	BHARAT HEAVY ELECTRICALS LIMITED, TIRUCHIRAPPALLI – 620 014 **ADVANCED TECHNOLOGY PRODUCTS**

Scope of Work for

ELECTRO CHEMICAL POLISHING OF STAINLESS STEEL TUBES

Stainless Steel Tubes of size OD17 x 2t and OD28 x 3t and length 15 m / 20 m are to be electro chemically polished on internal and external surfaces as per the **PROCEDURE FOR ELECTRO CHEMICAL POLISHING**. Details of type, size and quantity are listed below for reference:-

Item No.	Item Type	Description	Qty.
1	TRIAL-1	Tube OD 17 x t2 - 20000 mm long	3
2	TRIAL-2	Tube OD 28 x t3 - 15000 mm long	2
3	TRIAL-3	Tube OD 28 x t3 - 20000 mm long	3
4	Production Job	Tube OD 17 x t2 - 20000 mm long	65
5	Production Job	Tube OD 28 x t3 - 15000 mm long	85
6	Production Job	Tube OD 28 x t3 - 20000 mm long	85

Scope of work:

1. Electro-chemical Polishing **Trial - 1 to 3** on tubes (as listed above in the Table) as per the PROCEDURE FOR ELECTRO CHEMICAL POLISHING (attached).
2. On successful results of Trials, electro-chemical Polishing of Production Jobs is to be done.

NOTE: PROCEDURE FOR ELECTRO CHEMICAL POLISHING is attached herewith for reference.

PROCEDURE FOR ELECTRO CHEMICAL POLISHING

This procedure deals with step by step instruction for ELECTRO CHEMICAL POLISHING OF TUBES of specification SA213 GR TP 321

The Electro chemical polishing procedure shall be established first on the trial tubes. Trial material shall be taken from supplied tubes itself. Electro chemical polishing shall be done on both inner & outer surface of tubes. Electrode size may be selected based on job requirements. All process parameters like temperature, current density, time duration etc. shall be established for each tube size.

A. Trial Electro polishing

1. Preparatory Operations

Take the supplied tubes and verify their identification.

The tubes are to be subjected to preparatory operations to remove surface soil such as polishing compounds, oils, etc. Clean the OD/ID of tubes with detergent soap solution and demineralised water. Further pickle the surface to be polished with 10-20% HNO3 by keeping in bath of this solution for about 10 to 20 minutes followed by cleaning with demineralised water.

Following Tube sizes shall be used as trials for establishing process parameters:

Sl.No	Description	Reqd Qty, in no	Surface finish of raw material supply
01	Tube 17 x 2 x 20000 mm (Trial-1)	03	OD 0.9 microns ID 0.9 microns
02	Tube 28 x 3 x 20000 mm (Trial-2)	03	OD 0.8 microns ID 1.3 microns
03	Tube 28 x 3 x 15000 mm (Trial-3)	02	OD 0.8 microns ID 1.3 microns

2. Electro chemical Polishing

Subsequently, the tubes shall be introduced into the electrochemical polishing solution for a period of time, at current density & temperature required to produce the surface finish of **Ra0.5 microns** or better based on the values from trial. Electrical contact is acceptable only at ends, maximum up to 200 mm from ends.

If polishing is not good and uniform, the electrochemical polishing process shall be repeated with different combination of current, temperature and process duration in consultation with BHEL and BARC.

3. Post-treatment and Rinsing

The electrochemical polishing process produces a residual surface film when withdrawn from the electrochemical polishing solution that can adversely affect appearance or performance.

The film shall be removed by:

a) Immerging the article in nitric acid solution of 10% volume fraction to 30% volume fraction (relative density 1.42; 70% mass fraction) at room temperature;

OR

b) Using several rinse stages. The article shall be rinsed subsequently to remove all traces of acidic water that can affect the appearance and performance of passive part.

c) Final rinsing shall be done with DM water.

4. Material sampling & Testing Plan Acceptance:

4.1 Passivation Testing:

The material after post-treatment and rinsing shall be tested/inspected in the presence of BHEL/BARC engineers for the tests mentioned in table 1. One tube from each size will be taken at random and will be cut into required length to do all the tests at OD & ID.

TABLE-1

Sl. No.	Test	Description	Acceptance Criteria
01	Water immersion test	The article shall be alternately immersed in distilled water for 1 hr then allowed to dry for 2 hrs for eight wet-dry cycles (24 hrs total)	No evidence on the article of red rust or other visible products resulting from the test
02	Copper Sulphate test	**Principle:** The article is swabbed with an acidified solution of copper sulphate and inspected for evidence of a copper-coloured spots indicating the presence of free iron	No evidence of a copper coloured deposit and/or copper coloured spots
		Reagent: A fresh copper sulphate test solution, prepared by dissolving 1.6 g of analytical reagent grade copper sulphate (CuSO4.5H2O) in 100ml of distilled water and 0.4 ml of sulphuric acid of 96% mass fraction	
		Procedure: Using a cotton swab, apply the test solution to a clean area of passivated surface to be tested, ensuring that the surface is kept wet for 6 min. Inspect the surface for the formation of copper coloured deposit and/or copper colour spots. Discard or reprocess parts used for testing	

4.2 Surface Finish inspection:

Surfaces of the tubes on ID & OD shall be free from clearly visible defects such as pits, roughness, striations or discoloration when examined with 20/20 eyesight at a distance of approx. 0.5 m.

Surface finish on OD of sample tubes will be checked and recorded using RA meter. Then, sample tube of length 100 mm (min) (approx.) will be cut longitudinally and surface finish on ID side will be checked and recorded using RA meter. For circumferential direction on both OD & ID, the surface finish will be checked by comparator method**.**

5. Test reports:

Test report detailing the results of passivation and surface finish will be made with reference to the sampling location, number of specimens used and deviations observed (if any) and submitted for review.

B. <u>Electro Chemical polishing of actual tubes</u>: Based on successful completion of trial as above and established procedure approved by BHEL, electrochemical polishing of actual tubes shall be taken up.

C. <u>Packing & dispatch:</u>

After drying the tubes with Nitrogen gas, properly pack the components with polythene sheets.

Before loading the tubes, thermocol sheets shall be placed at the bottom of wooden boxes. The tube shall be packed tightly in the supplied wooded box. Balance free space shall be filled with thermocol sheets including top side.
