ANNEXURE-A

PRE-QUALIFYING REQUIREMENTS FOR PURCHASE INDENT 20220040 DT. 29.04.2022 FOR FRAMEWORK AGREEMENT OF SILVER PLATING ON ALUMINIUM & COPPER SPLICE PLATES / FLATS / FLEXIBLES / CONDUCTORS / BARS INCLUDING HANDLING, POLISHING, BUFFING ON ITEMS ON FOR BHEL RUDRAPUR BASIS

Sl. No.	PRE-QUALIFYING REQUIREMENTS	DETAIL DESCRIPTION
01	**Size & Type of Job**	**Job Type-** Octagon, Square, Flat, Rectangular, L, Z & U type or as per design. **Size of Job:** Length- 4000 mm (Max.), Width- 500 mm (Max.), Thickness- 50 mm (Max.) **Note: - For jobs involving multiple sides (like octagon, square shape etc.), BHEL will be free to ask for plating on only one side (on selective portion) of the job. In that case, vendor will have to make suitable masking arrangement with no extra cost implication to BHEL.**
02	**Technical requirement**	1. Bidder shall have silver plating processing plant as per BHEL standard SG14610 R04, SG15600 R04 & AA0673613 R04. 2. Bidder shall have at least 2 years' experience (with documental proof) in silver plating on electrical grade aluminium alloy conductors and bus bars, to ensure required quality as per BHEL standard, as it is a specialized and expensive process for very high current carrying electrical application (up to 26000 Amps. at working temperature of 85°C). 3. The technical offer of new bidder other than BHEL PMD vendor, who is not listed with BHEL, shall be reviewed as per BHEL standard. The expert team of BHEL will visit their plant to examine the silver plating facilities as per SG14610 R04, SG15600 R04 & AA0673613 R04. Failing to meet the standard requirement will be liable for rejection of offer technically.
03	**Testing Facilities**	Bidder shall have testing facilities for i. Chemical composition analysis as per product standard SG14610 R04, SG15600 R04 & AA0673613 R04. ii. Thickness measurement iii. Anti-tarnishing iv. Adhesion v. Salt spray & vi. Humidity test etc.

ANNEXURE-B

TECNH-COMMERCIAL TERMS AND CONDITIONS FOR PURCHASE INDENT 20220040 DT. 29.04.2022 FOR FRAMEWORK AGREEMENT OF SILVER PLATING ON ALUMINIUM & COPPER SPLICE PLATES / FLATS / FLEXIBLES / CONDUCTORS / BARS INCLUDING HANDLING, POLISHING, BUFFING ON ITEMS ON FOR BHEL RUDRAPUR BASIS

Sl. No.	TECHINCAL TERMS	DETAIL DESCRIPTION
01	**Price Basis**	Rates shall be quoted for entering into framework agreement for One Year. Rates quoted shall be firm for 12 months for ordering including PV clause for silver. Multiples Orders shall be placed during validity period of this agreement on finalized rates.
02	**Delivery Destination**	Rates shall be quoted on F.O.R. BHEL Rudrapur basis. (Jobs shall be lifted by the bidder from BHEL-Rudrapur and shall be delivered back to BHEL Rudrapur after Silver Plating duly packed).
03	**Delivery requirement**	Delivery time shall be within 21 days from receipt of raw material (Al/Cu) from BHEL Rudrapur (under GST Job Work norms) after placement of purchase order.
04	**PVC Clause**	Rates shall be subject to Price Variation Clause (PVC) at the base rate of Silver (99.9% purity) @ Rs. 65,100/- As per Mumbai Bullion market (Ready) date 27.04.2022. For any change in this rate, the silver closing rate of Mumbai Bullion market on the 1st working day of the calendar month as published on ET-INTELLIGENCE shall be effective for supplies till the end of that month in which the plated components are to be supplied to BHEL/BHEL's fabricators.
05	**PVC Ratio & Formula**	Price Variation Formula: - **S=SF*{1+70%*(SI-SB)/SB}** Where, S = Applicable Rate of Silver Plating at the time of invoicing, SF = Applicable Rate of Silver Plating finalised in the NIT, SI = Applicable Base rate of Silver at the time of invoicing, SB = Applicable Base rate of Silver as per NIT,
06	**Test Certificate**	TC as per specification shall be submitted along with material.

<table>
<tr><td>07</td><td>Silver plating procedure/Inspection procedure/Packing</td><td>As per attached Product Standard SG14610 R04, SG15600 R04 & AA0673613 R04 and drg. No.- 45410001025 /Packing instructions as per BHE/Pack/SP/001 REV02.
- Quality assurance plan: QAP/BD/164/R02 (Copy attached)
- Composition of components to AA12329
- The chemical composition of material when analyzed in accordance with IS:504
- Method of chemical analysis of Aluminium and its alloys shall be as follows:
<table><tr><th>Elements</th><th>Min.</th><th>Percent Max.</th></tr><tr><td>Magnesium</td><td>0.4</td><td>0.90</td></tr><tr><td>Silicon</td><td>0.4</td><td>0.90</td></tr><tr><td>Manganese</td><td>0.4</td><td>0.90</td></tr><tr><td>Copper</td><td>0.4</td><td>0.90</td></tr><tr><td>Iron</td><td>0.4</td><td>0.90</td></tr><tr><td>Aluminium</td><td>Remainder</td><td></td></tr></table></td></tr>
<tr><td>08</td><td>Inspection</td><td>100% inspection shall be done by BHEL/BHEL's representative before dispatch.</td></tr>
<tr><td>09</td><td>Important IS</td><td>IS:1959 (Silver Anode)
IS:3203(Thickness)
IS: 1771(Adhesion/Tarnish Resistance test)
For all other required IS details vide Product standard SG15600 REV.03</td></tr>
<tr><td>10</td><td>Distribution Clause</td><td>Distribution shall be done as per below matrix as applicable: -
<table><tr><th>Distribution Matrix</th><th>L1</th><th>L2</th></tr><tr><td>02 lowest acceptable bidders</td><td>60%</td><td>40%</td></tr><tr><td>01 lowest bidder</td><td>100%</td><td>-</td></tr></table></td></tr>
<tr><td>11</td><td>Quantity variation</td><td>All the quantities in the enquiry are tentative being framework agreement and BHEL shall have no commitment for exact ordering. Supplier shall be prepared to accept orders of reduced quantities without any implication.</td></tr>
<tr><td>12</td><td>Insurance of BHEL issued material</td><td>Being Job Work contract, semi-finished / finished material shall be issued to sub-contractor for Silver Plating.
As the material being issued is sole property of BHEL, Insurance shall be done by BHEL for every consignment under prevailing Insurance Policy.</td></tr>
</table>

