.75 (0.6 - 0.9)	3000 max.	52 (50 - 54)°C 126 (122 - 130)°F	Vertical : 90 - 180 Horizontal : 60 - 120

- ⁽³⁾ operating conditions detailed in customer specific Operating Guide take precedence over these parameters.
- ⁽⁴⁾ operating temperature & contact time should be adjusted within the given range to achieve the desired deposit thickness.
- ⁽⁵⁾ may not be applicable when processing BMVs; please contact your MacDermid representative for recommendations.

**BATH
MAINTENANCE &
REPLENISHMENT:****STERLING PREDIP BATH & STERLING SILVER BATH****I. Acid Normality****A. Reagents & equipment**

1. 0.1N sodium hydroxide [NaOH]
2. pH meter and calibration buffers for pH 4 and 10
3. Stir plate, 100 mL beaker and magnetic stir bar

B. Procedure

1. Pipette a 5 mL sample of the working bath into a 100 mL beaker.
2. Add 50 mL of DI water and start the stirrer.
3. Titrate with 0.1N NaOH to pH 4.0 and record the mL titrated as V4.

C. Calculation

$$\text{Acid Normality} = \frac{V4 \times (N \text{ of NaOH})}{\text{Sample Size}}$$



D. Maintenance

1. Maintain the acid normality within the range detailed in the Operating Conditions.
2. An addition of 0.63 mL/L (2.4 mL/gal) of 70% Nitric Acid will raise the acid normality by 0.01N.

II. Chelator Molarity**A. Reagents**

1. 0.05M Copper Nitrate (11.63 g $\text{Cu}(\text{NO}_3)_2 \cdot 2.5\text{H}_2\text{O}$ to 1.0 L with DI water)**
2. Acetate Buffer (82 g/L Anhydrous Sodium Acetate & 60 mL/L Glacial Acetic Acid)
3. PAN indicator

**** 0.05 M Copper Sulfate can be used in place of Copper Nitrate**

B. Procedure:

1. Pipette a 20 mL sample of the working bath into a 250 mL Erlenmeyer flask.
2. Add 25 mL Acetate buffer.
3. Dilute to 100 mL with DI water.
4. Add 3-5 drops PAN indicator.
5. Slowly titrate to a permanent purple endpoint.

C. Calculation:

$$\text{Chelator Molarity} = (\text{mL of Copper Nitrate}) \times (\text{M of Copper Nitrate}) \times 0.05$$

D. Maintenance:

1. Maintain the chelator molarity within the range detailed in the Operating Conditions.
2. An addition of 3.3 mL/L (12.5 mL/gal) of Sterling Silver Part B will raise the chelator molarity by 0.001M.
3. When adding more than 15 mL/L of Part B (175098), re-analyze the acid normality after all additions are well mixed, and adjust the acid normality if necessary.

III. Copper Concentration**A. Reagents**

1. 1 mg/L Copper Standard
2. 5 mg/L Copper Standard



B. Procedure

1. Pipette 1 mL (**S**) of the working bath into a 100 mL (**V**) volumetric flask.
2. Dilute to volume with DI water. Mix well.
3. Set up the atomic absorption spectrophotometer for copper:

Wavelength:	324.8 nm
Slit width:	0.7 nm
Flame	Lean, blue
4. Aspirate the 1 mg/L copper standard.
5. Aspirate the 5mg/L copper standard.
6. Aspirate the diluted sample and record the reading.

Note: *If reading is out of range, adjust the dilution made in Step 1 and repeat the procedure.*

C. Calculation

$$\frac{\text{mg}}{\text{L}} \text{ Copper} = \frac{(\text{AA Reading}) \times V(\text{mL})}{S(\text{mL})}$$

D. Maintenance:

1. Dump the bath per specification outlined in the Operating Conditions.

IV. Sterling™ Silver – pH measurement (optional)**A. Equipment & Standards**

1. pH meter capable of 0.01 accuracy.
2. Refillable glass pH probe. Do not use gel filled epoxy pH probe.
3. pH buffers 1, 4, 7 and 10.

