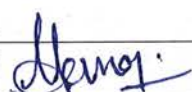


ANNEXURE-A

PRE-QUALIFYING REQUIREMENTS FOR PURCHASE INDENT 20260004 Rev.02 DT. 01-07-2026 (for Material Code RW2202200061) 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	ACCEPTANCE CRITERIA
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.	Self-undertaking required on Company Letter Head mentioning material code(s) for which offer submitted.
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.	1-Signed documents required 2- PO/Invoices are required. 3-BHEL reserves the right.
03	Testing Facilities	Bidder shall have testing facilities for - Chemical composition analysis as per product standard SG14610 R04, SG15600 R04 & AA0673613 R04. - Thickness measurement - Anti-tarnishing - Adhesion - Salt spray & - Humidity test etc.	Signed documents required

Prepared By 	Approved By 
Sr.Engineer (PDN/PPC)	Sr.Manager (PDN/PPC)

PRE-QUALIFYING REQUIREMENTS FOR PURCHASE INDENT 20260004 Rev.02 DT. 01-07-2026 (for Material Code RW2202200045 & RW2202200053) FOR FRAMEWORK AGREEMENT OF SILVER PLATING ON ALUMINIUM & COPPER COMPONENTS, CONDUCTORS INCLUDING BLANKING PLATES & PALMS

Sl. No.	PRE-QUALIFYING REQUIREMENTS	DETAIL DESCRIPTION	ACCEPTANCE CRITERIA
01	Size, Type & Weight of Job	Job Type- Octagon, Square, Flat, Rectangular, L, Z & U type or as per design. Conductor / Blanking Plate / Palms Size of Job: Height- 4000 mm (Max.), Width- 1000 mm (Max.), Depth- 1000 mm (Max.) Weight of Job: - For MATERIAL CODE RW2202200045 – Upto 100 Kg. - For MATERIAL CODE RW2202200053 – More than 100 Kg. Note: - For palm 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 palm. In that case, vendor will have to make suitable masking arrangement with no extra cost implication to BHEL.	Self-undertaking required on Company Letter Head mentioning material code(s) for which offer submitted.
02	Technical requirement	- Bidder shall have silver plating processing plant as per BHEL standard SG14610 R04, SG15600 R04 & AA0673613 R04. - For MATERIAL CODE RW2202200053 where weight of job is more than 100 Kg., Bidder shall have overhead crane and transporter facility with process time control system to maintain the process parameter (like voltage, current and temperature) and to meet the required quality as per BHEL standard. - 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). - 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.	For SI No 1, Signed documents is required. For SI No 2, Self-undertaking is required. For SI No 3, PO/Invoices are required. For SI No 4, BHEL reserves the right.
03	Testing Facilities	Bidder shall have testing facilities for - Chemical composition analysis as per product standard SG14610 R04, SG15600 R04 & AA0673613 R04. - Thickness measurement - Anti-tarnishing - Adhesion - Salt spray & - Humidity test etc.	Signed documents is required.

Prepared By	Approved By
Sr.Engineer (PDN/PPC)	Sr.Manager (PDN/PPC)

ANNEXURE-C

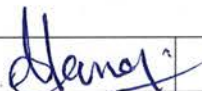
**TECHNO-COMMERCIAL TERMS AND CONDITIONS FOR PURCHASE INDENT
20260004 Rev.02 DT. 01-07-2026 FOR FRAMEWORK AGREEMENT OF SILVER PLATING
ON ALUMINIUM & COPPER COMPONENTS (Material Code- RW2202200061,
RW2202200045 & RW2202200053)**

Sl. No.	TECHINICAL TERMS	DETAIL DESCRIPTION
01	Price Basis	Rate shall be quoted for entering into framework agreement for One Year. Rate to be quoted on Price Variation Clause for silver. Multiples Orders shall be placed during validity period of this agreement on finalized rates.
02	Delivery Destination	Rate 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) by bidder at BHEL Rudrapur (under GST Job Work norms) after placement of purchase order.
9	PVC Clause	Rates shall be subject to Price Variation Clause (PVC) at the base rate of Silver (99.9% purity) @ Rs. 2,66,000 per kg/- As per Mumbai Bullion market (Ready) price circular of ET Intelligence date 01.06.2026 . For any change in this rate, the silver closing rate of Mumbai Bullion market on the 1 st 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	PVC ratio shall be 1:0.7. i.e. A change in base rate of silver shall impact 70% change in finalized basic rate of silver plating. 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.

