

# ARGUNA® 621

## Operating Instructions

Edition: 26 April 2007

- bright silver bath for rack and barrel
- can also be used at relatively high temperatures
- brilliant white colour without a blue cast
- no silver strike required on nickel
- wide range of applicable current density
- very good throwing power
- high tolerance to carbonate

### Bath Characteristics

The ARGUNA® 621 silver bath deposits bright, brilliant white coatings. It is preferably used on jewellery or similarly profiled parts. The bath exhibits a very good throwing power and can also be used at higher temperatures. When plating nickel, no silver strike is required.

Bath type:	alkaline-cyanide silver bath
Silver content:	40 g/l (35 - 45 g/l) standard bath 25 g/l (25 - 30 g/l) special bath with low silver content
KCN content:	130 g/l standard bath 120 g/l special bath
pH-value:	no control required
Temperature:	room temperature, range 20 °C to max. 45 °C
Current density:	0.5 - 5 A/dm <sup>2</sup> standard bath 0.5 - 4 A/dm <sup>2</sup> special bath
Deposition speed:	proportional to current density: at 1 A/dm <sup>2</sup> : 0.64 µm/min at 1.6 A/dm <sup>2</sup> : 1.0 µm/min at 2 A/dm <sup>2</sup> : 1.28 µm/min at 4 A/dm <sup>2</sup> : 2.56 µm/min

### Coating Characteristics

Coating:	fine silver
Fineness:	99.9 %
Colour:	brilliant white
Density:	10.5 g/cm <sup>3</sup>
Max. coating thickness:	over 100 µm
Hardness:	approx. 110 HV 0.025 as deposited, dropping to a final value of approx. 80 HV 0.025

### Form of Supply

- |                     |  |
|---------------------|--|
| Bath makeup:        | <p>a) Potassium Cyanide 98-99 % techn., sodium-free quality<br/>120 g salt for 1 l bath with 25 g/l Ag<br/>130 g salt for 1 l bath with 40 g/l Ag<br/>Storage stability: unlimited</p> <p>b) Potassium Silver Cyanide 54 %<br/>46.3 g salt for 1 l bath with 25 g/l Ag<br/>74.1 g salt for 1 l bath with 40 g/l Ag<br/>Storage stability: unlimited</p> <p>c) Potassium Carbonate sodium-free quality<br/>40 g for 1 l bath<br/>Storage stability: unlimited</p> <p>d) ARGUNA® 621 Brightener 1<br/>free from precious metal<br/>25 ml for 1 l bath<br/>Storage stability: min. 2 years</p> <p>e) ARGUNA® 621 Brightener 2<br/>free from precious metal<br/>15 ml for 1 l bath<br/>Storage stability: min. 2 years</p> <p>f) ARGUNA® Conducting Salt 2<br/>free from precious metal<br/>20 g for 1 l bath<br/>Storage stability: unlimited</p> |
| Bath replenishment: | <p>g) ARGUNA® 621 Brightener 1 (as item d)<br/>for consumption, see "Bath Replenishment"</p> <p>h) ARGUNA® 621 Brightener 2 (as item e)<br/>for consumption, see "Bath Replenishment"</p>  |
| Bath correction:    | <p>i) For correction purposes according to requirement should be available:<br/>Potassium Silver Cyanide 54 %<br/>Potassium Cyanide</p>  |

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## Bath Makeup

**Preparations:** **Important hint:**  
All plastic parts coming into contact with the bath, e.g. tank, rack insulation, barrels, filter elements, pumps and hoses, must be alkali-proof. Prior to use, they must be treated for several hours in 5 - 10 % sodium hydroxide solution at operating temperature. Then rinse carefully until alkali-free. Filter cartridges in particular should be carefully cleaned and rinsed repeatedly, changing the water each time. The last rinse must always be deionized water.

**Makeup sequence:** To make up the bath, fill deionized water corresponding to half of the final bath volume into a spare tank and heat to 30 - 40 °C. Stir in first Potassium Cyanide and then Potassium Silver Cyanide 54 % and dissolve. The necessary amounts depend on the desired silver content of the bath:

For the standard bath containing 40 g/l Ag  
130 g/l Potassium Cyanide and  
74.1 g/l Potassium Silver Cyanide  
54 %

are required.

For the bath with the lower silver content of 25 g/l Ag  
120 g/l Potassium Cyanide and  
46.3 g/l Potassium Silver Cyanide  
54 %

are used.