Bidder's Sign & Seal

BULLION as on 27 Apr 2022	
GOLD(10 Gm) - CLOSE	
BENGALURU	
Ornament	49880.00
Standard	53480.00
DELHI	
Biscuit	53375.00
Gold Sovereign	51375.00
One Kg.Bar(99.5)	53150.00
Ornaments (22 C)	49000.00
Standard (99.5)	53400.00
HYDERABAD	
Ornamental Gold (22 carats) (Per 10 G	48460.00
Standard Gold (24 carats) (Per 10Gms)	52870.00
KOLKATA	
22 Carat	49650.00
24 Carat	52350.00
Hallmark (22 carat)	50450.00
MUMBAI	
Bar	51650.00
IBJA Gold 585	30273.00
IBJA Gold 750	38812.00
IBJA Gold 916	47402.00
IBJA Gold 995	51542.00
IBJA Gold 999	51749.00
Ornaments (22 C)	47400.00
Standard (99.5)	51400.00
SILVER(1 Kg) - CLOSE	
BENGALURU	
Bar Wholesale	67100.00
DELHI	
Coins Local(10gms a Pc)	40000.00
Spot(.999)	67000.00
Weekly Delivery	65100.00
HYDERABAD	
Silver (0.999) (Per Kg)	70000.00
KOLKATA	
Portion	65650.00
Ready Bar	65450.00
MUMBAI	
Delivery	65200.00
IBJA Silver 999	65277.00
Raw	62900.00
Ready	65100.00

REV	DATE	ALTERED	REV	DATE	ALTERED	ADDITIONAL INFORMATION
11	29.07.08	CHECKED			CHECKED	STAUS OF DRAWING
DRAWING RETRACED.						DISTRIBUTION OF PRINTS

<ALL DIM. IN MM>

1. SURFACE PREPARATION FOR SILVER PLATING (BY FABRICATORS) :-

A. WELDED FACES OF CONDUCTOR OR ANY DENT MARK PRESENT ARE TO BE REMOVED EITHER BY SKIM CUT/GRINDING /EMERYING BUT DEPTH OF CUT SHALL NOT EXEED 1.0 mm.

B. DRILLED HOLES SHALL BE DEBURRED ON BOTH SIDE.

C. DRILLED END OF THE CONDUCTOR SHALL BE FACED PERPENDICULAR TO THE AXIS OF CONDUCTOR. SILVER PLATING IS TO BE DONE 35 mm FROM LAST HOLE (SEE FIG -1)

2. SPECIAL INSTRUCTION FOR ELECTROPLATERS :-

A. SILVER PLATING TO BHEL STANDARD 'BP 0673697/REV.00' SILVER PLATING TO BE MINIMUM 13 MICRON SILVER OR AS SPECIFIED ON CUSTOMERS SPECIFICATION WHICH EXCLUDES THIKNESS OF COPPER STRIKE AND DOUBLE ZINCATE TREATMENT FIG -1 TO BE FOLLOWED FOR SILVER PLATING OF SURFACE IF SPECIFIED ON DRAWING.

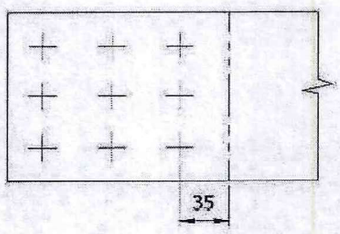

FIG - 1

3. PRECAUTIONS AFTER SILVER PLATING :-

A. PROTECTIVE COATING ON PLATED SURFACE : SILVER PLATED SURFACE SHOULD BE COVERED BY COTTON TAPE IMMEDIATELY AFTER PLATING (BY ELECTROPLATERS).

B. WHILE DOING WELDING, PRECAUTIONS TO BE TAKEN SO THAT SILVER PLATED SURFACE IS NOT DAMAGED (BY FABRICATORS).

C. COTTON TAPE SHOULD NOT BE REMOVED AT ANY STAGE IN THE SHOP. THIS WILL BE REMOVED AT SITE BEFORE MAKING BOLTED JOINTS.

		NAME	SIGN	DATE
BHARAT HEAVY ELECTRICALS LTD. RUDRAPUR	DRN	VISHAL		29.07.08
	CHD	P.SINGH		29.07.08
	APPD	RK LAL		29.07.08

DEPT.	SCALE	Wt. [Kg]	REF. TO ASSY. DRG.	ITEM No
ECC	N.T.S.			

TITLE	DRAWING NO.	REV.
GEN. INSTRUCTION FOR SILVER PLATING ON ALUMINIUM CONDUCTOR & FLEXIBLE	4 541 00 01 025	11

SHEET NO. -02	NO. OF SHEETS -03

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

1/4 [4-Page]

B.H.E.L. 2X0007/0006	STANDARD SUB-VENDOR QUALITY PLAN FOR Electro Plating of Silver On Aluminium and it's Alloys	MATERIAL INSPECTION / IN PROCESS INSPECTION / INAL INSPECTION	SUB-VENDOR'S / VENDOR'S / CONTRACTOR'S WORKS	QP.No. QP/BD/154, Ro2 Rev.02 Date 16.07.2003 Page 1 of 4

SL.No.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE O CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
	2	3	4	5	6	7	8	9	10	11
A	Composition And maintenance of Bath Solution	a) Alkaline degreasing solution	B	I	Sample to be taken from bath	SG: 15600 Cl. 6.1	SG: 15500 Cl. 6.1	Sub vendor Check list / Formats / Records	Sub vendor	Review of records by BHEL (periodic surveillance by BHEL inspection)
		b) Chromic sulphuric acid picking solution	B	I		Cl. 6.2	Cl. 6.2			
		c) De oxidizing solution	B	I	Sample	Cl. 6.4	Cl. 6.4			
		d) Zincate solution	B	I	Sample	Cl. 6.5	Cl. 6.5			
		e) Copper plating solution	B	I	Sample	Cl. 6.6	Cl. 6.6			
		f) Poltasium Cyanide dip solution	B	I	Sample	Cl. 6.7	Cl. 6.7			
		g) Silver strike solution	B	I	Sample	Cl. 6.8	Cl. 6.8			
		h) Silver plating solution	B	I	Sample	Cl. 6.9	Cl. 6.9			
		I) Brighter addition	B	I	Sample	Cl. 7.9	Cl. 7.9			
		j) Anti tarnishing solution	B	I	Sample	Cl. 6.10	Cl. 6.10			

(100)

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

B.H.E.L. QX/007/0005	STANDARD SUB-VENDOR QUALITY PLAN FOR Electro Plating of Silver On Aluminium and it's Alloys	MATERIAL INSPECTION / IN PROCESS INSPECTION / FINAL INSPECTION	SUB-VENDOR'S / VENDOR'S / CONTRACTOR'S WORKS	QP.No. QP/BD/104-Ro:2 Rev.02 Date 16.07.2003 Page 2 of 4

S. No.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
B	Cleaning / preparation of Aluminium Items	a) wire brushing	B	V	100%	SG: 15600 Cl. 8.1	SG: 15600 Cl. 8.1	Sub vendor Check list / Formats / Records	Sub vendor	Review of Records
		b) solvent degreasing	B	V	100%	Cl. 8.2	Cl. 8.2			
		c) alkaline degreasing	B	V	100%	Cl. 8.3	Cl. 8.3			
		d) Rinsing	B	V	100%	Cl. 8.4	Cl. 8.4			
		e) Acid cleaning / picking	B	V	100%	Cl. 8.4.1	Cl. 8.4.1			
		(i)Chromic sulphuric acid picking	B	V	100%	Cl. 8.4.2	Cl. 8.4.2			
		(ii)Rinsing	B	V	100%	Cl. 8.4.3	Cl. 8.4.3			
		(iii)Nitric Hydrofluoric acid picking	B	V	100%	Cl. 8.4.4	Cl. 8.4.4			
		(iv)Rinsing	B	V	100%	Cl. 8.4.5	Cl. 8.4.5			
		f) Deoxidation	B	V	100%	Cl. 8.5	Cl. 8.5			
		g) Rinsing	B	V	100%	SG: 15600 Cl. 8.6	SG: 15600 Cl. 8.6	Sub vendor Check list / Formats / Records	Sub vendor	Review of records by BHEL Periodic surveillance by BHEL Inspector
C	Preparation for Silver plating	a) First zincate treatment	B	I	100%	Cl. 8.6.1	Cl. 8.6.1			
		b) Rinsing	B	I	100%	Cl. 8.6.2	Cl. 8.6.2			
		c) Deoxidation	B	I	100%	Cl. 8.6.3	Cl. 8.6.3			
		d) Rinsing	B	I	100%	Cl. 8.6.4	Cl. 8.6.4			
		e) Second zincate treatment	B	I	100%	Cl. 8.6.5	Cl. 8.6.5			
		f) Rinsing	B	I	100%					