Prepared By 	Approved By 
Sr.Engineer (PDN/PPC)	Sr.Manager (PDN/PPC)

07	Silver plating procedure/Inspection procedure/Packing	As per attached Product Standard SG14610 R04, SG15600 R04 & AA0673613 R04 and drg. No.- 416325500210 R.00 /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>	Elements	Min.	Percent Max.	Magnesium	0.4	0.90	Silicon	0.4	0.90	Manganese	0.4	0.90	Copper	0.4	0.90	Iron	0.4	0.90	Aluminium	Remainder	
Elements	Min.	Percent Max.																					
Magnesium	0.4	0.90																					
Silicon	0.4	0.90																					
Manganese	0.4	0.90																					
Copper	0.4	0.90																					
Iron	0.4	0.90																					
Aluminium	Remainder																						
08	Inspection	100% inspection shall be done by BHEL/BHEL's representative before dispatch.																					
09	Important IS	IS:1959 (Silver Anode) IS:3203(Thickness) IS: 1771(Adhesion/Tarnish Resistance test) For all other required IS details vide Product standard SG15600 REV.04																					
10	Distribution Clause	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>	Distribution Matrix	L1	L2	02 lowest acceptable bidders	60%	40%	01 lowest bidder	100%	-												
Distribution Matrix	L1	L2																					
02 lowest acceptable bidders	60%	40%																					
01 lowest bidder	100%	-																					
11	Quantity variation	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.																					
12	Insurance of BHEL issued material	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.																					

Bidder's Sign & Seal

Prepared By		Approved By	
Sr.Engineer (PDN/PPC)		Sr.Manager (PDN/PPC)	

REV	DATE	ALTERED	REV	DATE	ALTERED	ADDITIONAL INFORMATION
		CHECKED			CHECKED	STATUS OF DRAWING
						DISTRIBUTION OF PRINTS

PROJECT: NPCIL KAIGA UNITS 5&6

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

- WELDED FACES OF CONDUCTOR OR ANY DENT MARKS PRESENT ARE TO BE REMOVED EITHER BY SKIM CUT/GRINDING /EMERYING ETC. BUT DEPTH OF CUT SHALL NOT EXCEED 1.0 mm.
- DRILLED HOLES SHALL BE DEBURRED ON BOTH SIDES.
- DRILLED END OF THE CONDUCTOR SHALL BE FACED PERPENDICULAR TO THE AXIS OF CONDUCTOR.

2. SPECIAL INSTRUCTION FOR ELECTROPLATERS :-

- SILVER PLATING TO BE DONE AS PER BHEL STANDARD SG 15600 REV.04.
- SILVER PLATING THICKNESS TO BE MINIMUM 05 MICRONS SILVER COAT AND EXCLUDES THICKNESS OF UNDERCOATS LIKE COPPER/NICKEL STRIKE AND DOUBLE ZINCATE TREATMENT.
- FIG-1 TO BE FOLLOWED FOR SILVER PLATING OF SURFACE IF DISTANCE FROM LAST HOLE NOT SPECIFIED IN CONDUCTOR'S OGA DRAWING.

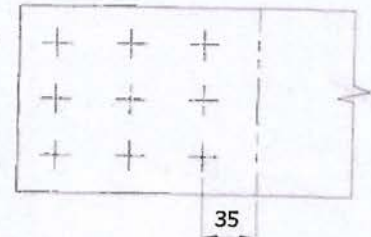


FIG - 1

3. PRECAUTIONS AFTER SILVER PLATING :-

- PROTECTIVE COATING ON PLATED SURFACE : SILVER PLATED SURFACE SHOULD BE COVERED BY COTTON TAPE IMMEDIATELY AFTER PLATING (BY ELECTRO-PLATERS).
- WHILE DOING WELDING, PRECAUTIONS TO BE TAKEN SO THAT SILVER PLATED SURFACE IS NOT DAMAGED (BY FABRICATORS).
- COTTON TAPE SHOULD NOT BE REMOVED AT ANY STAGE IN THE SHOP. THIS WILL BE REMOVED AT SITE BEFORE MAKING BOLTED JOINTS.



BHARAT HEAVY ELECTRICALS LTD.
RUDRAPUR

DEPT.

ECC



SCALE

N.T.S.

Wt. [Kg]

	NAME	SIGN	DATE
DRN	SKANDSHIV		07.04.26
CHD	SKANDSHIV		07.04.26
APPD.	RUPESH KR		07.04.26
REF. TO ASSY. DRG.			ITEM No

TITLE

**GEN. INSTRUCTION FOR SILVER PLATING ON
ALUMINUM CONDUCTOR & FLEXIBLE FOR
NPCIL KAIGA UNIT 5 & 6 PROJECTS**

DRAWING NO.

416325500210

REV.

00

SHEET NO. -01

NO. OF SHEETS -01



CORPORATE STANDARD

AA 067 36 13

Rev. No. 04

PAGE 1 OF 8

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 :

CL34.11.12 of MOM of MRC (CPO)

APPROVED :

INTERPLANT MATERIAL
RATIONALISATION COMMITTEE- MRC (CPO)

Rev. No. 04

Amd.No.

Reaffirmed

Prepared
HYDERABAD

Issued
Corp. R&D

Dt. of 1st Issue
April, 1989

Dt:15.11.2005

Dt :

Year :

**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 surfen 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 surfen 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



CORPORATE STANDARD

AA 067 36 13

Rev. No. 04

PAGE 3 OF 8

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			
Name of salt	I	II	III	IV
	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.



