

PMD (UK) LTD PROCESS DATA

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ISSUE 4
PREV 3

PMD ARGONAUT **BRIGHT SILVER PLATING SOLUTION**

INTRODUCTION

PMD Argonaut Bright Silver Plating Solution produces a fully bright, pure silver deposit on plated or polished substrates. The bright throwing power of the solution is exceptionally high giving a brilliant deposit even on deeply recessed work. The brightness is maintained with two separate addition agents. PMD Argonaut Bright Silver Plating Solution contains no alloying brighteners, therefore deposit resistivity is equivalent to pure silver enabling the process to be used for electrical, electronic or microwave purposes as well as for the more normal decorative applications.

The solution will operate over a wide range of silver concentrations and is suitable for both rack and barrel applications.

APPLICATION

The solution is recommended for the bright plating of cutlery and other tableware, for jewellery, medallions and statuary. The bright throw makes Argonaut especially suitable for holloware and deep drawn components such as trophies and goblets.

In the technical field the deposit is suitable for p.c.b.'s, connectors and contacts, switch gear and high frequency applications such as waveguides.

SOLUTION MAKE-UP

PMD Argonaut Bright Silver Solution is normally supplied ready to use with brighteners and an appropriate silver content required by the customer. However, if the solution is to be stored, the Brighteners are supplied separately. When ordering PMD Argonaut Bright Silver Solution, it is necessary to state whether the solution is to be supplied ready for use or for storage and to specify the silver content required depending on the use of the process, either rack, barrel or a special requirement.

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Tanks in which the Argonaut Bright Silver Solution is to be put should be thoroughly cleaned before use.

If new rubber lined tanks are used, these should be leached thoroughly with sodium hydroxide solution (25 gm/l) at 50 Deg. C for at least ten hours. After leaching, the tank should be thoroughly rinsed with water, firstly tap then deionised or distilled. The Argonaut Bright Silver Solution may then be poured into the tank, taking care to avoid any undue splashing. If supplied ready for use, after hanging the anodes in the vat, plating can commence. If brightener additions are to be made the concentrations are:

Argonaut PA Additive (Liquid) *	20 ml/l
Argonaut SA Additive (Liquid)	1.25 ml/l

* (See notes for preparation of the Argonaut PA Additive (Liquid). This solution may be ordered ready for use but only if it can be used within one week).

After the addition agents have been added optimum results will be obtained if the solution is allowed to stand for 24 - 48 hours before use.

EQUIPMENT

Tanks	Moulded polypropylene or polythene, rubber or plastic lined mild steel or resin bonded glass fibre.
Heating	PTFE immersion type or suitable heat exchangers.
Filtration	Glandless all plastic construction capable of at least one turn-over/hour through a paper or polypropylene cartridge.
Anodes	PMD pure silver anodes, preferably with nylon or cotton anode bags.
Agitation	Cathode rod movement 2 - 6 m/min.

OPERATING DATA

	<u>Rack</u>	<u>Barrel</u>
Silver	35 - 40 g/l	20 - 25 g/l
Free Potassium Cyanide	100 - 120 g/l	100 - 120 g/l
Potassium Carbonate	100 g/l max.	See "notes"
Cathode Current Density	0.5 - 2.5 A/dm ²	0.1 - 0.5 A/dm ²
Anode Current Density	2.0 A/dm ² max.	2.0 A/dm ² max.
Temperature	20 - 30 Deg. C	20 - 30 Deg. C
pH	11.5 - 12.5	11.5 - 12.5
Agitation	Work Movement (2 - 6 m/ minute)	Work Movement

MAINTENANCE AND CONTROL

Salts

The silver and potassium cyanide concentrations should be maintained at the levels stated above. (See appendix for analysis methods).

If the potassium cyanide concentration is correct and it is required to increase the silver concentration, add 1.85 g/l PMD Potassium Silver Cyanide Salts - 54% to increase the silver by 1 g/l.

If the silver content is low and the potassium cyanide excessively high, the addition of 1.24 g/l PMD Silver Cyanide Salts - 80.5% will increase the silver by 1 g/l and reduce the free potassium cyanide by 0.6 g/l.

Brighteners

Argonaut PA Additive is consumed by electrolysis and also by decomposition on standing.

Argonaut SA Additive is lost only by drag-out.

Recommendations for maintenance of these Addition Agents are therefore only a general guide and will vary according to the manner of operation, i.e. regular, spasmodic, rack, barrel etc. However, the following figures can be used as a basis:-

Argonaut PA Additive (Solid) - 100 gm/1000 amp. hours
Argonaut SA Additive - 5 ml/1000 amp. hours

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See appendix for the effect on Hull Cell panels of imbalance of the Brightener System and other variables.