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BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

B.H.E.L. CQX/007/0006	STANDARD SUB-VENDOR QUALITY PLAN FOR Electro Plating of Silver On Aluminium and it's Alloys	MATERIAL INSPECTION / IN PROCESS INSPECTION / FINAL INSPECTION	SUB-VENDOR'S / VENDOR'S / CONTRACTOR'S WORKS	QP.No: QP/BD/164-Rev.02 Date 16.07.2003 Page 3 of 4

S.No.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1.	2	3	4	5	6	7	8	9	10	11
D	Silver plating Process	a) Copper plating	B	I	100%	Cl. 8.7.1	Cl. 8.7.1	Sub vendor Check list / Formats / Records	Sub vendor	Review of records by BHEL (periodic surveillance by BHEL Inspector
		b) Rinsing	B	I	100%	Cl. 8.7.2	Cl. 8.7.2			
		c) Cyanide dip	B	I	100%	Cl. 8.7.3	Cl. 8.7.3			
		d) Silver striking	B	I	100%	Cl. 8.8	Cl. 8.8			
		e) Silver plating	B	I	100%	Cl. 8.10 & 8.11	Cl. 8.10 & 8.11			
		f) Dragout & rinsing	B	I	100%	Cl. 8.12	Cl. 8.12			
		g) Hot rinsing	B	I	100%	Cl. 8.13	Cl. 8.13			
		h) Anti tarnishing	B	I	100%	Cl. 8.14	Cl. 8.14			
		i) Rinsing	B	I	100%					
E	Inspection of Electroplated Surface	a) Surface finish	B	V	Sample	IS:1771 / 3203	Drg	Sub vendor Test report	Sub vendor	CHP by BHEL At sub vendor Works.
		b) Thickness of Plating	B	T	Sample					
		c) Adhesion	B	T	Sample					
		(I) Burnishing test or	B	T	Sample					
		(II) Bend test or	B	T	Sample					
		d) Anti tarnish Treatment	B	T	100%					

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GRAUER & WEIL (INDIA) LIMITED

4/4

B.H.E.L. COX/D07/B006	STANDARD SUB-VENDOR QUALITY PLAN FOR Electro Plating of Silver On Aluminium and it's Alloys	MATERIAL INSPECTION / IN PROCESS INSPECTION / FINAL INSPECTION	SUB-VENDOR'S / VENDOR'S / CONTRACTOR'S WORKS	QP.No. QP/BD/164 Rev.02 Date 16.07.2003 Page 4 of

SL.NO	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
F	Protection coating for silver plating	a) Application of protective coating	B	I	100%	BD:15012 P Cl. 1.0	BD:15012 P Cl. 1.0	Sub vendor Check list / Formats	Sub vendor	Review of Records
		a) Drying	B	I	100%	Cl. 2.0	Cl. 2.0			
		b) Packing	B	I	100%	Cl. 3.0	Cl. 3.0		At Site	
		c) Removal of packing & protective coating	B	I	100%	Cl. 4.0	Cl. 4.0			

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LEGENT :- A :- Critical, I :- Inspection, B :- Major, TC :- Test Certificate, T :- Testing
OS :- Observation sheet, C :- Minor, V :- Visual, Drg. :- Drawing.

Prepared by

(H N SHAKYA)
Dy. MANAGER (COX)

Approved by

(P K JAIN)
DGM (COX)

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PACKING OF SILVER/TIN PLATED ITEMS/ BUS DUCT PALMS

1.0 INTRODUCTION:

This standard covers the procedure for packing of Silver / Tin plated items / bus duct palms.

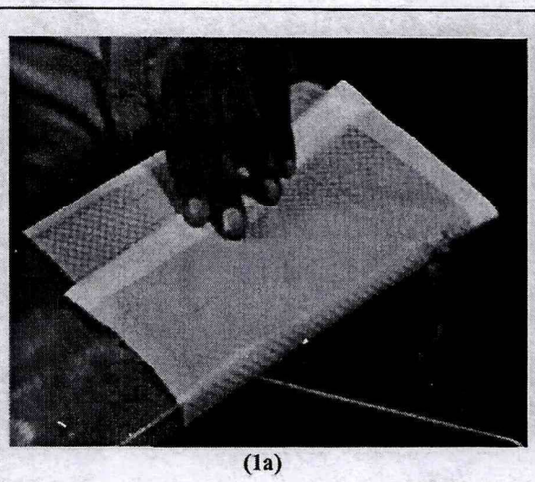
2.0 APPLICATION:

Shall be used for packing of silver plated Al splice plates / palms, silver & tin plated Copper plates.

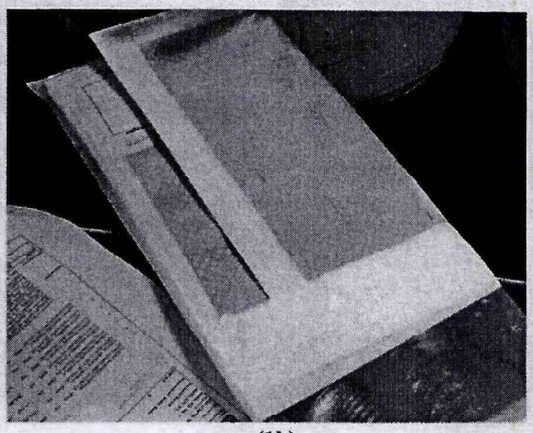
3.0 PROCEDURE:

1. After clearance from inspecting agency, surface of the plated portion to be cleaned by using dry cotton cloth to remove dust, loose particles etc.
2. Plated surface shall be covered using envelope of suitable size made of HDPE VCI film and HDPE VCI tape such that air & moisture does not trap between VCI film and Plated surface. (FIG-1a, 1b, 1c, 1d)
3. This assembly shall now be covered with cotton tape for providing cushion.
4. Cotton tape wrapped surface shall be covered with two layers of bubble sheets to avoid ingress of moisture and for providing cushion to plated surface (refer FIG-2a,2b).
5. Bubble sheet shall be covered with VCI Tape.
6. Edges of plated palms shall be covered with hard foam to avoid damage to edges during handling (refer FIG-3a, 3b).
7. Packed components shall be stored under covered shed.
8. Before dispatch of the item / Bus Duct to site, proper packing of Silver / Tin plated surface shall be ensured.
9. If any damage is noticed in the packing, it shall be re-packed by the above given process.