CORPORATE STANDARD

AA 067 36 13

Rev. No. 04

PAGE 5 OF 8

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

**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.



CORPORATE STANDARD

AA 067 36 13

Rev. No. 04

PAGE 7 OF 8

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 originally 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 | | |



PRODUCT STANDARD

CFP-RUDRAPUR

Ref:
BHE/PACK/SP/001
REV-02

Page | 1

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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.

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



PRODUCT STANDARD

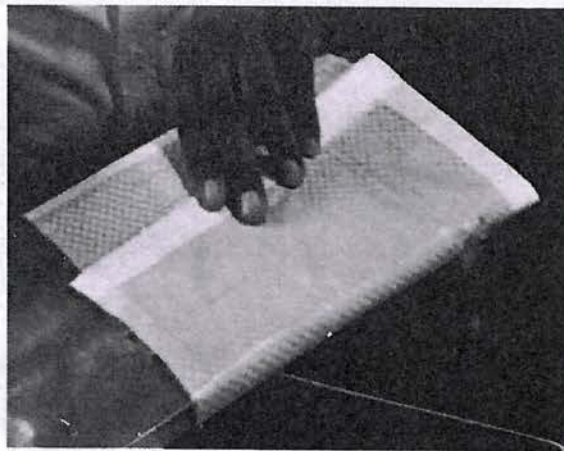
CFP-RUDRAPUR

Ref:
BHE/PACK/SP/001
REV-02

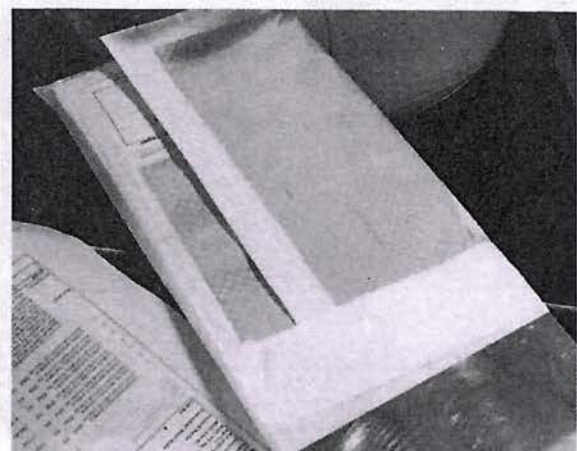
Page | 2

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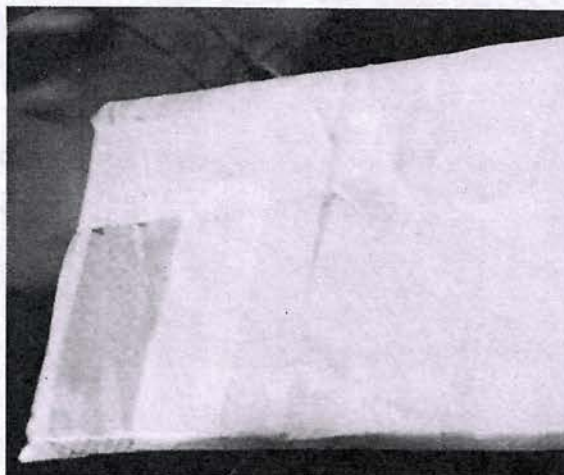
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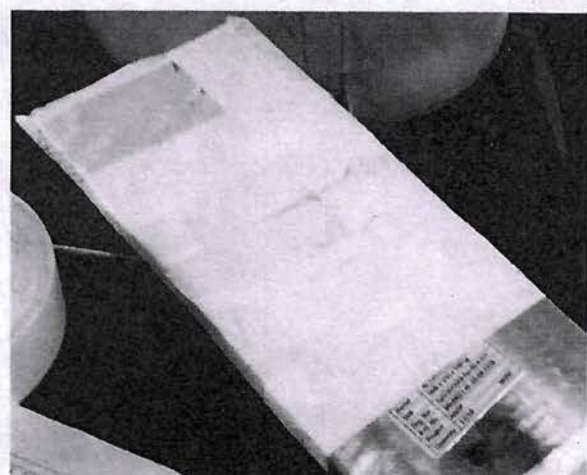
(1a)



(1b)

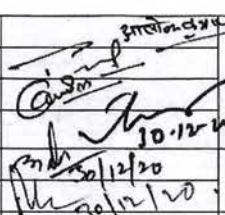


(1c)