Then dissolve 40 g/l Potassium Carbonate, 20 g/l ARGUNA® Conducting Salt 2 and slowly add 25 ml/l ARGUNA® 621 Brightener 1, stirring vigorously. The solution will take on a dark-brown colour. Filter the electrolyte through a cleaned filter cartridge into the actual bath tank. Fill up to final volume with deionized water and slowly add 15 ml/l ARGUNA® 621 Brightener 2, stirring vigorously.

### Important hints:

Using sodium-free chemicals is absolutely essential.

After makeup the bath must be allowed to stand for several hours - overnight would be best.

Example:	1. desired bath volume	100 l
	2. initial volume of deionized water (30 - 40 °C)	50 l
	3. amount of Potassium Cyanide	13 kg
	4. amount of Potassium Silver Cyanide 54 %	7.41 kg
	5. amount of Potassium Carbonate	4 kg
	6. amount of ARGUNA® Conducting Salt 2	2 kg
	7. amount of ARGUNA® 621 Brightener 1	2.5 l
	8. amount of ARGUNA® 621 Brightener 2	1.5 l
	9. amount of deionized water	up to 100 l

## Operating Conditions

Silver content:	Standard bath with specified content of 40 g/l Ag (35 - 45 g/l Ag)
	Special bath with low content of 25 g/l Ag (25 - 30 g/l Ag) for lower current density / speed
Potassium Cyanide content:	Bath with 40 g/l Ag: 130 g/l KCN Bath with 25 g/l Ag: 120 g/l KCN
Potassium Carbonate content:	40 - 150 g/l K <sub>2</sub> CO <sub>3</sub> , see "Bath Monitoring and Correction"
Operating temperature:	20 - 45 °C; at higher temperatures higher current densities are applied.
pH-value:	Alkaline, not controlled
Bath density:	New makeup with 40 g/l Ag: 1.14 g/cm <sup>3</sup> New makeup with 25 g/l Ag: 1.12 g/cm <sup>3</sup> Rising during operation up to 1.16 g/cm <sup>3</sup>
Agitation of parts:	required, approx. 5 cm/sec
Filtration:	continuous filtration is recommended PP filter cartridges ≤ 5 µm pore size
Current density:	approx. 1 - 2 A/dm <sup>2</sup> at 20 - 30 °C at higher temperatures up to 5 A/dm <sup>2</sup> for standard bath or 4 A/dm <sup>2</sup> for special bath can be achieved.
Voltage:	1 - 3 volts, depending on distance of the electrodes and current density
Deposition rate:	67 mg/Amin
Current efficiency:	100 %
Deposition speed:	proportional to current density: at 1 A/dm <sup>2</sup> : 0.64 µm/min at 1.6 A/dm <sup>2</sup> : 1.0 µm/min at 2 A/dm <sup>2</sup> : 1.28 µm/min at 4 A/dm <sup>2</sup> : 2.56 µm/min

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## Calculation of Coating Thickness and Plating Time

Coating weight in mg = surface in cm<sup>2</sup> x 1.05 x coating thickness in µm

Plating time in minutes =  $\frac{\text{required coating weight in mg}}{67 \times \text{current in amperes}}$

Plating time for 1 µm: approx. 1 min at 1.6 A/dm<sup>2</sup>

Density of the coating: 10.5 g/cm<sup>3</sup>

## Bath Replenishment

The bath must be kept clean. Any contamination (metallic, organic) must be avoided. The bath should be filtered occasionally, preferably during non-plating periods.

The consumption of **ARGUNA® 621 Brightener 1** is approx. 1 - 1.5 litres per 2000 Ah (8 kg Ag) or approx. 124 - 187 ml per 1 kg Ag.

**ARGUNA® 621 Brightener 2** is consumed only by drag-out. Therefore consumption normally is approx. 1 litre per 10000 Ah (40 kg Ag) or approx. 24 ml per 1 kg Ag.

Brightener 1 and 2 should be added with vigorous stirring before non-plating periods, never directly during silver-plating.

We recommend using an amperehour meter for determining the exact amount of silver which is deposited. 1000 Amin are equivalent to 67 g silver (1 Ah = 4 g). 100 g silver are equivalent to approx. 1500 Amin.

## Bath Monitoring and Correction

### Silver content:

The bath works with soluble anodes which replace the silver deposited. Therefore the silver content of the bath has to be controlled only at longer time intervals and should be corrected with Potassium Silver Cyanide 54 %, if necessary. A low silver content reduces the maximally applicable current density.

### Potassium Cyanide:

The content of free Potassium Cyanide must be controlled and corrected more frequently. Its concentration should be kept between 120 g/l and 140 g/l. A KCN content which is too low narrows the applicable current density range.