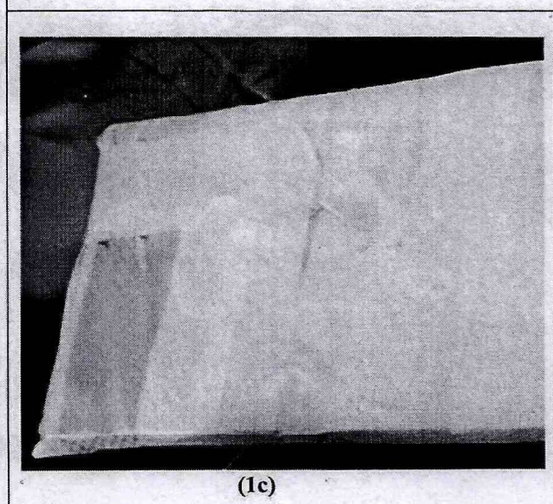
COMMITTEE MEMBERS / AGREED DEPTT.	DESIGNATION	SIGN. & DATE	PACKING OF SILVER/TIN PLATED ITEMS/ BUS DUCT PALMS		
ALOK KUMAR	Manager (REG)				
PARUSH KUMAR	Manager (Engg)				
KAPIL KUMAR BHARTI	Sr.Mgr (Quality & BE)				
AJIT SAHAY	Sr.Mgr (PDN & FES)	30.12.20			
ARVIND NARAYAN	Sr.Mgr (Engg).	30/12/2020	PREPARED BY	SANJAY KR. GUPTA - DY ENGR	
R.K. SAXSENA	Sr.DGM (MM & Stores)	31/12/20			
			CHECKED BY	RUPESH KUMAR - MGR	
		Approved by:	PLANT STANDARIZATION COMMITTEE		
REVISION NO.: 02 DATE:30.12.2020		Prepared by:	ENGINEERING. DEPARTMENT.		DATE: 15.12.20



(1a)



(1b)



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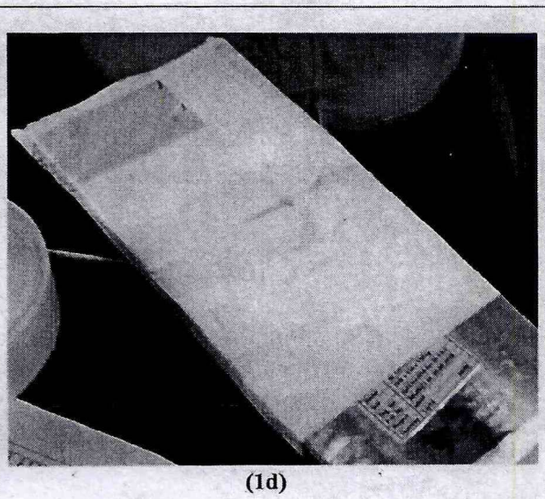


(1d)

FIG-1

COMMITTEE MEMBERS / AGREED DEPTT.	DESIGNATION	SIGN. & DATE
ALOK KUMAR	Manager (REG)	
PARUSH KUMAR	Manager (Engg)	
KAPIL KUMAR BHARTI	Sr.Mgr (Quality & BE)	30.12.20
AJIT SAHAY	Sr.Mgr (PDN & FES)	
ARVIND NARAYAN	Sr.Mgr (Engg).	30/12/20
R.K. SAXSENA	Sr.DGM (MM & Stores)	30/12/20

PACKING OF SILVER/TIN PLATED ITEMS/ BUS DUCT PALMS

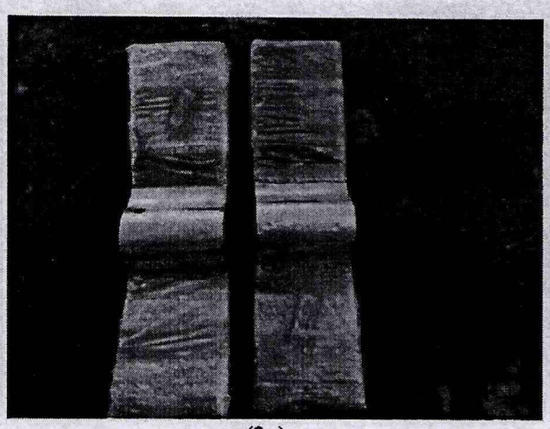
PREPARED BY	SANJAY KR. GUPTA - DY ENGR		
CHECKED BY	RUPESH KUMAR - MGR		

Approved by: PLANT STANDARIZATION COMMITTEE

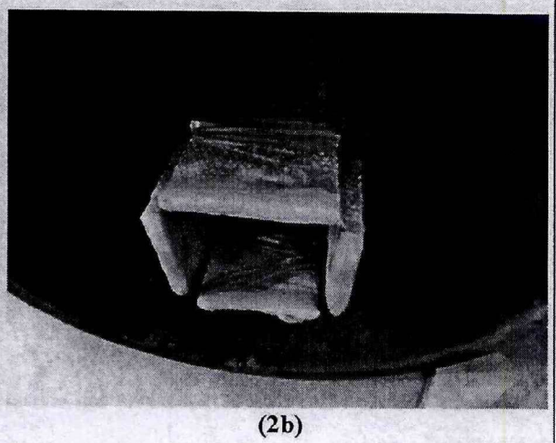
Prepared by: ENGINEERING. DEPARTMENT. DATE: 15.12.20

REVISION NO.: 02

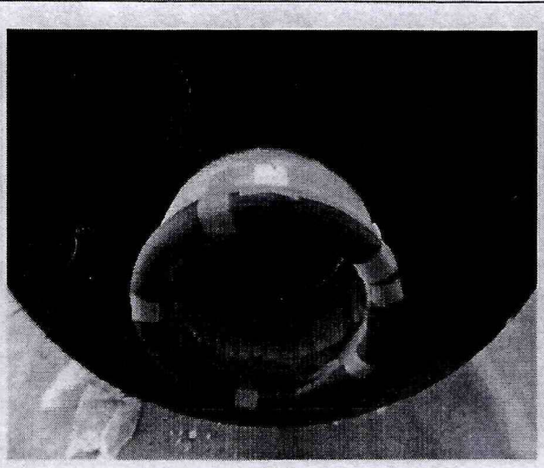
DATE: 30.12.2020



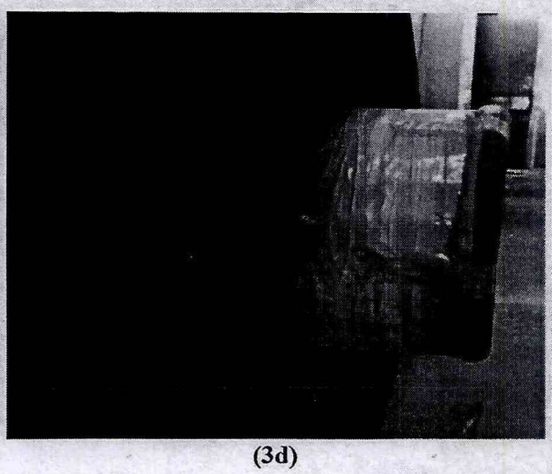
(2a)



(2b)



(3c)



(3d)

FIG - 3

COMMITTEE MEMBERS / AGREED DEPTT.	DESIGNATION	SIGN. & DATE
ALOK KUMAR	Manager (REG)	
PARUSH KUMAR	Manager (Engg)	
KAPIL KUMAR BHARTI	Sr.Mgr (Quality & BE)	30.12.20
AJIT SAHAY	Sr.Mgr (PDN & FES)	
ARVIND NARAYAN	Sr.Mgr (Engg).	30/12/20
R.K. SAXSENA	Sr.DGM (MM & Stores)	30/12/20

PACKING OF SILVER/TIN PLATED ITEMS/ BUS DUCT PALMS

PREPARED BY	SANJAY KR. GUPTA - DY ENGR	
CHECKED BY	RUPESH KUMAR - MGR	

Approved by: PLANT STANDARIZATION COMMITTEE

Prepared by: ENGINEERING. DEPARTMENT. DATE: 15.12.20

REVISION NO.: 02
DATE: 30.12.2020

ELECTROPLATING INSTRUCTIONS FOR BUSBARS & CONNECTIONS.