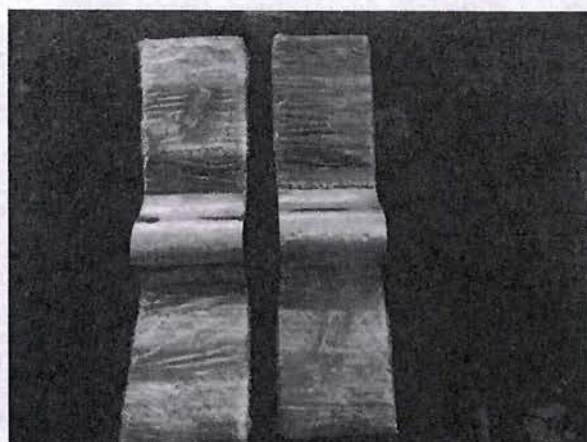
(1d)

FIG-1

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

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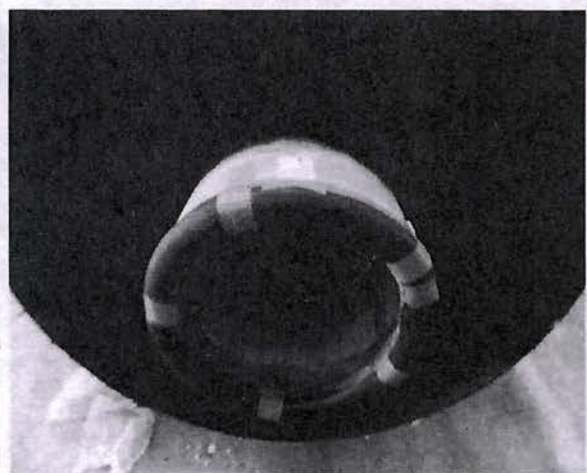
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(2a)



(2b)

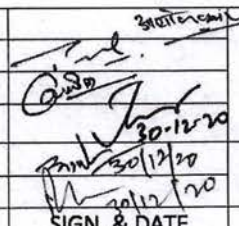


(3c)



(3d)

FIG - 3

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



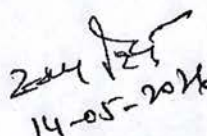
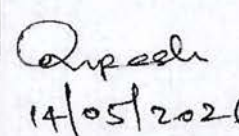
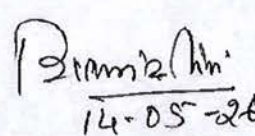
Product Standard for Electro-plating on Busduct application

BHEL Ref No. : BDE/RU/EP/01
Revision No. : R0
Date of Issue : 14-05-2026
(dd/mm/yyyy)

Product Standard for Electro-plating on Busduct application

Bharat Heavy Electricals Ltd
(a Govt. of India Undertaking)

Component Fabrication Plant
Rudrapur-263153, Distt. US Nagar (Uttarakhand)

 14-05-2026	 14/05/2026	 14-05-26
Skandshiv Bhardwaj Manager/Engg BHEL Rudrapur	Rupesh Kumar Sr Manager/Engg BHEL Rudrapur	Shilanand Minj AGM/Engg-HoD BHEL Rudrapur
Prepared by	Reviewed by	Approved by



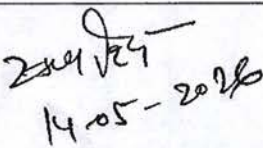
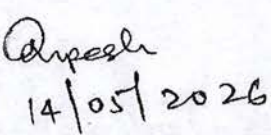
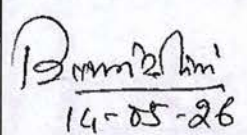
Product Standard for Electro-plating on Busduct application

In line with Product Standard SG14610 of BHEL Bhopal, and considering the fact that busbars/busduct also falls in broad category of metal clad switchgear, it is recommended to adopted the aforesaid product standard in verbatim for busbars/Busduct in CFP Rudrapur also.

Accordingly, it is to be followed.

1. Product Standard SG14610 Rev.04 shall be applicable for electro-plating instructions.
2. Unless otherwise is stated in MIS/ General Instructions issued for the specific project, the plating thickness shall be minimum 5 microns.

Attachment: SG 14610 Rev 04.

 14.05-2026	 14/05/2026	 14-05-26
Skandshiv Bhardwaj Manager/Engg BHEL Rudrapur	Rupesh Kumar Sr Manager/Engg BHEL Rudrapur	Shilanand Minj AGM/Engg-HoD BHEL Rudrapur
Prepared by	Reviewed by	Approved by



PRODUCT STANDARD

SWITCHGEAR ENGINEERING DIVISION

SG14610 Rev 04

PAGE 1 OF 1

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 micron.

