
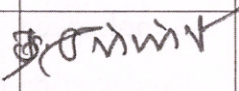

	<p>Bharat Heavy Electricals Ltd. Tiruchirappalli 620014</p> <p>Advanced Technology Products Operation Planning &amp; Control</p>	<p>OP&amp;C: PROC: RPVB3: 003</p>
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## PROCEDURE FOR ZINC PHOSPHATE COATING

Revision no and date	No of pages	Description	Prepared by (BHEL)	Reviewed by (BHEL)	Approved by (BARC)
00  16-12-2016	07	Fresh Submission	K Ramasamy (OP&C)	Dr.V Rajasekaran (Plant Lab)	PK Mishra
01  07-02-2020	10	Re-submitted for approval based on RPVB2 procedure as commented by BARC. Procedure no. given	 07.02.2020 (ATP/OP&C)		

  
19/2/2020



## 1. Scope

This procedure details the process of Zinc Phosphate coating followed by supplementary oil treatment for components made of Carbon steel & Low Alloy steel.

Applicable specifications: -

- Phosphate coating process – IS 6005
- Testing and Inspection – IS 3618, IS 1367

Refer Annexures-1 for list of components to be Zinc phosphate coated.

## 2. Quality Control

- 2.1. Details of the chemicals, test methods and the equipment proposed to be used shall be submitted by the firm while giving the offer. The exact designation of all proprietary materials proposed for use shall be stated in offer.
- 2.2. All machined components shall have been subjected to LPT prior to coating.
- 2.3. The offer shall include a detailed method of control, with limits for time, temperature and pH values, and all other pertinent details that will ensure compliance with the requirements of this Procedure.
- 2.4. No deviation from the approved Procedure shall be permitted without prior written approval of BHEL and Customer/QS.
- 2.5. Process parameters shall be established by the phosphating firm initially on mock-up coupons provided by BHEL. Mock-up coupons are representative of actual job materials.
- 2.6. Phosphating process, Testing and Inspection shall be carried out in the presence of BHEL and Customer/QS.
- 2.7. Only after process parameters have been established on mock-up coupons and accepted by BHEL and Customer/QS, job production can be taken up.
- 2.8. Production Test coupons supplied by the manufacturer shall be processed concurrently with each batch of job and shall be sufficient to conduct inspection/testing as per paragraph no. 13.0 of this procedure. Only when results of testing conducted on Production Test Coupons in the presence of BHEL and Customer/QS are satisfactory, it can be concluded that phosphate coating process



is satisfactory. Actual job shall also be subsequently inspected as per paragraph no. 13.0 of this procedure. Spare quantity of job identified by Purchaser can be taken as Production Test Coupons

- 2.9. Approval of process, materials and equipment implies no guarantee of acceptance of the results obtained after testing. Acceptance of the test results for Production Test coupons does not guarantee acceptance of the phosphate coating on components and component will be accepted only after complete inspection of the same. Test specimens shall be used only once and then preserved only for records.
- 2.10. Care shall be taken at all stages to prevent contamination of the surfaces being treated by touching with bare hands, splashing with undesirable liquids or the condensation of moisture on parts after drying.
- 2.11. Care must be taken to ensure that parts are kept in process baskets/pallets such that air entrapment in part internals is minimized during bath immersion.
- 2.12. Carryover of solution from one chemical process tank to next shall be totally avoided.
- 2.13. The process salt solutions and rinsing water shall be analyzed regularly as per IS 6005.
- 2.14. Audit checks on mass of coating shall be carried out once in a week using carbon steel test coupons of 3"x 2" (approximately 75 x 50 mm) processed along with the components.

