RHODUNA® DX

Operating Instructions

Edition: 30 August 2007

Decorative brilliant white rhodium

- **developed for the plating of chains and other complex shaped articles**
- **excellent throwing power**
- **highest covering speed**
- **ultrabright coatings with excellent lightness**
- **for rack and barrel operation**

Bath Characteristics

RHODUNA® DX is a rhodium electrolyte for the deposition of decorative brilliant white coatings on chains and similar complex shaped parts.

The process offers outstanding covering speed and throwing power combined with an extraordinary wide operating window and silver-like perfect white coatings.

Bath type:	Acid rhodium electrolyte	
Rhodium content:	2 g/l Rh	(0.5 - 2.5 g/l)
pH-value:	<1	
Temperature:	40 °C	(20 - 65 °C)
Current density:	2 A/dm²	(1 - 20 A/dm²)
Voltage:	2.5 V	(2 - 4.5 V)
Deposition speed:	0.13 µm/min	(2 g/l Rh, 40 °C, 2 A/dm²)

Coating Characteristics

Coating:	99.9 % of rhodium
Colour:	Brilliant white
Hardness:	Approx. 800 - 900 HV
Density of coating:	Approx. 12.4 g/cm³
Max. coating thickness:	Bright coatings up to 0.3 µm

Form of Supply

Bath makeup:

a) RHODUNA® DX Concentrate
(4 g Rh/100 ml)
50 ml to make up 1 litre of bath with 2 g/l of rhodium
Storage stability: min. 2 years

b) Sulphuric Acid 94-98 % p.a.
D=1.84 g/cm³
15 ml (27 g) to make up 1 litre of bath
Storage stability: unlimited

Bath replenishment:

c) RHODUNA® DX Concentrate
(4 g Rh/100 ml)
(as item a)
25 ml for 1 g of rhodium
Storage stability: min. 2 years

Bath Makeup

Makeup sequence:

For 1 litre of RHODUNA® DX with 2 g/l of Rh:

Slowly and carefully stir 15 ml (27 g) of sulphuric acid 96 % into 900 ml of deionized water and add 50 ml of RHODUNA® DX Concentrate, mix well and fill up to 1 litre with deionized water.

Hint: For other Rh concentrations just vary the necessary amount of RHODUNA® DX Concentrate, e.g. for an electrolyte containing 1 g/l Rh only 25 ml/l of RHODUNA® DX Concentrate have to be added to the 15 ml (27 g) of sulphuric acid 96 % diluted with 900 ml of deionized water.

Operating Conditions

Rhodium content:	2 g/l of Rh	(0.5 - 2.5 g/l)
Sulphuric acid content:	30 g/l (28 - 30 g/l) after makeup For further details, see "Bath Replenishment".	
Operating temperature:	40 °C	(20 - 65 °C)
pH-value:	<1, no monitoring required	
Bath density:	1.020 g/cm³ / 2.8°Bé (2.0 g/l of Rh) 1.017 g/cm³ / 2.4°Bé (1.0 g/l of Rh) 1.016 g/cm³ / 2.3°Bé (0.5 g/l of Rh) All values are for a new makeup.	
Product agitation:	Optional (5 cm/s). Mechanical tapping to dislodge adhering hydrogen bubbles is recommended.	
Voltage and Current density:	2.5 V 2 A/dm²	(2 - 4.5 V) (1 - 20 A/dm²)

For thin deposits a high current density & voltage is advantageous to achieve the best brightness (see under "Special Operating Conditions/ Cost saving conditions for thin ultrabright deposits").

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Deposition rate, current efficiency, deposition speed:

The following table states the values for current efficiency, deposition rate and deposition speed at different current densities.

Valid for 40 °C:

Current density A/dm²	1.0	**2.0**	5.0	10	20
Deposition rate in mg/Amin					
2.0 g/l Rh	13	8.2	4.1	2.4	1.6
1.0 g/l Rh	7	3.3	2	1.7	0.7
0.5 g/l Rh	4	1.8	1	0.8	0.4
Current efficiency in percent					
2.0 g/l Rh	61	38	19	11	8
1.0 g/l Rh	33	15	9	8	3
0.5 g/l Rh	19	8	5	4	2
Deposition speed in microns/minute					
2.0 g/l Rh	0.11	0.13	0.17	0.19	0.26
1.0 g/l Rh	0.06	0.07	0.09	0.10	0.13
0.5 g/l Rh	0.03	0.03	0.04	0.06	0.06

All values are a guide only. At 20 °C deposition rate, efficiency and deposition speed will be reduced to approx. half of the stated values. At 60 °C deposition rate, efficiency and plating speed are approximately 1.3 times of the values at 40 °C.