5. QUALITY CHECKS AND ACCEPTANCE CRITERIA 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 CRITERIA:-

- Plating thickness as per drawing/specification.
- Adhesion test.
- Anti-Tarnishing Test.
- Packing and marking as per SG16054

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

2004 Dec
1405-2024

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

1/4 14.02.2003

SHARAT HEAVY ELECTRICALS LIMITED, JHANSI

BHEL CX0007/0006		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		QF.No. QP/BD/154, Ro2- Rev.02 Date 16.07.2003 Page 1 of 2	
COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTAN CE NORMS	FORMAT OF RECORD	AGENCY	REVIEW	
2	3	4	5	6	7	8	9	10	11
A Composition And maintenance of Bath Solution	a) Alkaline degreasing solution	B	1	Sample to be taken from bath	SG: 15603 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 inspector)
	b) Chromic sulphuric acid pickling solution	B	1		Cl. 6.2	Cl. 6.2			
	c) De oxidizing solution	B	1	Sample	Cl. 6.4	Cl. 6.4			
	d) Zincate solution	B	1	Sample	Cl. 6.5	Cl. 6.5			
	e) Copper plating solution	B	1	Sample	Cl. 6.6	Cl. 6.6			
	f) Potassium Cyanide dip solution	B	1	Sample	Cl. 6.7	Cl. 6.7			
	g) Silver strike solution	B	1	Sample	Cl. 6.8	Cl. 6.8			
	h) Silver plating solution	B	1	Sample	Cl. 6.9	Cl. 6.9			
	i) Brighter addition solution	B	1	Sample	Cl. 7.9	Cl. 7.9			
	j) Anti tarnishing solution	B	1	Sample	Cl. 6.10	Cl. 6.10			
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BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

24

S.H.E.L. 00X/007/0006	STANDARD SUB-VENDOR QUALITY PLAN FOR Electro Plating of Silver On Aluminium and it's Alloys	CHARACTERISTICS	CLASS	MATERIAL INSPECTION / IN PROCESS INSPECTION / FINAL INSPECTION		ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
				TYPE OF CHECK	QUANTUM OF CHECK				
B	Cleaning / preparation of Aluminium Items	3	4	5	6	7	8	9	10
		a) wire brushing	B	V	100%	SG: 15600	SG: 15600	Sub vendor	Review of Records
		b) solvent degreasing	B	V	100%	CL 8.1	CL 8.1	Sub vendor	Review of Records
		c) alkaline degreasing	B	V	100%	CL 8.2	CL 8.2	Sub vendor	Review of Records
		d) Rinsing	B	V	100%	CL 8.3	CL 8.3	Sub vendor	Review of Records
		e) Acid cleaning / pickling	B	V	100%	CL 8.4	CL 8.4	Sub vendor	Review of Records
		f) Chromic sulphuric acid pickling	B	V	100%	CL 8.4.1	CL 8.4.1	Sub vendor	Review of Records
		g) Rinsing	B	V	100%	CL 8.4.2	CL 8.4.2	Sub vendor	Review of Records
		h) Nitric Hydrofluoric acid pickling	B	V	100%	CL 8.4.3	CL 8.4.3	Sub vendor	Review of Records
		i) Rinsing	B	V	100%	CL 8.4.4	CL 8.4.4	Sub vendor	Review of Records
		j) Deoxidation	B	V	100%	CL 8.4.5	CL 8.4.5	Sub vendor	Review of Records
C	Preparation for Silver plating	g) Rinsing	B	V	100%	CL 8.5	CL 8.5	Sub vendor	Review of Records
		a) First zincate treatment	B	I	100%	SG: 15600	SG: 15600	Sub vendor	Review of Records by HDEL
		b) Rinsing	B	I	100%	CL 8.6	CL 8.6	Sub vendor	Review of Records by HDEL
		c) Deoxidation	B	I	100%	CL 8.6.1	CL 8.6.1	Sub vendor	Review of Records by HDEL
		d) Rinsing	B	I	100%	CL 8.6.2	CL 8.6.2	Sub vendor	Review of Records by HDEL
		e) Second zincate treatment	B	I	100%	CL 8.6.3	CL 8.6.3	Sub vendor	Review of Records by HDEL
		f) Rinsing	B	I	100%	CL 8.6.4	CL 8.6.4	Sub vendor	Review of Records by HDEL

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94



3/4

BHARAT HEAVY ELECTRICALS LIMITED, JHAMSIL

S.B.E.L. C2X007/0006		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/154-K62 Rev.02 Date 16.07.2003 Page 3 of 4		
COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTAN. CE 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) Rinsing c) Cyanide dip d) Silver striking e) Silver plating f) Dragout & rinsing g) Hot rinsing h) Anti tarnishing i) Rinsing	B B B B B B B B B	— — — — — — — — —	100% 100% 100% 100% 100% 100% 100% 100% 100%	CL 8.7.1 CL 8.7.2 CL 8.7.3 CL 8.8 CL 8.10 & 8.11 CL 8.12 CL 8.13 CL 8.14	CL 8.7.1 CL 8.7.2 CL 8.7.3 CL 8.8 CL 8.10 & 8.11 CL 8.12 CL 8.13 CL 8.14	Sub vendor Check list / Forms / Records	Sub vendor Review of records by BHEL (periodic surveillance by BHEL Inspector	
E	Inspection of Electroplated Surface	a) Surface finish b) Thickness of Plating c) Adhesion d) Burnishing test or Bend test or Anti tarnish Treatment	B B B B B	V T T T T	Sample Sample Sample Sample 100%	IS 1771 / 3203	Drg	Sub vendor Test report	Sub vendor	CHP by BHEL At sub vendor Works