B. Procedure

1. Calibrate meter to 1 - 4 pH range.
2. Cool a sample of the working bath to about 25°C; measure and record the pH.
3. If the pH exceeds 1.3 follow the procedure outlined below under C. Maintenance.
4. Re-check and record the pH.

C. Maintenance

1. Maintain the pH below 1.3 or within the range detailed in the Operating Conditions.
2. Addition of 1.2mL/L of concentrated Nitric Acid (15.9N) will lower the pH by 0.1 unit.



STERLING SILVER BATH

V. Silver Concentration

A. Reagents

1. 100 mg/L Silver standard
2. 4 mg/L Silver standard

B. Procedure

1. Pipette a 10 mL sample of the working bath into a 100 mL volumetric flask.
2. Dilute to volume with DI water. Mix well.
3. Pipette a 1 mL aliquot of the above solution into each of 3 separate 100 mL volumetric flasks labeled A, B and C.
4. Pipette 1 mL of the 100 mg/L Silver Standard into the flask labeled B and 2 mL of the Silver Standard into the flask labeled C.
5. Dilute all three flasks to volume with DI water. Mix well.
6. Set up the Atomic Absorption Spectrophotometer for Silver:

Wavelength:	328.1 nm
Slit Width:	0.7 nm
Flame	Lean, blue

7. Optimize the Atomic Absorption Spectrophotometer with the 4 mg/L Silver standard.
8. Read the absorbency for each solution (A, B and C) a minimum of three times and average the readings for each.

C. Calculation

$$\frac{0.5 \times Abs_A}{Abs_B - Abs_A} + \frac{Abs_A}{Abs_C - Abs_A} = g/L \text{ Silver}$$

D. Maintenance

1. Maintain the silver concentration within the range detailed in the Operating Conditions.
2. An addition of 3.3 mL/L (12.5 mL/gal) of Sterling Silver Part A (175097) will raise the silver concentration by 0.1 g/L.

VI. Silver analysis by Ion Specific Probe Methodology

(Follow standard laboratory practices including meter and electrode handling)

A. Equipment & Reagents

1. Portable pH/mV Meter, Thermo Orion Model 290A+ (or equivalent).
2. Silver/Sulfide Ion Selective Electrode, Orion Model 96-16 ionplus.
3. Access to a PC with MS Excel (or similar software).



4. Ring stand with clamp; magnetic stir plate with stir bar; 150 mL beaker; 100 mL, 10 mL, 2 mL and 1 mL pipettes; DI wash bottle; Kimwipes.
5. 1.0N silver nitrate standard solution.
6. Orion Ionic Strength Adjustor (ISA) solution

B. Procedure

(Adopted from the instruction manual for the 96-16 electrode, Known Addition Method)

1. Electrode Slope Determination (perform once a month or more often in case of heavy usage, similar procedure also on page 9 in the manual):
 - a. Place 100 mL of distilled water in a 150 mL beaker. Add 2 mL of the ISA solution.
 - b. Set the meter to the mV mode.
 - c. Pipette 1 mL of the 1.0N silver nitrate solution into the beaker, start stirrer and record the electrode potential in mV.
 - d. Into the same beaker, pipette 10 mL of the 1.0N silver nitrate solution, stir and record the electrode potential in mV.
 - e. The difference of the potential readings is the slope of the electrode (should be between 54 and 60). Use it in the procedure below (enter into cell C7 of the Excel table).