1. **GENERAL: -**
This standard facilitates the selection of Tin / Silver Plating procedure for all connections / bus bar of metal clad switchgear.

2. **APPLICATION: -**
Aluminium/Copper busbars, Connections, Droppers, Link plates, Earth connection and other similar items of metal clad switchgear type VM12, BVM12, VMN12, VN12(Kiosk), VM36.

3. **SELECTION CRITERIA: -**
All, busbars / connections mentioned above shall be electro-tin plated unless otherwise specifically called as silver plating in Drawing / PO / MID / Engg specification of Work Order.

4. **PLATING THICKNESS: -**
Unless otherwise stated in Drawing / PO / MID / Engg specification, Plating thickness shall be minimum 5 microns.

5. **QUALITY CHECKS AND ACCEPTANCE CRIETERIA OF MACHINED COPPER CONTACTS: -**
All the clauses called in SG 16054 shall be complied for machined copper contacts.

4. **ELECTRO PLATING PROCESS SPECIFICATIONS: -**

Table-1

CONN. MATERIAL TO BE PLATED	PLATING	PROCESS SPECIFICATION
Aluminium	Tin	SG 15605
	Silver	SG 15600
Copper	Tin	AA 0673602
	Silver	AA 0673613

5. **ACCEPTANCE CRITRERIA: -**
A. Plating thickness as per drawing/specification.
B. Adhesion test.
C. Anti-Tarnishing Test.
D. Packing and marking as per SG16054

Above test shall be performed as per relevant process specification specified in Table-1.

REV.	04	PRINTS TO:-	APPROVED –		
ALTD.	BPC	Issued Online	RKS		
APD	SKP		PREPARED	ISSUED	DATE
DATE.	21.3.14		DB	RKJ	17.03.00

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.

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

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/1	6	100	50	100
Potassium cyanide, g/1	37	--	40-50	--
Voltage, V	2-4	0.5-2	2-4	0.5-2.0
Current density A/dm2	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			
	I	II	III	IV
Name of Salt	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 Brightener ml/l (Optional)	---	---	25	---
Voltage, V	1-2	1-1.5	1-1.5	1-1.5
Current density, A/dm2	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.

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 Table1

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/1	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/1
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

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.

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, Cl 1.3.1) :

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

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		

ELECTROPLATING OF SILVER ON ALUMINIUM AND ITS ALLOYS

1. GENERAL: This standard details the process for plating silver on aluminum and its alloys. It covers surface preparation and modified zincate treatment required prior to electroplating silver with a copper under-coat on aluminium surfaces both in the wrought and cast forms normally used in electrical industry.

2. APPLICATION: Used for Bus Bars, Bus Duct Conductors, Bus Duct Flexible, Link plates, packers, Top and Bottom flanges of Switchgear equipments etc.

3. COMPLIANCE: WITH NATIONAL STANDARDS — This specification has reference to following Indian standards regarding surface prepration and quality of deposits.

IS 2450 : 1963 Reaffirmed 1992 - Recommended practice for plating on Alluminium and its alloys.

IS 3203 : 1982 Reaffirmed 1992 - Method of testing local thickness of electroplated coatings.

IS 1771 : 1986 Reaffirmed 1991 - Electroplated coatings of Silver and Silver Alloys for general engineering purposes.

IS 6012 : 1992 - Method of coating thickness by eddy current.

4. MATERIALS:

4.1 Trichloroethylene -(Technical) : AA 56706/IS: 245 Type 2

4.2 Chromium Trioxide(ELectroplating Grade) : AA 54205/ IS: 330

4.3 Sulphuric Acid -(Technical) : AA 54101/ IS: 266

4.4 Nitric Acid - (Technical) : AA 54102/ IS: 264

4.5 Caustic Soda -(Technical) : AA 54201/IS: 252

4.6 Zinc oxide -(Technical) : IS: 1880

4.7 Rochelle salt(Technical) : IS: 4846
(sodium -potassium Tartarate)

4.8 Ferric chloride -(Technical) : IS: 711
(FeCl3.12H2O)

4.9 Hydrofluoric Acid (40% purity)(Tech.A): IS: 10332

4.9.1 Acitek 707 : M/s Artek Surfin Chemicals Bombay

4.10 Coppele 160 (Rochelle Copper salt) : M/s platewel processes & chemicals Ltd, Vadodara

4.11 Rochelle Copper salt : M/s Grauer & weil (I) Ltd, Bombay

4.12 Sodium Cyanide - : IS: 6358/AA 55610

4.13 Copper Anode (99.9% pure) - Oval shape preferred. : IS: 2603

4.14 Aludegreaser : M/s Srinivasa Industrial Chemicals, Bangalore

4.14.1 Cleaner S-21 : M/s Platewel Processes & Chemical Ltd, Vadodara

4.15 Deoxidiser : M/s Srinivasa Industrial Chemicals Ltd Bangalore

4.16 Alzincate : -do-

4.17 Silvernix' Bright silver salt : M/s Grauer & weil (I) Ltd. Bombay.

4.17.1 Argomax Bright Silver Salt : M/S Artek surfin Chemicals Ltd Bombay

4.18 Silver potassium cyanide (54% Silver) : I.S.6267:90

4.19 Argomax Strike Silver Salt : M/s Artek Surfin Chemicals LTD Bombay

4.19.1 Strike Silver Salt : M/S Grauer and Weil (I) Ltd Bombay

4.19.2 Strik Sil 610 Salt : M/S Platewel processes and Chemical Ltd Vadodara

4.20	Silvernix' Make-up Brightener	: M/s Grauer & weil (I) Ltd Bombay
4.21	Silvernix' standard Brightener	: M/s Grauer & weil (I) Ltd Bombay
4.22	Silchrome	: M/s Grauer & weil (I) Ltd Bombay
4.23	Alzincate D	: -do-
4.24	Potassium Cyanide	: IS: 6358/AA 55609
4.25	Silver Anode	: IS: 1959
4.26	Stainless Steel Anode	: IS:6911, Gr.07 Cr18, Ni9
4.27	Stopping off Lacquer (Resistant to acid, alkali, cyanide and heat)	: M/s Shalimar paints, Bombay OR I.E.L. Ltd, Calcutta
4.27.1	Grey Masking compound	: M/s Phiroz Sethna Bombay
4.28	Activated carbon powder	: M/s Grauer & weil (I) Ltd. Bombay or M/s C.M.P. Ltd Bombay or M/s Sharabhai M. Chemicals, Baroda.
4.29	Ammonium Biflourede	: IS : 13119

