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PROCESS FOR ELECTROPLATING OF SILVER ON COPPER AND COPPER BASED ALLOYS					
1.0 GENERAL : This standard details the process for silver plating on copper and copper based alloys from cyanide bath to protect them against corrosion, to provide decorative finish and to improve electrical conductivity. 2.0 APPLICATION : Used for contact rods, rollers, guide tubes, contact fasteners, etc., in switch gear, out put leads of generators, busbars, ferrules, shunt terminals, control gear equipment, etc. 3.0 COMPLIANCE WITH NATIONAL STANDARDS : There is no National standard covering this process. However, assistance has been derived from the following National standard regarding surface condition and quality of deposit. i) IS : 1067-1981 : Electroplated Coatings of Silver for Decorative And Protective Purposes. ii) IS : 1771-1986 : Electroplated Coatings of Silver and Silver Alloys for General engineering purposes. iii) IS : 5925-1970 : Recommended Practice for Silver plating for General Engineering Purposes.					
Revisions : Cl.34.11.12 of MOM of MRC (CPO)			APPROVED : INTERPLANT MATERIAL RATIONALISATION COMMITTEE- MRC (CPO)		
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4.0	MATERIALS :		
	Material	CPS No. / IS No. / Available from	
4.1	Sulphuric Acid-Technical	:	IS:266
4.2	Silver potassium cyanide 54%	:	IS:6267
4.3	Potassium Cyanide	:	AA 556 09
4.4	Silver anodes	:	IS : 1959
4.5	Potassium Hydroxide (Caustic Potash)	:	IS : 6831
4.6	Stainless Steel Anodes	:	IS : 6911, Gr:07Cr18 Ni9.
4.7	Activated carbon pure (for Electroplating)	M/s Graur and weil (India) Ltd. Mumbai. M/s Artek surfin Chemicals (P) Ltd, Mumbai,	
4.8	Silsal ‘AX’	:	
4.9	Silsal ‘Z’	:	M/s. Canning Mitra Phonix Ltd.,
4.10	Silver Brights	:	Mumbai
4.11	Passival ‘AG’		
4.12	‘Silvernix’ Bright Silver salt	:	
4.13	‘Strike Silver’ Salt	:	M/s. Grauer and weil (India) Ltd.,
4.14	‘Silvernix’ Standard Brightener	:	Mumbai
4.15	‘Silvernix’ Make-up Brightener	:	
4.16	‘Silchrome’ Anti-Tarnishing Solution	:	
4.17	‘Sil Glo’ Salt 601A	:	
4.18	‘Sil Glo’ Salt 601B	:	
4.19	‘Strik sil’ 610 Salt	:	M/s. Platewel Processes and
4.20	‘Sil Glo’ 602 Brightener	:	Chemicals Ltd.,
4.21	‘Sil Glo’ 603 Brightener	:	
4.22	Stopping off lacquer (Resistant to acid, alkali, cyanide and heat)	:	M/s. IEL Ltd.,Kolkata M/s. Shalimar Paints, Kolkata.
4.23	Grey Mesking compound	:	M/s. Phiroz Sethna, Mumbai.
4.24	Argomax Strike silver salt	:	M/s. Artek surfin chemical (p) Ltd.,
4.25	Argomax Bright silver salt	:	Mumbai.

5.0	EQUIPMENT :		
5.1	Striking Tank: The tank for striking solution shall be made of welded steel lined with rubber / FRP/PVC.		
5.2	Plating Tank : The tank shall be made of welded steel lined with rubber/FRP/PVC fitted with cathode rod movement system.		
5.3	Rinsing Tanks : Mild steel tanks		



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5.4 Antitarnishing Treatment Tank :

The tank shall be made of welded steel lined with rubber/PVC.

5.5 Filter Pump :

Rubber lined standard filter pump.

5.6 Drag out Tank :

The tank shall be made of welded steel lined with Rubber / PVC / FRP.

5.7 Hot Water Rinsing Tank :

M.S. tank fitted with heating arrangement.

5.8 Ampere-Hour Meter.

Suitable for the work.

6.0 COMPOSITION OF ELECTROLYTE AND OPERATING INSTRUCTIONS :

6.1 Electrolyte for Striking Bath :

The electrolyte for striking bath shall be prepared according to any one of the compositions specified in Table - 1 and operated at the conditions specified therein.