2. Prepare an Excel table as below (skip quote signs in software):

A	B	C
1	Volume of sample + ISA solution (mL)	102
2	Volume of addition (mL)	10
3	Concentration of addition (g/L)	107.9
4	Volume of sample (mL)	100
5	Initial mV	
6	Final mV	
7	Electrode slope	
8		
9		
10	MV difference	"=C6-C5"
11	Solution volume ratio	"=C2/C1"
12	Antilog term	"=10^(C10/C7)"
13	Sample volume ratio	"=C1/C4"
14	Q term	"=C11*C13/(((1+C11)*C12)-1)"
15	Sample concentration (g/L)	"=C14*C3"

3. Determination of Ag Concentration

- Place a 100 mL of the analyzed bath (previously cooled to room temperature) in a 150 mL beaker. Add 2 mL of the ISA solution.
- Place the electrode in the beaker and start stirrer. Record the mV reading as "initial mV reading" and enter into cell C5 of the Excel table.
- Pipette 10 mL of the 1.0N silver nitrate solution into the beaker, stir. Record the mV reading as "final mV reading" and enter into cell C6 of the Excel table (5 mL or 2 mL aliquot can also be used; then enter this volume into cell C2).
- MS Excel will automatically calculate the Ag concentration in cell C15 of the table in g/L.

For example: if, C5 = 313, C6 = 364 and C7 = 58 the result is 1.47 g/L



C. Maintenance

1. Maintain the Silver concentration within the range detailed in the Operating Conditions.
2. An addition of 3.3 mL/L (12.5 mL/gal) of Sterling Silver Part A (175097) will raise the concentration by 0.1 g/L.

SOLUTION LIFE:

The **Sterling Predip** working bath must be replaced when the copper concentration exceeds 1000 mg/L or whenever the Sterling Silver bath is dumped, whichever comes first.

The **Sterling Silver** working bath must be replaced after 7.5 g/L of silver metal are replenished or when the copper concentration exceeds 3000 mg/L or every 6 months, whichever comes first.

To calculate the Metal Turnover (MTO) life of a bath, multiply the bath volume (L) by 0.25; the result is the number of Sterling Silver Part A liters to be replenished to reach the bath's MTO life.

SAFETY & WARNING:

MacDermid Inc. recommends that the company/operator read and review the MacDermid MSDS for the appropriate health and safety warnings before use.

The Sterling Silver working bath is acidic. Avoid eye, skin and oral contact. When handling, wear protective clothing, rubber gloves and safety goggles. Flush exposed areas with large amounts of clean, cold water. Contact a physician in case of injury.

Flush spillage generously with water. Do not mix the Sterling Silver with strong alkaline solutions as an explosive reaction may occur.

Store Sterling Silver Part A and B in a cool and dry area in tightly closed containers.

Material Safety Data Sheets are available from MacDermid, Inc.



**WASTE
TREATMENT:**

Prior to using any recommendations or suggestions by MacDermid Inc. for waste treatment, the user is required to know the appropriate local/state/federal regulations for on-site or off-site treatment, which may require permits. If there is any conflict regarding our recommendations, local, state or federal regulations take precedence.

MacDermid Sterling Silver is a complexed silver/organic system. The spent bath can be treated in the following way:

1. Add 1.0 g/L sodium chloride. The silver will precipitate as AgCl.
2. Filter or decant the solution to separate the supernatant from the precipitate.
3. Slowly add 15 mL/L of MRA-10 metal reducing agent (Product Code #175057) while mixing.
4. Continue agitation until reaction has stopped and copper has precipitated out of solution.
5. Filter or decant the spent bath to separate the supernatant from the sludge.
6. Adjust the pH of the supernatant to 7.0 with additions of 20% by volume sulfuric acid.
7. Dispose of supernatant and sludge in accordance with local, state and federal waste treatment regulations.

Observe all local, state and federal waste treatment regulations.

**ORDER
INFORMATION:**

<u>Product Name</u>	<u>Product Code</u>	<u>Container</u>
Sterling Silver Part A	175097	5, 55 gal
Sterling Silver Part B	175098	5, 55 gal

Also read carefully warning and safety information on the Material Safety Data Sheet. This data sheet contains technical information required for safe and economical operation of this product. READ IT THOROUGHLY PRIOR TO PRODUCT USE. Emergency directory assistance Chemtrec 1 - 800 - 424 - 9300.

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