PROCESS FOR ELECTROPLATING TIN FROM ALKALINE BATH ON FERROUS AND NON-FERROUS METAL PARTS

1 GENERAL

This standard details the process for Tin plating by Vat and Barrel process from an alkaline tin solution on articles of steel, copper and copper alloys to protect them against corrosion, to provide surface for soldering of electrical contacts & terminals and for masking during nitriding. Barrel process for smaller components and tank process for larger components shall be followed.

2 APPLICATION

Used for bus-bar connections, spout connections, cable sockets, etc., of switchgear; hardware like nuts, bolts, connection cams of transformer; brush holder, cable glands, etc., of traction motors; clamp plates, support plates, etc., of capacitors; clamps, brackets, etc., of electronics.

3 COMPLIANCE WITH NATIONAL STANDARDS

This Standard has reference to IS 1359 : 1992: Electroplated coating Tin-Specification.

4 MATERIALS

Materials	Available from
Satin Tin Salt-721	M/S Platewel Processes & Chemicals Ltd., Baroda
Satin Tin Salt	M/S Grauer & Weil (I) Ltd., Mumbai
Mutton Tallow (Optional)	Having acid neutralization value of 2.3 to 6.6 mg of KOH/g of mutton tallow
Sodium Perborate	IS 3598
Hydrogen Peroxide -20 volume	
Caustic Soda	AA54201
Tin Anodes	IS 2384
Sodium Stannate	IS 3026

5 EQUIPMENT

5.1 Plating Tank / Vat

The Tank/vat shall be made of mild steel. The vat shall be provided with an insulated frame on top fitted with insulators for holding the anode and cathode rods. The solution shall be heated by steam, gas or electrical heater.

5.2 Barrel

The plating barrel shall be constructed of hard rubber, polypropylene, etc., and shall be so driven as to rotate at 10 to 15 rpm.

5.3 Cold Water Rinsing Tank

Mild steel tank.

5.4 Hot Water Rinsing Tank

Mild steel tank with heating arrangements.

6 COMPOSITION OF ELECTROLYTE AND OPERATING INSTRUCTIONS

6.1 Electrolyte (Bath Solution) And Operating Conditions

The electrolyte shall be of the following compositions and operating conditions as specified below:

	SATIN TIN SALT-721	SATIN TIN SALT
Salt for Vat Plating	150 g/l	110 g/l
Salt for Barrel Plating	250 g/l	200 g/l
Temperature	60 - 70°C	60 - 80°C
Ratio of Anode to Cathode Area (Approximately)	1:1	1:1
Current density (for information only and not a controlling parameter)	1.5-2 A/dm^2 (15-20 A/sq.ft)	1.5-2 A/dm^2 (15-20 sq/ft)
Voltage for Vat	2-6 V	2-6 V
Voltage for Barrel	10±2 V	10±2 V

6.2 Preparation of Electrolyte

The vat/barrel shall be filled with water to about 2/3rd capacity and then heated to nearly 50°C.

The required amount of tin salt shall be added to the water in small quantities with stirring.

After complete dissolution, the electrolyte shall be brought upto the working level by adding water and subsequently stirred thoroughly and heated to the operating temperature.

6.3 Analysis of the Electrolyte

The electrolyte shall be analysed after initial make-up and subsequently at suitable intervals.

The concentration of the electrolyte shall be maintained at the following limits:

Tin (Metal) For vat plating : 30 - 40 g/litre

For barrel plating : 50 - 60 g/litre

Free Caustic Soda (NaOH) For vat plating : 8 - 16 g/litre

For barrel plating : 20 - 30 g/litre

6.4 Temperature and voltage shall be recorded during plating.

7 PROCESS OF PLATING

7.1 Cleaning

All articles shall be properly cleaned as described in BHEL Standard AA0673601:

Process for cleaning and preparation of metal surfaces prior to electroplating, except passivation. If required electrolytic cleaning can also be carried out additionally.

7.2 Rinsing

All articles shall be rinsed thoroughly after cleaning to avoid contamination of the plating solution.

7.3 Pre-heating (Optional)

Before dipping in the plating bath all articles should be dipped in a hot water (80-90°C) bath for pre-heating purpose.

7.4 Plating

All articles shall be plated at the specified current density for a duration which will depend on the thickness of the deposit required.

Note: It shall be ensured that the anodes are never put in the solution before the vat/barrel is loaded and the current switched on. Likewise the anodes shall be removed before switching off the current after the plating is done.

7.5 Cold Rinsing

After removal from the plating bath, all articles shall be rinsed thoroughly in cold running water till any trace of tin solution is removed.

7.6 Hot Rinsing

Finally, all articles shall be rinsed in clean hot water at 80-90°C and dried.

7.7 Reflowing of Tin Deposit (Optional)

Castings having surface impurities like cavities and blow holes, where removal of entrapped alkaline tin solution is not possible, shall be immersed in a mutton tallow bath maintained at 260±10°C for 2 to 10 seconds. After flow melting, the articles are quenched in a bath containing kerosene oil at the top and water at the bottom. The residual oil from the flow melted surface shall be removed by vapour degreasing or by dipping in trichloroethylene. The thickness range of coating that can be flow melted is 2.5 to 7.5 microns.