TABLE - 1 : ELECTROLYTE FOR STRIKING BATH

Parameter	Composition			
	I	II	III	IV
Name of salt	Silal Z	Srike Silver	Strik Sil 610	Argomax Strike Silver Salt
Salt Content, g/l	6	100	50	100
Potassium cyanide, g/l	37	--	40-50	--
Voltage, V	2-4	0.5-2	2-4	0.5-2.0
Current density A/dm ²	2-3	0.1-0.20	2-4	0.10-0.20
Time, Sec. (or as required)	15	30-60	30-45	30-60
Temperature	Room	Room	Room	Room
Anodes	Stainless Steel	Silver	---	Silver or Stainless Steel

6.2 Electrolyte for Silver Plating :

The electrolyte for silver plating shall be prepared according to any one of the compositions specified in Table-2 and operated at the conditions specified therein.

TABLE - 2 : ELECTROLYTE FOR SILVER PLATING

Parameter	Composition			
Name of Salt	I	II	III	IV
	Silsal AX	Silvernix	Sil Glo 601 and 601B	Argomax Bright Silver Salt
Salt content, g/l	212.5	200	601A:200 601B:115	200 ---
Potassium cyanide, g/l	19	---	---	---
Silvernix Make-Up	---	30	---	30
Brightener, ml/l (Optional)				
Sil Glo : 602	---	---	25	---
Brightener ml/l (Optional)				
Voltage, V	1-2	1-1.5	1-1.5	1-1.5
Current density, A/dm ²	1.5-2.0	0.5-2.0	0.5-2.0	0.5-2.5
pH	---	12-12.5	12.2-12.5	---
Temperature	Room	Room	Room	Room
Agitation	---- Cathode Movement recommended ----			
Anodes	Silver	Silver	Silver	Silver
Brightener per kAhr, ml (Optional) :	---	---	---	---
Standard Brightener	---	500-1,000	---	500-1000
Sil Glo : 603 Brightener	---	---	600-700	---
Anode to Cathode ratio	1:1	1:1	1:1	1:1
Time	--- As per Thickness Requirement ----			

6.3 Preparation of Electrolyte for strike and plating :

The tank shall be filled with demineralised water to 1/3 to 1/2 the required volume and the required amount of strike and plating salts as per tables 1 & 2 respectively shall be added to the bath in small quantities with stirring.

After complete dissolution, the electrolyte shall be brought up to the working level by adding demineralised water and subsequently stirred thoroughly.



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6.4 Analysis of the Electrolytes :

6.4.1 The electrolytes prepared shall be analyzed after initial make up and subsequently at suitable intervals.

6.4.2 The Silver metal content after initial make up shall be minimum.

40 for composition I Table 2

30 --- do --- II, III and IV Table 2

6 ---- do --- I Table 1

3 ---- do --- II, III and IV Table 1

6.4.3 The composition of electrolytes as referred in clause 6 shall be maintained at the following limits by adding required quantity of salt or Potassium Cyanide as per the table 3 and 4.

TABLE - 3 : STRIKE BATH

Parameter	Composition			
	I	II	III	IV
Silver as metal, g/l	6	3-4	2-5	3-4
Free potassium Cyanide, g/l	37	90-130	40-45	90-130

TABLE - 4 : SILVER PLATING BATH

Parameter	Composition			
	I	II	III	IV
Silver as metal. g/l	40	40-45	30-35	40-45
Free potassium cyanide, g/l	50-55	100-140	95-100	100-140
Potassium hydroxide, g/l	9-10	--	--	--

6.5 Antitarnishing Electrolyte :

The antitarnishing electrolyte shall be prepared according to any one of the compositions specified in Table - 5 and operated at the conditions specified therein.