NOTES

Preparation of Argonaut PA Additive (Liquid)

To prepare 1 litre:-

1. Dissolve 70 gm potassium hydroxide in 800 ml water.
2. Heat to 49 - 51 Deg. C (IMPORTANT) and dissolve 125 gm Argonaut PA Additive (Solid).
3. Allow to stand overnight then adjust the volume to 1 litre.
4. Filter into a storage container through a cotton or nylon anode bag.

Argonaut PA Additive (Liquid) does not have an indefinite life and it is advisable to prepare only enough material for one week's consumption.

CAUTION DO NOT INHALE THE ARGONAUT PA ADDITIVE DUST

pH

It is important that the pH of the PMD Argonaut Bright Silver Solution is maintained between 11.5 and 12.5. Milky deposits will be produced at pH in excess of 12.5. The pH can be reduced by carefully adding potassium bicarbonate solution - a 50 ml/l addition of a 200 g/l solution will reduce the pH from 12.7 to 12.0.

CAUTION SOME HYDROCYANIC GAS MAY BE RELEASED BY THIS TREATMENT

Anodes

Anodes recommended for use with the PMD Argonaut Bright Silver Solution are PMD pure silver anodes which are 99.96% silver, carefully rolled and annealed to ensure uniform dissolution characteristics. Anode bags are not essential but if desired, nylon or cotton bags nylon stitched are recommended. Anodes should dissolve uniformly and at all times have a crystalline appearance. If black films form on the anode then the solution is low in free potassium cyanide. Current density should not exceed 2 A/dm².

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Carbonate Concentration

As the PMD Argonaut Bright Silver Solution ages, in common with all cyanide solutions, there is a gradual increase in the concentration of potassium carbonate. There is no clearly defined limit at which excessive carbonate concentrations begin to affect the brightness of deposits, but as an approximate value, concentrations above 100 gm/l are liable to give rise to loss of brightness particularly at high current densities. A certain amount of carbonate is useful in that it stabilizes pH within the range 11.5 to 12.5 and increases conductivity. In barrel plating operations it is often possible to produce satisfactory deposits at carbonate levels in excess of 100 g/l.

Deposition Rate

At a current density of 1 A/dm² 25 microns will be obtained in 40 minutes.

Silver Strike

To achieve good adhesion of the silver coating to the base metal it is important that a silver strike be included in the basis metal preparation sequence. As soon as the article has a light silver colour, it should be transferred to the silver plating vat. If the work is left for too long in the strike solution the silver coating will be misty in appearance.

A suitable strike formulation is :-

PMD Silver Cyanide Salts (54%)	-	6 gm/l
Potassium Cyanide	-	80 gm/l

This solution should be used at 15 - 25 Deg. C, 3 - 4 volts for 8 - 12 seconds

Passivity

PMD Argonaut Bright Silver deposits have slight tarnish resistant properties and may therefore be slightly passive to post plating treatments. Immersion in 50 g/l potassium hydroxide solution or cathodic treatment in 25 g/l potassium cyanide will activate the surface.

DISPOSAL

Dispose of in accordance with local authority requirements.

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PRODUCT FAMILIES

The following Products or Product families are referred to in this data sheet.

Product Name

Product Number

The PMD Argonaut Bright Silver Plating System:

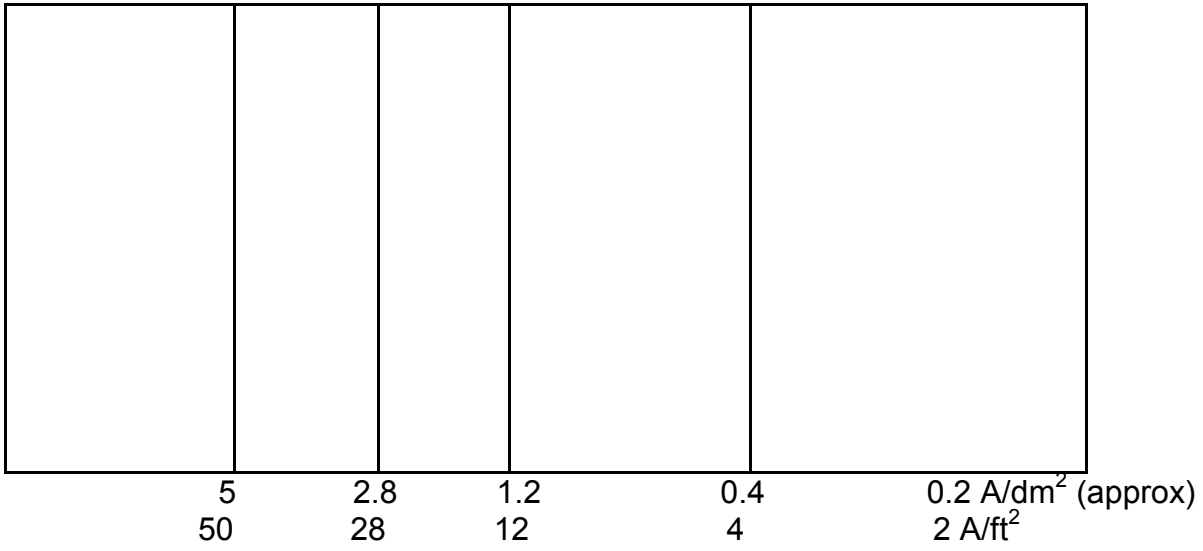
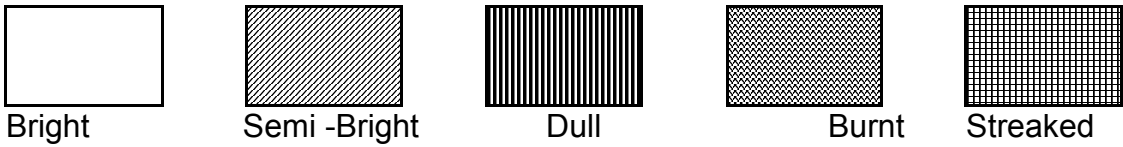
PMD Argonaut Silver Solution	148003
Argonaut PA Additive (Solid)	152001
Argonaut PA Additive (Liquid)	155001
Argonaut SA Additive	154001
PMD Silver Cyanide - 80.5%	119001
PMD Silver Cyanide - 54%	119002

Whilst every endeavour has been made to ensure that the information given in this data sheet is correct, PMD (UK) Limited gives no warranty, express or implied as to the use or performance of this system.

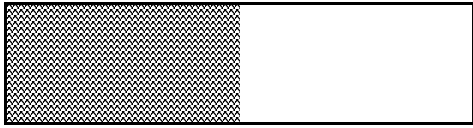
ARGONAUT BRIGHT SILVER
TROUBLE SHOOTING GUIDE

OPERATING CONDITIONS:

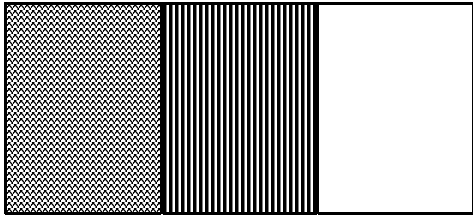
- Hull Cell - 267 or 320 mls capacity
- Temperature - 25°C
- Current - 1 amp.
- Time - 10 minutes
- Anode - Silver
- Cathode - Polished Brass Panel, Silver Flashed.



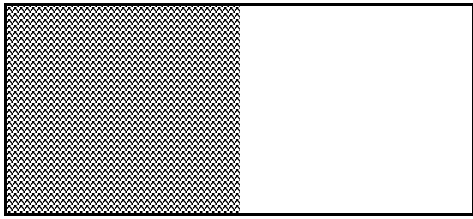
Argonaut Bright Silver Plating Solution



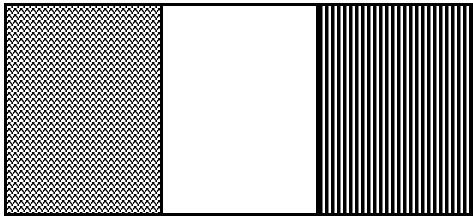
NORMAL DEPOSIT



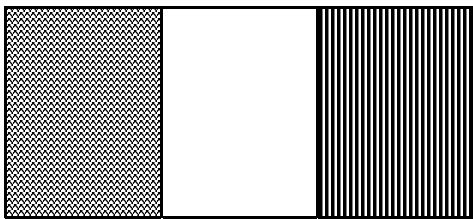
BASIC COMPOSITION NORMAL
ADDITION AGENT SA NORMAL.
ADDITION AGENT PA LOW.



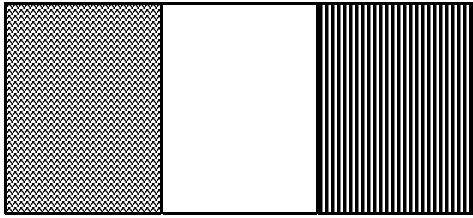
AS ABOVE WITH ADDITION
AGENT PA HIGH.



BASIC COMPOSITION NORMAL.
ADDITION PA NORMAL
ADDITION AGENT SA LOW.