### Potassium Carbonate:

Good conductivity and throwing power require a minimum concentration of Potassium Carbonate. For a new makeup, this is 40 g/l K<sub>2</sub>CO<sub>3</sub>. The concentration of Potassium Carbonate will rise during operation of the bath and result in a narrower applicable current density range. When reaching a maximum content of 120-150 g/l K<sub>2</sub>CO<sub>3</sub>, a new bath should be made up.

### Brightener 1:

ARGUNA® 621 Brightener 1 produces brilliant brightness and very white coatings. It is consumed only during operation of the bath, see "Bath Replenishment". A moderate overdose of Brightener 1 is harmless, with higher overdoses bluish hazes may occur. If the brightness should be unsatisfactory although there is enough KCN in the bath, there is a lack of Brightener 1. Add ARGUNA® 621 Brightener 1 to the bath in steps of 5 - 10 ml/l. We recommend checking the effect of special additions in a Hull cell in advance; see "Hull cell test".

### Brightener 2:

ARGUNA® 621 Brightener 2 acts as a carrier of brightness. This component is long-time stable and is essentially only consumed by drag-out. Brightener 2 must not be overdosed, otherwise the coatings will be milky in low current density areas and yellowish in high current density areas. A lack of Brightener 2 is indicated by matt deposits in low current density areas. It is essential to check additions of Brightener 2 in a Hull cell in advance, see below under "Hull cell test".

### Hull cell test:

The Hull cell test is a fast method of checking the bath.

The operating conditions are:

250 ml Hull cell with fine silver anode

1 A cell current

10 min plating time

agitation: magnetic stirrer 25 mm length, 300 rpm normal operating conditions of the bath

The Hull cell panel should be bright, with only a small burnt area (approx. 2 - 3 cm, high current density).

## Special Process Hints

**Pre-treatment:** The parts to be silver-plated made of copper or copper alloys\* are degreased in the usual way in an electrolytic degreasing bath for 1- 1.5 minutes at 6 V, after thorough rinsing pickled in dilute acid, rinsed again thoroughly and then plated for approx. 0.5 minutes in a silver strike solution (e.g. in ARGUNA® Flash Silver) at 4 - 6 V. A thin silver coating of good adherence will be formed. After draining, insert the parts without intermediate rinsing in the silver bath and finish silver-plating.

\*Parts made of iron, zinc, tin, lead, and their alloys must be previously thickly plated with copper. When silver-plating nickel, silver striking will not usually be necessary.

**Barrel plating:** Approx. 3 - 5 barrel rotations per minute. Voltage approx. 3 - 6 volts. A total current of approx. 20 - 40 A for 10 - 15 l of bulk volume. A recovery rinse is required.

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**Post-treatment:** After silver plating, rinse in a recovery rinse, then under running water and finally in deionized and if possible warm water. The coatings from ARGUNA® 621 will not take on a brown colour even if the transfer times during automatic operation are longer (i.e. longer periods of remaining in the air between silver plating and first rinse).

## Equipment

**Bath tanks:** Alkali-resistant plastic tanks, preferably steel tanks lined with hard rubber, smaller tanks also from stoneware or glass

**Heating:** Immersion heaters sheathed with porcelain, quartz, or Teflon suitable for the bath volume

**Anodes:** As anode material, only fine silver is suitable. Choose the anode area as large as possible, at least as large as the surface of the parts. In order to avoid contamination of the bath by undissolved silver particles, using anode bags of polypropylene, mesh size 10 µm, is absolutely essential. Any anode rests can be used up in titanium baskets which have to be also enclosed by anode bags.

**Agitation of parts:** Required, approx. 5 cm/s

**Rectifier:** Infinitely variable, with current display, possibly Ah-meter; residual ripple < 5 %

**Exhaust system:** For larger baths an effective exhaust system is absolutely essential to remove any cyanide vapours!

**Warning signs:** Bath or equipment should be provided with warning signs warning of cyanide and hydrocyanic acid.

## Note

Our information relating to the storage stability refers to storage in closed original storage containers under the conditions stated on the label.

## Precautionary Measures/Safety Hints

### Caution:

The bath contains highly toxic cyanide in a high concentration. Exhaust system for the bath is required. Point out the dangerous nature of the bath by putting up danger signs.

For information on safety, please see the corresponding Material Safety Data Sheets! The valid accident prevention regulations and safety information must be observed.

## Reference to

Trouble-shooting table: available on request

Analytical control: available on request

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