TABLE - 5 : ANTITARNISHING ELECTROLYTE

Parameter	Composition	
	I	II
Name of Chemical	Passival 'AG'	Silchrome
Chemical content	100 g/l	200-250 ml/l
Voltage, V	4 - 6	3 - 7
Current density, Ad2m	2.7	1.5 - 4.5
Temperature	Shop	Shop
Time, minutes	1-2.5	2-5
pH	---	8-9
Anodes	Stainless Steel	Stainless Steel
Pointage	---	20-25

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7.0 PROCESS : 7.1 Cleaning : Articles shall be cleaned as described in Corporate Standard AA 067 36 01. Stopping off lacquer is applied wherever the plating is not needed before pickling. 7.2 Rinsing : All articles after cleaning shall be rinsed thoroughly in running water to avoid contamination of the electrolyte. Note: 1) In case the articles to be plated are made of brass/bronze, an undercoat of electroplated copper (conforming to AA 067 36 07) or dull nickel (conforming to AA 067 36 05) shall be given. 2) After Bright dip pickling (Clause 8.6 of AA 067 36 01 Rev 05, Page No 9) and cold water rinse (clause 8.7 of AA 067 36 01, Rev 05 Page No 9) give acid activation dip in 5 to 8% sulphuric acid (CP grade for 1 to 2 minute followed by thorough water rinse in cold running water so as to remove last traces of acid from the component. 7.3 All articles shall be given a strike coat of silver to get an adherent silver deposit as per conditions given in Table - 1. It shall be ensured that current is 'ON' before the articles are put into the tank. 7.4 Silver Plating : All articles shall be plated at the specified current density for a duration which will depend on the thickness of the deposit required 7.5 Drag Out : All articles after removal from the plating bath shall be rinsed in drag out tank till all the traces of plating solution are removed. 7.6 Cold Rinsing : All articles after removal from the plating bath shall be rinsed in cold running water till all the traces of plating solution are removed. 7.7 Anti-Tarnishing : All articles shall be treated for anti-tarnishing, as per the conditions given in Table-5. 7.8 Cold Rinsing : All articles after removal from the anti-tarnishing bath shall be rinsed in cold running water till all the traces of anti tarnishing solution are removed. 7.9 Hot Rinsing : All articles after cold rinsing shall be rinsed thoroughly in hot water. Finally, after hot water treatment, articles are allowed to dry in hot air.		



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8.0 MAINTENANCE OF ELECTROLYTE :

If the working concentration of the plating solution does not lie in the limits as mentioned in Table-4, additions of silver salts and / of potassium cyanide shall be made according to requirement. Potassium hydroxide shall be added to maintain the desired pH value of 12-12.5.

The bath shall be filtered periodically through activated carbon filter beds for removing organic impurities.

Addition of silver brightener (optional) as recommended by the supplier shall be made to maintain the brightness of silver deposit.

9.0 PRECAUTIONS :

Anodes are to be removed from the plating baths after completion of the work. Stainless steel inverted 'V' shaped anode hooks only shall be used to suspend anodes from bus bar.

Any article or copper wire, used for suspending the parts for electroplating, which might have dropped into the tank shall be removed immediately to prevent contamination by their dissolution.

10.0 INSPECTION AND QUALITY OF DEPOSIT :

When tested in accordance with the test methods shown against each, the deposit shall conform to the norms specified below :

10.1 Sampling :

A minimum of 1% of each batch of vat/barrel load or part thereof shall be taken at random for testing with a minimum of 3 samples. When the plated components are big and can not be subjected to any of the specified test, a test panel of suitable size of the same basis metal should be plated along with component under identical condition for the purpose of testing. Approximate size of test panel (25 mm wide 100 mm length 1 mm thick).

10.2 Condition of Surface :

The plated surface shall appear as a smooth and continuous film over the basis metal and shall be free from surface defects such as pits, stains, blisters, un plated areas and other superficial blemishes visible to the naked eye. The plated surface shall be bright and free from nodules.

10.3 Thickness of Deposit (IS : 3203 or IS : 6012) :

The minimum thickness shall be as specified in BHEL order / drawing.

10.4 Adhesion (IS : 1771, CI 1.3.1) :

The blistering detachment of the coating shall be taken as evidence of unsatisfactory adhesion.

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10.5 Anti Tarnishing test (IS : 1771) :

Shall not show black or brown colour .

11.0 REJECTION :

If the samples taken do not comply with clauses 10.2, 10.3 and 10.4 a further quantity not less than twice the number orginally taken shall be subjected to these tests. If any one of these samples also fails, the whole batch shall be rejected.

12.0 REFERRED STANDARDS : (Latest Publications Including Amendments) :

1) IS : 1771	2) IS : 1959	3) IS : 3203	4) IS : 6012
5) IS : 6831	6) IS : 6911	7) IS 8366	8) AA 54101
9) AA 541 02	10) 55609		