### 3. Phosphating stages

- 3.1. Consecutive stages shall follow one another without delay.
- 3.2. Major stages along with the associated equipment are listed below:

Stage	Equipment
I - Pre-treatment	Electric Furnace (applicable only for material grade 38XH3MΦA)
II – Surface preparation	Degreasing tank, Rust and scale removing solution tank
III – Water rinsing	Cold water tank (with constant water overflow)
IV - Activation rinse	Activation rinse tank
V - Phosphating	Phosphating tank (SS), heated by gas, steam or electricity



VI - Rinsing	Running water and Hot Chromic acid rinse tank
VII - Drying	Compressed air or Drying oven
VIII – H <sub>2</sub> Embrittlement relief	Electric Furnace (applicable only for material grade 38XH3MΦA)
IX – Supplementary treatment	Oil immersion
X – Packing	Packing as per approved procedure

#### 4. Stage I - Stress relief HT (Pre-treatment for high strength steels)

- 4.1. Steels of specification 38XH3MΦA shall be given stress-relieving treatment before phosphating.
- 4.2. The parts should be heated for at least 30±10 minutes at a temperature of 190±10°C.
- 4.3. Minimum duration of heating – 1 hour for every 25.4 mm (1 inch) of thickness but not less than 0.5 hour for thicknesses less than 12.7 mm (0.5 inch).

#### 5. Stages II – Surface preparation

- 5.1. Before processing, all scale, rust, grease oil & foreign matter shall be removed from surface to be treated by a method, or combination of methods, suitable for meeting the requirement.
- 5.2. Choice of the appropriate process depends upon the type and degree of contamination and the size and shape of the parts. Method of cleaning or a combination thereof shall be finalized after discussions with Purchaser.
- 5.3. For material grade 38XH3MΦA, non-electrolytic alkaline or anodic alkaline cleaners or mechanical cleaning procedures are preferred to avoid the risk of producing hydrogen embrittlement during cleaning.
- 5.4. At the end of immersion, the items shall be lifted above the solution level to allow draining of excess chemicals.

#### 6. Stage III - RINSING AFTER DEGREASING AND RERUSTING

- 6.1. Items shall be rinsed thoroughly in cold water rinsing tank both after de-scaling and after de-rusting. Items shall be drained of excess water.





- 6.2. Care should be taken to ensure that the water supply itself is sufficiently free from harmful salts as given below:

- a) 100 ppm total chlorides (calculated as  $Cl^-$ )
- b) 200 ppm total alkalinity (calculated as  $CaCO_2$ )

- 6.3. Adequacy and effectiveness of cleaning shall be demonstrated on the mock-up coupons. Cleaned components are to be offered to BHEL and Customer/QS before any further processing.

**7. Stage IV – Activation Rinse**

Components after rinsing shall be subjected to activation rinse.

**8. Stage V - ZINC-PHOSPHATING PROCESS**

- 8.1. Method of application – Immersion only.
- 8.2. Phosphate coating treatment shall be carried out as per agreed operating instructions and chemicals such that all testing and inspection requirements are met.
- 8.3. At the end of the phosphating operation the items shall be lifted above the solution level to drain excess chemical.

**9. Stage VI - RINSING AFTER PHOSPHATING**

- 9.1. Items after phosphating operation shall be rinsed thoroughly first in running water and then in hot dilute chromate solution (temperature 60°C minimum).
- 9.2. Care should be taken to ensure that the water supply itself is sufficiently free from harmful salts as given below:

- c) 100 ppm total chlorides (calculated as  $Cl^-$ )
- d) 200 ppm total alkalinity (calculated as  $CaCO_2$ )

**10. Stage VII – Drying**

- 10.1. Items after rinsing shall be forced dried thoroughly.
- 10.2. Precautions shall also be taken to avoid local accumulation of solid residues, such as may be formed on the surface, when hard water is used for rinsing. Special attention being paid to the parts that contain pockets crevices.
- 10.3. In case Compressed air drying is used, air should be dry and free from oil and dirt. The pressure of air shall not exceed 6.3 kgf/cm<sup>2</sup>.