5. EQUIPMENT

5.1	Vapour Degreasing plant	: Any standard plant for the purpose.

5.2 Alkaline Degreasing Tank	: Mild steel Tank fitted with steam coils or Electrical Heater for heating the tank solution.
5.3 Acid cleaning Tank	
5.3.1 For chromic-sulphuric Acid Soln	: Lead & PVC / FRP lined mild steel Tank fitted with heating arrangements.
5.3.2 For Nitric-Hydrofluoric Acid Solution	: PVC/PVC lined mild steel tank.
5.3.3 For Nitric Acid solution	: PVC / FRP Rubber lined mild steel Tank
5.3.4 For Deoxidiser solutions	: -do-
5.4 Zincate Treatment Tank	: Mild steel tank
5.5 Rinsing Tanks	
5.5.1 For Rinsing After Alkali Degreasing/Electroplating	: Mild steel tank
5.5.2 For Rinsing After Acid cleaning	: PVC/PVC lined mild steel tank
5.6 Copper plating Tank	
PVC or Rubber lined mild steel tank or plain mild steel tank	
5.7 Potassium Cyanide dip tank	: Mild steel tank
5.8 Silver strike tank	: FRP / PVC / Rubber lined mild steel tank
5.9 Silver plating tank	: FRP / PVC / Rubber lined mild steel tank
5.10 Swilling tanks	: PVC / Rubber lined mild steel tanks
5.11 Anti-tarnishing treatment Tank	: PVC/Rubber lined mild steel Tank
5.12 Portable filter pump	: Any suitable filteration pump.

6. COMPOSITION/PREPARATION OF SOLUTIONS & OPERATING CONDITIONS

6.1 Alkaline Degreasing solution

Cleaner S-21 (clause 4.14.1) : 35 to 50 grams/litre

Water : To make up the volume

Temperature : 90 to 102 deg. C

Immersion time : 5 to 10 minutes
OR as required

OR

Alu-degreaser (Clause. 4.14) : 200 to 250 ml/litre

Water :

Temperature : 50-60 deg. C

Immersion time : 1 to 3 minutes
OR as required

6.1.1 The tank shall be filled with clean cold water to about 2/3rd of its capacity and then the necessary quantities of S-21 clearer OR Aludegreaser shall be added to the bath with stirring. When the chemicals are dissolved and properly mixed, the solution shall be brought to the operating level by adding more water, and heated to the operating temperature.

6.2 Chromic-Sulphuric Acid pickling solution

Chromic Acid (Clause.4.2) - 20 to 30 gm/litre

Sulphuric Acid (Clause.4.3) - 140 to 150 gm/litre

Water - To make up the volume

Temperature deg. C - 60-70

Immersion time - 2 to 3 minutes OR as required

6.2.1 The tank shall be filled with clean cold water to about 2/3rd of its capacity and then the necessary quantity of sulphuric acid shall be poured into the bath with constant stirring. When the acid is mixed then the chromic acid shall be added to the bath and after proper mixing, the the solution shall be brought to the operating level by adding more water, and then shall be heated to the operating temperature.

6.3 Nitric - Hydroflouric Acid pickling solution

Nitric Acid (Clause. 4.4) - 750 ml/litre

Hydroflouric Acid (Clause. 4.9) - 250 ml/litre

Temperature - Shop temperature

Immersion time - 2 to 5 minutes OR as required

OR

Nitric acid (clause 4.4) - 700 ml/litre

Acitek 707 (clause 4.9.1) - 60 to 120 gram/litre

Temperature - Shop temperature

Time - 2 to 3 minutes OR as required

OR

Nitric acid (clause 4.4) - 700 to 750 ml/litre

Ammonium Biflouride (clause 4.32) - 100 to 120 grams/litre

Temperature - Shop temperature

Time - 10 to 20 Seconds OR as required

6.3.1 The tank, shall be first filled with the required quantity of concentrated nitric acid and then the necessary quanti-ty of hydrofluoric acid OR Acitek 707 (clause. 4.9.1) OR Ammonium Biflouride (clause. 4.33) shall be mixed in it with constant stirring.

6.4 De-oxidizing Solution (Solution A OR B may be used)

Solution - A

Nitric Acid (Clause. 4.4) 500 to 750 ml/litre

Water - To make up the volume

Temperature - Shop temperature

Immersion Time - 15 to 30 seconds OR as required

Solution - B

Deoxidiser (Clause. 4.15) - 2 parts

Water - 1 part

Temperature - Shop temperature.

Time of immersion - 30 to 60 secs OR as required

6.4.1 The tank shall be filled with clean cold water to about 1/3rd of its capacity. Then the necessary quantity of nitric acid or Deoxidiser as required shall be added to the tank with stirring and the solution shall be brought to the operating level by adding more water.

Note: Two Nos. of solution - A Bath or B Bath shall be prepared.

6.5 Zincate solution

6.5.1 composition and operating conditions
any one of three composition and operating condition as detailed below shall be used

	Composition I	Composition II	Composition III
Caustic soda (Clause.4.5)	300 to 500 grams/litre	-	-
Zinc oxide (Clause.4.6)	100 grams/litre	-	-
Rochelle salt (Clause.4.7)	10 grams/litre	-	-
Ferric chloride (Clause.4.8)	1 gram/litre	-	-
-		Alzincate (M/s Srinivasa) as supplied	Alzincate D (M/s Grauer & weil) as supplied
Water	To make up the volume	-	-
Temperature	Shop temperature.	Shop temperature	Shop temperature
Immersion time	1 to 3 . minutes or as required	15 to 60 seconds OR as required	15 to 60 seconds OR as required

6.5.2 For Composition I

The tank shall be filled with about 1/4th of its working capacity with clean water and then required quantity of Zinc oxide added with stirring so as to make a slurry of it.

Now tank again filled with clean water to 1/4th of its working capacity and required quantity of Sodium Hydroxide gradully added with stirring. Stir till Sodium Hydroxide is dissolved completely.

For quick dissolution of Chemicals Rochelle salt (Sodium-potassium tartarate) and Ferric Chloride in the required quantity shall be separately dissolved in water and then added in main bath.

The contents shall be thoroughly mixed and brought to operating level by adding more water.

For Composition II & III

The bath shall be brought to the operating level by Alzincate itself. No dilution is required.

6.5.3. In case, any air pockets/ blister is observed after plating then the zincate solution should be sent to the laboratory for chemical analysis and necessary replenishment shall be made on the basis of the test result.

6.6 Copper plating solution

6.6.1 Composition & Operating conditions

The electrolyte shall be made according to any one of the following composition

	Composition-I (M/s G & W)	Composition-II (M/s Platewel)
Coppele 160 salt (g/l) (Clause 4.10)	-	150
Rochelle Copper salt (g/l (clause. 4.11)	150	-
Water	To make up the volume	
Temperature	Shop Temperature.	Shop Temperature.
Current density A/sq.ft.	1.0 to 20	1.0 to 20
A/sq.dm.	0.1 to 2	0.1 to 2
Voltage V	3 to 4.5	3 to 4
Time	as per thickness requirement	

6.6.2 Preparation of Electrolyte

6.6.2.1 The tank shall be half filled with demineralised water and heated to make it warm.

6.6.2.2 The calculated amount of copper salf as per the composition in clause 6.6 shall then be gradually added to the water with stirring.