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GRANITE ELECTRONICS LIMITED

B.E.L. COX/007/0006		STANDARD SUB-VENDOR QUALITY PLAN FOR Electro-Plating of Silver on Aluminium and its Alloys	MATERIAL INSPECTION / IN PROCESS INSPECTION / FINAL INSPECTION		SUB-VENDOR'S / VENDOR'S / CONTRACTOR'S WORKS	Q.P.No. QP/BD/164 Rev. 02 Date 15.07.2012 Page 4 of 4	
COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	QUANTUM OF CHECK DOCUMENT	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY REMARKS
2	3	4	5	6	7	8	9
F: Protection coating for silver plating	a) Application of protective coating a) Drying b) Packing c) Removal of packing & protective coating	B B B B	1 1 1 1	BD:15012 P Cl. 1.0 Cl. 2.0 Cl. 3.0 Cl. 4.0	BD:15012 P Cl. 1.0 Cl. 2.0 Cl. 3.0 Cl. 4.0	Sub vendor Check list / Formats	Sub vendor At Site Review of Records
							10
							11

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LEGEND :- 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)
DSM (COX)

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			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION		SG 15600 REV.04			
					PAGE 1 OF 18			
		<u>ELECTROPLATING OF SILVER ON ALUMINIUM AND ITS ALLOYS</u>						
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.		1. <u>GENERAL:</u> 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. <u>APPLICATION:</u> Used for Bus Bars, Bus Duct Conductors, Bus Duct Flexible, Link plates, packers, Top and Bottom flanges of Switchgear equipments etc.						
		3. <u>COMPLIANCE:</u> This specification has reference to following WITH NATIONAL STANDARDS IS 2450 : 1963 - Recommended practice for plating on Reaffirmed 1992 Alluminium and its alloys. IS 3203 : 1982 - Method of testing local thickness of Reaffirmed 1992 electroplated coatings. IS 1771 : 1986 - Electroplated coatings of Silver and Reaffirmed 1991 Silver Alloys for general engineering purposes. IS 6012 : 1992 - Method of coating thickness by eddy current.						
		4. <u>MATERIALS:</u>						
		4.1 Trichloroethylene -(Technical) : AA 56706/IS: 245 Type 2						
		4.2 Chromium Trioxide(ELectroplating : AA 54205/ Grade) IS: 330						
		4.3 Sulphuric Acid -(Technical) : AA 54101/ IS: 266						
		4.4 Nitric Acid - (Technical) : AA 54102/ IS: 264						
		REV.		04	PRINTS TO :-		APPROVED –	
		ALTD.		AD	SWM(P) QCX		RKS	
APPD.		NB	PREPARED	ISSUED			DATE	
DATE.		07.12.15	MAS	RKJ			7.1.95	

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 2 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		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) - : IS: 2603 Oval shape preferred.		
		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			

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 3 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.		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
		<u>5. EQUIPMENT</u>		
		5.1	Vapour Degreasing plant	: Any standard plant for the purpose.

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 4 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		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 filtration pump.

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 5 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.	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 : 200 to 250 ml/litre (Clause. 4.14)			
	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.		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
		PAGE 6 OF 18		
		<u>6.3 Nitric - Hydroflouric Acid pickling solution</u>		
		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		
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		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		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION		SG 15600 REV.04	
						PAGE 7 OF 18
		<u>Solution - B</u>				
		Deoxidiser (Clause. 4.15) - 2 parts				
		Water - 1 part				
		Temperature - Shop temperature.				
		Time of immersion - 30 to 60 secs OR as required				
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.	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 300 to 500 (Clause.4.5) grams/litre - -					
	Zinc oxide 100 grams/litre (Clause.4.6) - -					
	Rochelle salt 10 grams/litre (Clause.4.7) - -					
	Ferric chloride 1 gram/litre (Clause.4.8) - -					
	-					

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION		SG 15600 REV.04																								
					PAGE 8 OF 18																								
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		<u>6.5.2 For Composition I</u>																											
		The tank shall be filled with about 1/4th of its work- ing 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. <u>For Composition II & III</u> 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 plat- ing then the zincate solution should be sent to the labo- ratory 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 <table><tr><td></td><td>Composition-I (M/s G & W)</td><td>Composition-II (M/s Platewel)</td></tr><tr><td>Coppele 160 salt (g/l) (Clause 4.10)</td><td>-</td><td>150</td></tr><tr><td>Rochelle Copper salt (g/l (clause. 4.11)</td><td>150</td><td>-</td></tr><tr><td>Water</td><td colspan="2">To make up the volume</td></tr><tr><td>Temperature</td><td>Shop Temperature.</td><td>Shop Temperature.</td></tr><tr><td>Current density A/sq.ft. A/sq.dm.</td><td>1.0 to 20 0.1 to 2</td><td>1.0 to 20 0.1 to 2</td></tr><tr><td>Voltage V</td><td>3 to 4.5</td><td>3 to 4</td></tr><tr><td>Time</td><td colspan="2">as per thickness requirement</td></tr></table>					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. A/sq.dm.	1.0 to 20 0.1 to 2	1.0 to 20 0.1 to 2	Voltage V	3 to 4.5	3 to 4	Time	as per thickness requirement	
			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. A/sq.dm.	1.0 to 20 0.1 to 2	1.0 to 20 0.1 to 2																											
Voltage V	3 to 4.5	3 to 4																											
Time	as per thickness requirement																												