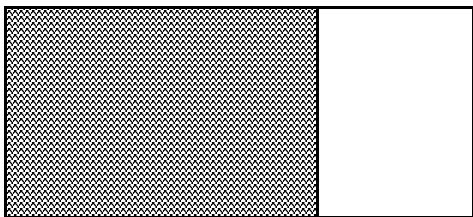
AS ABOVE WITH ADDITION
AGENT SA HIGH.



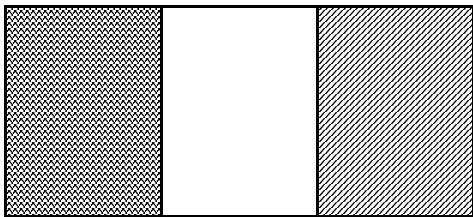
BASIC COMPOSITION NORMAL.
BRIGHTENERS NORMAL.
pH HIGH.



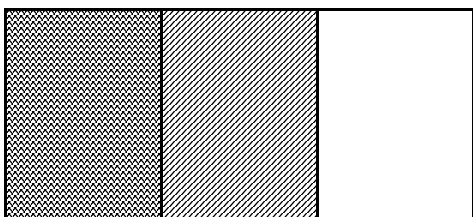
BRIGHTENERS NORMAL.
SILVER HIGH.



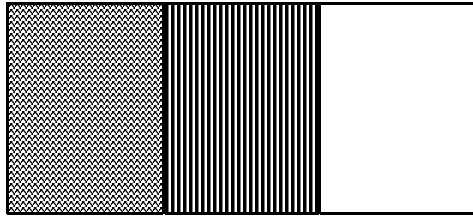
BRIGHTENERS NORMAL
SILVER LOW.



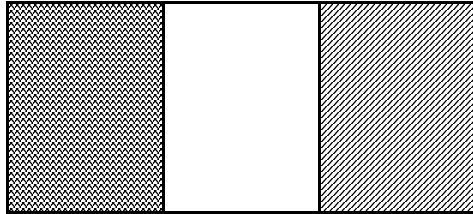
BRIGHTENERS NORMAL.
FREE CYANIDE LOW.



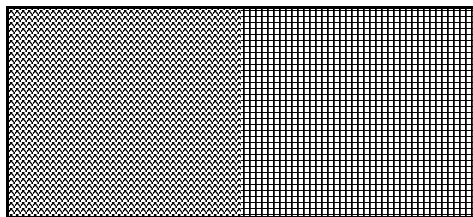
HIGH CARBONATES.



HIGH SODIUM ION
CONCENTRATION



INORGANIC IMPURITIES



SUSPENDED PARTICLES

ANALYSIS OF SILVER PLATING SOLUTIONS

Silver Content

Pipette 10 mls of the plating solution into a 250 conical flask. Add 20 mls sulphuric acid plus 5 mls nitric acid. Heat until the heavy fumes of sulphuric acid persist, and slowly cool to room temperature. Add 90 mls water, cool again then add 3 mls concentrated nitric acid and 2 mls of 2% ferric ammonium sulphate solution. Titrate to a pink end-point with 0.1N ammonium thiocyanate solution.

Mls. $0.1 \text{ NH}_4 \text{ CNS} \times 1.08 = \text{gm/litre silver in bath}$

N.B.

Additions of sulphuric/nitric acids to cyanide solution result in copious evolution of HCN, prussic acid. This operation should be conducted in a fume chamber.

FREE CYANIDE CONTENT

Pipette 2 mls of plating solution into a 250 mls conical flask. Add 80 mls distilled water and 10mls of a 5% potassium iodide solution. Titrate with 0.1N silver nitrate until turbidity is reached.

Mls $0.1 \text{N Ag NO}_3 \times 6.6 = \text{gm/l Free KCN in bath.}$

Carbonate Content

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Pipette 5 mls of plating solution into a 500 mls beaker and add about 150 mls distilled water. Raise almost to boiling and add 25 mls of 10% barium chloride solution. Allow precipitate to settle and carefully add a little more barium chloride. If no further precipitation occurs, allow about 10 minutes for the precipitate to completely settle and filter through a pulp pad.

Wash well with water until the filtrate is no longer alkaline to litmus paper. Transfer the pad to the original beaker and add sufficient 0.1N hydrochloric acid to dissolve the precipitate (25-80 mls should be sufficient). Let this amount be A mls. Add 50 mls distilled water and boil for a few minutes to expel all the liberated carbon dioxide. Cool, and back titrate with 0.1N sodium hydroxide to a pink end-point with phenolphthalein indicator. Let this titration be B mls. Then A-B represents the mls of HC1 used.

Mls. 0.1N HC1 used (A-B) x 1.38 = gm/l K_2CO_3 in bath.