6.6.2.3 The electrolyte shall be brought upto the desired level by adding more water and subsequently stirred thoroughly.

6.7 Pottasium Cyanide Dip Solution

6.7.1 Composition and operating condition

Potassium cyanide (Clause.4.24) : 40 to 50 gms/litre

Water (distilled) : To make up the volume

Operating Temperature : Shop temperature

Time : 1 to 2 minutes OR as required

6.8 Silver strike solution

6.8.1 Composition and Operating Conditions

Any one of the three composition and operating conditions as detailed below, shall be used.

	Composition-I (M/s G & W)	Composition-II (M/s Platewel)	Composition-III (M/s Artek Surferin)
'Strike' silver-salt (grams/litre) (Clause.4.19.1)	75	-	-
'Striksil-610 Salt (Clause.4.19.2) (grams/litre)	-	50	-
Argomax Strike silver Salt (clause.4.19)	-	-	100
Water	To make up the volume		
Operating Temperature	Shop temperature	Shop. temperature	Shop temperature
Current Density Ampere/dm2	0.1 to 0.2	0.1 to 0.2	0.1 to 0.2
Voltage(volt)	0.75 to 1.5	2 to 4	0.5 to 1.0
Treatment time(seconds)	30 to 45 OR as required	30 to 45 OR as required	30 to 60 OR as required

	Composition-I (M/s G & W)	Composition-II (M/s Platewel)	Composition-III (M/s Artek Surferin)
Anode	Silver/Stain-less Steel	Silver/Stainless Steel	Silver/ Stainless Steel

6.8.2 Preparation of strike solution

6.8.2.1 The tank shall be half filled with D.M. water. The required amount of salt shall be added with stirring.

6.8.2.2 After complete dissolution, the solution shall be brought upto the working level by adding water.

6.8.2.3 Analysis of Electrolyte

The Silver metal content after initial make up, analysed and shall be minimum
2 grams/Litre for composition II (clause 6.8.1)
3 grams/Litre for composition I and III (clause 6.8.1)

6.9 Silver plating solution

6.9.1 composition and operating conditions

Any one of the two composition and operating conditions as detailed below, shall be used.

	Composition-I (M/S G & W)	Composition-II (M/S Artek surfin)
'Silvernix' Bright silver Salt (gms/litre(Clause.4.17)	200	-
Argomax Bright Silver Salt (clause 4.17.1)	-	200
Silvernix Makeup Brightner (ml/L) (clause. 4.20)	30	30
Water	- To make up the volume -	
Operating Temperature :	Shop temperature	Shop temperature
Anode	Silver	Silver
Anode/Cathode Ratio	1:1	1:1
Current Density :		
Ampere/sq.dm	0.5 to 0.8	0.5 to 0.8
Voltage (volt)	1 to 1.5	1 to 1.5

	Composition-I (M/S G & W)	Composition-II (M/S Artek surfin)
pH of solution	12.0 to 12.5	12.2 to 12.5
Agitation(Optional)	- Cathode Rod Movement -	
Time	- as per thickness requirement -	

6.9.2 Preparation of Electrolyte for Silver plating

6.9.2.1 The tank shall be filled with luke warm demineralised water to 1/3 to 1/2 of the required volume and calculated amount of salt as per clause 6.9.1 shall be added with stirring.

6.9.2.2 After complete dissolution Activated carbon powder (clause 4.28) shall be added at the rate of 2 to 3 grams per litre of electrolyte and stirred for 3 to 4 hours. The solution is allowed to settle over night. Filter the solution.

6.9.2.3 After filteration the calculated amount of Make up Brighter (as per clause 4.20) shall be added, solution stirred thoroughly and made up to working volume by demineralised water.

6.9.3.0 Analysis of Electrolyte

6.9.3.1 The electrdyte, as prepared above shall be analysed after initial make up and subsequently at suitable intervals. The silver Metal content after initial make up shall be Minimum 30 grams / litre.

6.10 Anti-tarnishing solution

6.10.1 Composition and operating condition:

Silchrome (clause.4.22) - 200 to 250 ml/litre

Water - To make up the volume -

Operating Temperature Shop temperature.

Current Density

Ampere/ sq.dm	-	1 to 4.5
Voltage (volt)	-	3 to 7
pH of solution	-	8 to 9
Treatment Time(minutes)	-	2 to 5
Anode	-	Stainless steel
Anode-Cathode ratio	-	1:1

6.10.2 Preparation of Anti-tarnishing solution

6.10.2.1 The tank shall be half filled with water.

6.10.2.2 The required amount of salts as given in clause 6.10.1 shall then be added simultaneously with stirring.

6.10.2.3 After complete dissolution, the solution shall be brought upto the working level by adding water and subsequently stirred thoroughly.

7. MAINTENANCES OF BATH SOLUTION / BRIGHTER

7.0 The solutions shall be analysed after initial makeup and subsequently at suitable intervals. The concentration of bath solutions shall be maintained as given below.

7.1 Alkaline degreasing solution (clause. 6.1)
Cleaner S-21 Pointage 40 to 60

Aluo-degreaser Pointage 30 to 50

7.2 Chromic sulphuric Acid pickling (clause. 6.2)
Chromic acid 20 to 30 gms/Litre.
Sulphuric Acid 135 to 150 ml./Litre.

7.3 Deoxidizing solution (clause.6.4)

Solution A

Strength (Nitric acid content) /grams/litre. 260 to 390
copper content - Nil

Solution B

Pointage 20 to 30
Copper content - Nil

7.4 Zincate solution (clause. 6.5)
caustic content 300 to 525 grams/litre

7.5 Copper plating solution Composition-I Composition-II
(clause.6.6)

Copper metal grams/litre	15 to 17	18 to 20
Free sodium cyanide grams/ litre	5 to 7	6 to 8
Rochelle salt grams/llitre	30 to 50	40 to 50

7.6 Potassium cyanide dip solution (clause.6.7)

Potassium cyanide content grams/litre. 40 to 50

7.7 Silver strike solution (clause.6.8)

Silver as metal grams/litre 3 to 4
Free potassium cyanide grams/litre 90 to 130

7.8 Silver plating solution (clause.6.9)

Silver as metal grams/litre. 40 to 45
Free potassium cyanide grams/litre. 100 to 140

7.9 Brightner addition

Silverrux standard Brightner (clause 4.21)
500 to 1000 ml/1000 Ampere hour

7.10 Antitarnishing solution (clause. 6.10)

Pointage 20 to 25
PH 8 to 9

8. PROCESS:

8.1 Solvent Degreasing

The surface of the article shall be degreased by vapour degreasing OR excess grease, oil or cutting lubricants shall be removed by means of suitable solvent such as trichloroethylene and dried in air subsequently .

8.2 Alkaline Degreasing

Parts shall be immersed in the degreasing solution as mentioned in clause 6.1 till, free from any oil or grease.

8.3 Rinsing

After Alkaline degreasing, the parts shall be rinsed in clean cold running water. The surface of the article at this stage shall provide a continuous water film over it. A break in water film indicates that the surface is not clean, in which case the Alkaline degreasing (clause. 8.2) shall be repeated.