				PRODUCT STANDARD		SG 15600 REV.04	
				SWITCHGEAR ENGINEERING DIVISION			
						PAGE 9 OF 18	
		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 salt 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.					
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.		6.7 Pottasium Cyanide Dip Solution					
		6.7.1 <u>Composition and operating condition</u>					
		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 <u>Silver strike solution</u>					
		6.8.1 Composition and Operating Conditions					
		Any one of the three composition and operating conditions as detailed below, shall be used.					
		<u>Composition-I Composition-II Composition-III</u> (M/s G & W) (M/s Platewel) (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		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION		SG 15600 REV.04												
					PAGE 10 OF 18												
		Composition-I Composition-II Composition-III (M/s G & W) (M/s Platewel) (M/s Artek Surferin) Anode Silver/Stain- Silver/Stainless Silver/ less Steel Steel Stainless Steel															
		<u>6.8.2 Preparation of strike solution</u>															
		6.8.2.1 The tank shall be half filled with D.M. water. The required amount of salt shall be added with stirring.															
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		6.8.2.2 After complete dissolution, the solution shall be brought upto the working level by adding water.															
		<u>6.8.2.3 Analysis of Electrolyte</u>															
		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)															
		<u>6.9 Silver plating solution</u>															
		<u>6.9.1 composition and operating conditions</u>															
		Any one of the two composition and operating conditions as detailed below, shall be used.															
		Composition-I Composition-II (M/S G & W) (M/S Artek surfin) <table><tr><td>'Silvernix' Bright silver Salt (gms/litre(Clause.4.17)</td><td>200</td><td>-</td></tr><tr><td>Argomax Bright Silver Salt (clause 4.17.1)</td><td>-</td><td>200</td></tr><tr><td>Silvernix Makeup Brightner (ml/L) (clause. 4.20)</td><td>30</td><td>30</td></tr><tr><td>Water</td><td colspan="2">- To make up the volume -</td></tr></table>				'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 -	
'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 : Anode Anode/Cathode Ratio Current Density : Ampere/sq.dm Voltage (volt) Shop temperature Silver 1:1 0.5 to 0.8 1 to 1.5 Shop temperature Silver 1:1 0.5 to 0.8 1 to 1.5															

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION		SG 15600 REV.04
					PAGE 11 OF 18
		Composition-I Composition-II (M/S G & W) (M/S Artek surfín)			
		pH of solution 12.0 to 12.5 12.2 to 12.5			
		Agitation(Optional) - Cathode Rod Movement -			
		Time - as per thickness requirement -			
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		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 filtration 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.			
		<u>6.9.3.0 Analysis of Electrolyte</u>			
		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.			
		<u>6.10 Anti-tarnishing solution</u>			
		<u>6.10.1 Composition and operating condition:</u>			
		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			
		<u>6.10.2 Preparation of Anti-tarnishing solution</u>			
		6.10.2.1 The tank shall be half filled with water.			