8 HEAT TREATMENT

8.1 Stress Relieving Before Plating

Severely cold-worked steels or parts made from steel of tensile strength of 100 kgf/mm^2 or greater which have been ground or subjected to severe machining after tempering, shall normally be stress relieved by maintaining them at 200 ± 10°C, for not less than one hour or, preferably, for 30 minutes at the highest temperature within the limits imposed by the tempering temperature.

8.1.1 Some steels which have been carburized, flame-hardened or induction-hardened and subsequently ground would be impaired by the above treatment and shall instead be stress relieved at 140 ± 10°C for not less than five hours.

8.2 Heat Treatment after Plating (Optional)

8.2.1 Components subjected to critical fatigue or sustained loading stressed in service and made from severely cold-worked steels or from steels exceeding 100 kgf/mm^2 tensile strength shall be heat treated at 185 ± 5°C for not less than two hours.

8.2.2 Where the temperature of heat treatment in 8.2.1 would be harmful, for example, for some surface-hardened parts, a lower temperature for a longer time may be required.

NOTE:

When tin is plated on the article for soft soldering purposes, it may be flow melted at a temperature of 250 to 260°C to overcome difficulties in soldering during long periods of storage.

9 MAINTAINANCE OF ELECTROLYTE

9.1 If the electrolyte is low in tin and caustic soda, then add tin salt according to the requirement

9.2 To increase the tin content without affecting the caustic soda content, and addition of sodium stannate should be made.

9.3 If the bath works sluggishly and the anodes are coated with a thick encrustation, it is an indication that the solution is deficient in free caustic soda. The deficiency shall be corrected by maintaining free caustic soda as per clause 6.3.

9.4 If the deposit is rough, dark spongy, sodium perborate shall be added to the solution at the rate of 0.4 g/l of solution. Alternatively, 20 volume Hydrogen Peroxide to the extent of 1.5 ml/litre of solution may be added.

10 CARE OF ANODES

When working correctly the anodes are covered with a greenish yellow film the continuous maintenance of which is most important.

To obtain this film in the first instance, the vat/barrel shall be loaded with dummy cathodes (e.g. steel sheets). The current switched on and then the tin anodes shall be introduced on the one as each becomes filmed over. This is known as polarisation of anode. The current density necessary for this operation is about twice that normally used for plating. The formation of the film shall be at once apparent by the pale yellow brassy appearance of the anodes and shall also be indicated by a rapid fall in amperage and increase in voltage. As soon as the anodes are properly polarised in this manner, the current shall be reduced to normal and dummy cathodes replaced, one by one, with the articles to be plated. The batch shall be operated continuously for several hours, if possible, removing a number of articles at a time and replacing them with others before further unloading. In this way there will always be sufficient current passing to keep the anodes filmed the whole time they are in the vat/barrel.

At the end of day's work, anodes shall be taken out, current switched off and finally plated articles shall be removed. On commencing work again, the vat/barrel shall be loaded with articles current switched on and then anodes shall be introduced. If for any reason, the anodes lose their greenish yellow surface film and become a normal tin color they must be 'worked in' again as directed at the beginning of this clause until properly filmed over. It is important that the current be kept flowing continuously the whole time the anodes are in the vat/barrel in order to maintain the necessary film upon them. Failure to observe this precaution and keeping the anodes polarised will give rise to the formation of stannite (i.e. stannous tin) in solution and cause the plating to be dark and rough in texture.

11 PRECAUTIONS

Solution shall be kept covered when not in use.

Any chemical that may be necessary to be added shall be dissolved in a part of the original solution before adding it to the vat/barrel. It shall be poured through a filter.

Any metal that may be deposited on any part of the vat/barrel shall be removed

Any article that becomes lodged in any part of the vat / barrel shall be removed.

12 INSPECTION AND QUALITY OF DEPOSIT

12.1 Sampling

A sample from each batch of tank/barrel load shall be tested.

12.2 Condition of Surface

The plated surface shall appear as a smooth and continuous film over the base metal and shall be free from defects such as pits, stains, cracks, blisters, unplated areas and other superficial blemishes visible to the unaided eye. The plated surface shall be matt white and free from nodules.

12.3 Thickness of Deposit

Thickness of deposit shall be as per Appendix A of IS 1359.

12.4 Adhesion Type Test (Cl 9.3, Appendix- C of IS 1359)

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

12.5 Solderability test (Cl 9.5, Appendix-D of IS 1359)

This test shall be carried out whenever specified on BHEL order.

The samples shall be considered solderable, if they show a uniform coating free from discontinuities of breaks visible to the unaided eye.

Samples of tin coating on copper and copper alloys shall be subjected to preliminary artificial ageing treatment as per clause D-3.1.

13 REJECTION

If the samples taken do not comply with clauses 12.2 to 12.5 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.

14 REFRRED STANDARDS (Latest Publications Including Amendments)

1) IS 1359
2) IS 2384
3) IS 3026
4) IS 3598
5) AA54201
6) AA0673601