8.4 Acid Cleaning /Pickling

8.4.1 Chromic-sulphuric acid Pickling

After rinsing the parts shall be dip in the chromic-sulphuric acid pickling solution (clause 6.2) to remove the oxide film and micro-constituents present on the metal surface.

8.4.2 Rinsing

8.4.3 Nitric-Hydrofluoric acid Pickling (optional)

In case of high silicon content, the article shall be pickled in the nitric-hydrofluoric acid pickling solution. as maintained in clause 6.3 under proper hood.

8.4.4 Rinsing

8.4.5 De-oxidizing

After pickling as mentioned either in clause 8.4.1 or 8.4.2 depending on the requirement, the parts shall be first rinsed in clean cold running water and then immersed in eoxidizing solution No.1, A or B as mentioned in clause 6.4, to remove and residual smut left on the surface.

8.5 Rinsing

After de-oxidizing the parts shall be rinsed in clean cold running water. Double rinsing is preferred.

8.6 First Zincate Treatment

After rinsing the parts shall be immersed in zincate solution (clause.6.5). The articles shall be gently stirred during the treatment.

NOTE :- For high silicon content cast alloys, the treatment time shall be reduced to 5 to 10 seconds only.

8.6.1 Rinsing

After the first Zincate treatment. The parts shall be rinsed in clean running water, double rinse is required.

8.6.2 Deoxidizing Solution No 2 (Zincate removal)

After rinsing the parts shall be dipped in Deoxidising solution No 2 as mentioned in Clause. 6.4 to remove loose zincatelayer.

8.6.3 Rinsing

After deoxidising solution dip the double parts shall be rinsed in clean cold running water. Double water rinse is required.

8.6.4 Second Zincate treatment

After rinsing, the parts shall be immediately dipped in the zincate solution as mentioned in clause 6.5.

8.6.5 Water Rinsing

After second zincate treatment, the article shall be rinsed in clean running water. Two successive rinses shall be given to remove the last traces of viscous zincate solution. A dip in running water followed by a spray is more effective.

8.7 Electroplating

8.7.1 Copper plating/Strike

After the water rinsing, a copper strike/plating shall be given on the article from the copper plating bath (clause 6.6.1)

8.7.2 Rinsing

After copper plating the parts shall be swilled in clean cold running water.

8.7.3 Cyanide Dip

After rinsing parts shall be dipped in potassium cyanide dip solution (clause. 6.7) and then without swilling shall be transferred to silver strike solution (clause. 6.8).

8.8 Silver striking

It shall be ensured that the current is on before articles are introduced into the bath. Plating shall be done until articles are completely covered with silver. Articles shall then be transferred directly to the silver plating bath without swilling.

8.9 Silver plating

It shall be ensured that current is on before articles are immersed in the silver plating bath (clause. 6.9). The articles shall be electroplated at the specified current densities for a duration which will depend on the thickness of the deposit required.

8.10 Dragout

After removal from the tank, the parts shall be rinsed in dragout tank till all the traces of plating solution are removed.

8.11 Rinsing

After removing from dragout tank the parts shall be thoroughly rinsed in clean cold running water.

8.12 Hot rinsing -

After rinsing in cold running water the parts shall be rinsed thoroughly in Hot water.

8.13 Anti-tarnishing

Parts shall be treated in antitarnishing solution as mentioned in (clause.6.10)

8.14 Rinsing

After removal from antitarneshing bath the parts shall be rinsed in clean cold running water till all the traces of antitarnishing solution are removed. Finally the parts shall be air dried.

8.15.0 Lacquering

Surface which do not require silver plating, may be protected by chlorinated rubber based lacquer. After Acid cleaning / pickling (clause 8.4 to 8.4.3) and rinsing (clause 8.4.4)

8.15.1 After the end of the process of plating the lacquar is removed with suitable solvent e.g. trichlaoroethylene.

9. PRECAUTIONS :

9.1 Proper pre-treatments are essential for getting a good plating. Therefore, process parameters, whatever specified should be strictly followed.

9.2 In the plating of aluminium, racks OR wire should be made from pure aluminium or from the alloy similar to that being plated. The contact should be strong and sound.

9.3 Electrical contacts should invariably be established before putting the work in the electrolytes, so that immersion deposits formed by substitution process may not affect the adhesion of the subsequent electro- deposits.

9.4 A separate dilute nitric acid solution (Deoxidizing solution) should be used for cleaning treatment as followed in clause 8.6.2 after first zincate treatment.

9.5 If blisters are observed after silver plating, then pre-treatment cycles are to be checked and at the same time copper plating/ strike bath is to be tested.

9.6 Any chemical which may be necessary for addition, shall then be added in the bath through a filter/Perforated Bucket.

9.7 Any metal that may be deposited on any part of the bath, shall be removed immediately.

9.8 Care of Anodes

9.8.1 Ratio of anode to cathode surface shall not be less than 1.

9.8.2 Anodes shall be removed from the silver strike and silver plating vats when they are not operating, to prevent attack by the solution.

9.8.3 Stainless steel inverted 'V' shaped anode hooks only shall be used to suspend anodes from the Bus bar.

9.9 Wires used for suspending parts or electroplating and components which may accidently drop into the vat shall be removed at once to prevent contamination by their dissolution

9.10 Soluble organic impurities shall be removed by activated carbon treatment. Activated carbon 2 to 3 g/litre shall be added to the solution and the solution shall be thoroughly stirred for 3 to 4 hours and then filtered. This process shall be carried out in a separate bath. Alternatively, activated carbon shall be loosely packed in the filter unit of the filter pump and the solution shall be filtered through several times.

Note: 1) After each carbon treatment makeup brightener is to be added at the rate of 100 ml/1 no gram of carbon used.

2) The dragout solution shall be used for make-up of working volume of the silver plating bath whenever required.

9.12 Filtration

To get uniform results, continuous filtration of the bath shall be carried out. If continuous filtration is not possible, periodic filtration shall be done.

10. INSPECTION & QUALITY OF DEPOSITS:

10.1 Sampling

A minimum of 1% of each batch or bath load shall be taken at random for testing with a minimum of 3 samples.

10.1.1 For big components

When plated articles/components are big and can not be subjected to any of the specified tests, a test pannel of suitable size of the same basis metal shall be plated along with component under identical condition for the purpose of testing.

10.2 Condition of Surface

The plated surface shall be smooth and free from defects such as stains, blisters, exfoliations, unplated portions, nodules and cracks.

10.3 Thickness (I.S. 3203)

The minimum thickness shall be as specified on drawing OR purchase order

10.4 Adhesion (I.S. 1771)

The flaking and blistereing of Coating shall be taken as evidence of unsatisfactory adhesion.

10.5 Soldering Test

A strip of 24 S.W.G. tinned mild steel 9.5 mm wide x 75 mm length. (approx.) shall be soldered on the flat side to the plated surface. The soldering heat shall not produce blistering on the coating. The actual soldering on the component may be done on the shop floor.

10.6 Anti-tarnishing test (IS1771)

SHALL NOT SHOW BLACK OR BROWN COLOUR.

10.7 Rejection

If the sample taken does not comply with to as laid in clause 10 to 10.6 a further quantity not less than twice the number original taken, shall be subjected to the tests in which failure occured. If this sample also fails, the whole batch shall be rejected.

11.0 Safety measures are to be followed as detailed in AA0462801.