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 12 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		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) <u>Cleaner S-21</u> Pointage 40 to 60 <u>Aluo-degreaser</u> Pointage 30 to 50		
		7.2 <u>Chromic sulphuric Acid pickling (clause. 6.2)</u> Chromic acid 20 to 30 gms/Litre. Sulphuric Acid 135 to 150 ml./Litre.		
		7.3 <u>Deoxidizing solution (clause.6.4)</u> <u>Solution A</u> Strength (Nitric acid content) /grams/litre. 260 to 390 copper content - Nil <u>Solution B</u> Pointage 20 to 30 Copper content - Nil		
		7.4 <u>Zincate solution (clause. 6.5)</u> caustic content 300 to 525 grams/litre		
		7.5 <u>Copper plating solution Composition-I Composition-II (clause.6.6)</u> Copper metal grams/litre 15 to 17 18 to 20 Free sodium cyanide grams/ 5 to 7 6 to 8 litre Rochelle salt grams/litre 30 to 50 40 to 50		
		7.6 <u>Potassium cyanide dip solution (clause.6.7)</u> Potassium cyanide content grams/litre. 40 to 50		
		7.7 <u>Silver strike solution (clause.6.8)</u> Silver as metal grams/litre 3 to 4 Free potassium cyanide grams/litre 90 to 130		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 13 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.		<u>7.8 Silver plating solution (clause.6.9)</u> Silver as metal grams/litre. 40 to 45 Free potassium cyanide grams/litre. 100 to 140 <u>7.9 Brightner addition</u> Silverrux standard Brightner (clause 4.21) 500 to 1000 ml/1000 Ampere hour <u>7.10 Antitarnishing solution (clause. 6.10)</u> Pointage 20 to 25 PH 8 to 9 8. PROCESS: <u>8.1 Solvent Degreasing</u> 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 . <u>8.2 Alkaline Degreasing</u> Parts shall be immersed in the degreasing solution as mentioned in clause 6.1 till, free from any oil or grease. <u>8.3 Rinsing</u> 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. <u>8.4 Acid Cleaning /Pickling</u> <u>8.4.1 Chromic-sulphuric acid Pickling</u> 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. <u>8.4.2 Rinsing</u> <u>8.4.3 Nitric-Hydrofluoric acid Pickling (optional)</u> 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. <u>8.4.4 Rinsing</u>		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 14 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		<u>8.4.5 De-oxidizing</u> 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.		
		<u>8.5 Rinsing</u> After de-oxidizing the parts shall be rinsed in clean cold running water. Double rinsing is preferred.		
		<u>8.6 First Zincate Treatment</u> 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.		
		<u>8.6.1 Rinsing</u> After the first Zincate treatment. The parts shall be rinsed in clean running water, double rinse is required.		
		<u>8.6.2 Deoxidizing Solution No 2 (Zincate removal)</u> After rinsing the parts shall be dipped in Deoxidising solution No 2 as mentioned in Clause. 6.4 to remove loose zincatelayer.		
		<u>8.6.3 Rinsing</u> After deoxidising solution dip the double parts shall be rinsed in clean cold running water. Double water rinse is required.		
		<u>8.6.4 Second Zincate treatment</u> After rinsing, the parts shall be immediately dipped in the zincate solution as mentioned in clause 6.5.		
		<u>8.6.5 Water Rinsing</u> 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.		
		<u>8.7 Electroplating</u>		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 15 OF 18
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.		<u>8.7.1 Copper plating/Strike</u> After the water rinsing, a copper strike/plating shall be given on the article from the copper plating bath (clause 6.6.1)		
		<u>8.7.2 Rinsing</u> After copper plating the parts shall be swilled in clean cold running water.		
		<u>8.7.3 Cyanide Dip</u> 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).		
		<u>8.8 Silver striking</u> 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.		
		<u>8.9 Silver plating</u> 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.		
		<u>8.10 Dragout</u> After removal from the tank, the parts shall be rinsed in dragout tank till all the traces of plating solution are removed.		
		<u>8.11 Rinsing</u> After removing from dragout tank the parts shall be thoroughly rinsed in clean cold running water.		
		<u>8.12 Hot rinsing -</u> After rinsing in cold running water the parts shall be rinsed thoroughly in Hot water.		
		<u>8.13 Anti-tarnishing</u> Parts shall be treated in antitarnishing solution as mentioned in (clause.6.10)		
		<u>8.14 Rinsing</u> After removal from antitarnishing 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.		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 16 OF 18
		<u>8.15.0 Lacquering</u> 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.		
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		<u>9.8 Care of Anodes</u> 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		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
		PAGE 17 OF 18		
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited It must not be used directly or indirectly in any way detrimental to interest of Co.		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. <u>9.12 Filtration</u> 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: <u>10.1 Sampling</u> A minimum of 1% of each batch or bath load shall be taken at random for testing with a minimum of 3 samples. <u>10.1.1 For big components</u> 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. <u>10.2 Condition of Surface</u> The plated surface shall be smooth and free from defects such as stains, blisters, exfoliations, unplated portions, nodules and cracks. <u>10.3 Thickness (I.S. 3203)</u> The minimum thickness shall be as specified on drawing OR purchase order		

			PRODUCT STANDARD SWITCHGEAR ENGINEERING DIVISION	SG 15600 REV.04
				PAGE 18 OF 18
		<u>10.4 Adhesion (I.S. 1771)</u> The flaking and blistering of Coating shall be taken as evidence of unsatisfactory adhesion. <u>10.5 Soldering Test</u> 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. <u>10.6 Anti-tarnishing test (IS1771)</u> SHALL NOT SHOW BLACK OR BROWN COLOUR. <u>10.7 Rejection</u> 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 occurred. If this sample also fails, the whole batch shall be rejected. 11.0 Safety measures are to be followed as detailed in AA0462801.		

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Commodity (Prices are exclusive of GST)

Ready

SPOT -- BULLION -- SILVER -- Ready

Trading Date	Item	Variety(Wt.)	Centre	Price Range From	Price Range To
01-06-2026	SILVER	Ready1 Kg	MUMBAI	266000.00	266000.00

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