Calculation of Coating Thickness and Plating Time

Coating weight in mg = surface in cm² x 1.24 x coating thickness in µm

$$\text{Plating time in minutes} = \frac{\text{required coating weight in mg}}{\text{deposition rate in mg/Amin} \times \text{current in amperes}}$$

Bath Replenishment

To maintain constant operating conditions the rhodium content of the bath should not drop more than 20 % below the adjusted nominal value.

For 1 g of Rh add to the bath:
25 ml/l of RHODUNA® DX Concentrate (4 g Rh/100 ml)

Bath Monitoring and Correction

Keep the bath clean. Cover when not in use and remove the anodes from the bath. Store in a closed bottle when not in use for a longer period of time. Filter turbid baths.

Always correct the **rhodium content** with RHODUNA® DX Concentrate (4 g Rh/100 ml).

The content of **sulphuric acid** must be adjusted to the nominal value when making up the bath. It should be analysed on a regular base, if the bath is operated with high drag-out.

An **active carbon treatment**, e.g. for removing organic contaminants, can be carried out without any significant loss of rhodium. Add 2 g of Active Carbon 1 per litre of bath in a separate tank, stir for 2 hours at operating temperature and then filter.

To avoid any **metallic contaminants** (silver, copper and zinc in particular) and the drag-in of cyanide, good rinsing steps are essential prior to the rhodium plating!

Special Process Hints

Cost saving conditions for thin ultra-bright deposits:

For excellent results with a very short plating time and at low rhodium concentration:

Makeup with 1 g/l of Rh:
Stir 15 ml (27 g) of sulphuric acid 96 % slowly and carefully into 960 ml of deionized water and add 25 ml of RHODUNA® DX Concentrate.

Operating Conditions:
4.5 V (approx. 10-20 A/dm²)
10-20 s plating time
60 °C
no movement required

Pre-treatment:

Etch, grind, polish etc. the base metal to achieve the desired initial surface condition. Preliminary degreasing should be effected with e.g. an alkaline cleaning solution, or an ultrasonic bath. Rinse, then degrease electrolytically, rinse under running water, and finally with deionized water.

Pre-nickel plating

Rhodium can be directly deposited on silver, gold, copper and copper alloys, nickel and nickel alloys. When plating tin, lead, zinc, cadmium, aluminium and iron, intermediate nickel coatings of some micrometres thickness are absolutely essential.

When nickel plating is completed, rinse thoroughly. Each rinsing operation before rhodium plating should consist of rinsing under running water followed by rinsing with deionized water.

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Acid dip:	After degreasing or pre-nickel plating, dip the workpieces in 5 vol.% sulphuric acid (chemically pure) at room temperature before hanging them into the rhodium bath to ensure that no alkalis are dragged into the rhodium bath. If particularly great difficulties are encountered in wetting after pre-nickel plating, repeat the electrolytic degreasing and acid dip treatments. The last step before rhodium plating should always be an acid dip treatment.
Rhodium plating:	After the acid dip, drain the workpieces quickly, **connect to current** and hang into the rhodium bath without intermediate rinsing. Any adhering hydrogen bubbles should be continually removed.
Post-treatment:	Allow the bath fluid to drain off thoroughly. Rinse in deionized water, then in running water and - if possible - also in hot water. Dry immediately. Use the first recovery rinse water for topping up the rhodium bath.

Equipment

Bath tanks:	Tanks of acid-proof materials, preferably polypropylene.
Accessories:	All plastic parts coming into contact with the bath, e.g. bath tanks, rack insulation, barrels, pumps and hoses, prior to use must be acidified in 5 - 10 % cold sulphuric acid for approx. 24 hours. **Very important:** Prior to use, filter cartridges must be boiled in 10 % sulphuric acid for approx. 3 hours. Then they are inserted into the pump and thoroughly rinsed with water. It is essential to change the water several times.
Product agitation:	Optional. Mechanical tapping to dislodge adhering hydrogen bubbles is recommended.
Anodes:	Platinized titanium. We recommend PLATINODE® coated with 2.5 µm of platinum. We recommend removing the anodes from the bath during non-plating periods (during the night). Ratio of anode area to parts area at least 1 : 1.
Current source:	Infinitely variable, with current and voltage display; residual ripple < 5 %.
Exhaust system:	Required for large baths (strongly acidic bath mists entrained by evolution of hydrogen).

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

The bath contains strong acids in high concentration.

For information on safety, please see the corresponding Material Safety Data Sheets!

The valid accident prevention regulations and safety instructions must be observed.

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