**11. Stage VIII – Hydrogen Embrittlement relief (Only for material grade 38XH3MΦA)**

- 11.1. Steels belonging to material grade 38XH3MΦA shall be given embrittlement relief treatment immediately after phosphating, rinsing & drying without any of the parts developing cracks. This treatment is to be conducted after coating before any stressing operation.
- 11.2. Heat treatment is to be carried out at 98 – 107 °C for 8 hours.
- 11.3. Hardness shall be checked on mock-up and production test coupons subsequent to heat treatment to determine any unacceptable reduction in hardness. In such circumstances, treatment may be carried out at a lower temperature, but not less than 130°C, for a minimum period of 8 hours. It may be noted that a low temperature treatment can adversely affect the fatigue strength of the article.

**12. Stage IX – Supplementary Treatment**

- 12.1. Sealing of the phosphate coating shall be carried out using **inorganic** oil or lubricant as per approved grade.
- 12.2. Organic oils/lubricants are not permitted.

**13. Inspection & Testing**

**13.1. Process Examination**

- 13.1.1. The entire phosphate coating process along with the associated inventory shall be subject to examination at the discretion of representatives from BHEL and Customer/QS to verify conformance with this Procedure.
- 13.1.2. Sampling for process control testing shall be subject to the approval of the representatives from BHEL and Customer/QS. The sampling plan shall be sufficient to demonstrate adequate control of the process and conformance of products processed.
- 13.1.3. Tests shall be performed at the frequency established from mock-ups and approved by representatives from BHEL and Customer/QS.

**13.2. Surface texture**

Coated items shall be free of defects as per paragraph 6.1 of IS 3618.

**13.3. Dimensions of coated items**





- 13.3.1. Coating weight is a requirement while thickness values are simply guidelines. Expected thickness of manganese phosphate coatings is 5 to 10 microns. Suitable pre-coating allowance shall be provided for threaded items in machining stage.
- 13.3.2. Threaded items shall **answer GO and NO GO gauges as per ISO 1502 after coating.**
- 13.4. Visual Tests  
Method of visual examination of items and acceptance shall be as per paragraph 6.2 of IS 3618.
- 13.5. Test for coating weight
  - 13.5.1. Method of testing coating weight shall be as per paragraph 6.3 of IS 3618.
  - 13.5.2. The weight of phosphate coating shall be a **minimum of 7.5 grams per square meter (g/m<sup>2</sup>)**. Upper limit on coating weight is governed by meeting dimensional requirements of drawing.
- 13.6. Test for resistance to corrosion
  - 13.6.1. Mock-up coupons shall be subjected to 5% salt spray (fog) test for determination of accelerated corrosion resistance as per ASTM Test Standard B117.
  - 13.6.2. Exposure time of coatings for salt spray shall be **72 hours**. No evidence of corrosion for the above specified time shall be seen.
- 13.7. Test for Corrosive residues  
Method of testing rinsing efficiency and acceptance shall be as per paragraph 6.4 of IS 3618.
- 13.8. Test for presence of Phosphate coating  
Method of testing and acceptance shall be as per Appendix A of IS 1367.
- 14. Packing and Documentation**
  - 14.1. Phosphate coated products shall be individually packed in polyethylene cover or wrapped in oil paper followed by soft packing so as to avoid any damage during handling or shipping. Parts/articles cleared for shipment but found damaged after receipt shall be accounted as "Rejected". Marking of items shall be on tag.
  - 14.2. The following completed documents for mock-up, Production Test Coupons & actual job shall be supplied along with the job: -



- OPS, Inspection and Testing records
- Process parameters & Phosphating log records
- Stress relief and Hydrogen embitterment relief treatment records

*Handwritten signature*



Annexure 1LIST OF COMPONENTS FOR PHOSPHATE COATING (RPV-B3)

Sl. No.	Component	Material grade	Qty. (nos.)	Individual Weight (grams)	BHEL Drawing No.	Threads available on component
1	BOLT Var. 1	25X1MØ	180	34	1-PV-629-00557/R02	M12 – 6g
2	BOLT Var. 2	25X1MØ	60	216	1-PV-629-00557/R02	M20 – 6g
3	WASHER Φ120.2H12	30XMA	24	6000	1-PV-629-00557/R02	NONE
4	WASHER Φ85.2H11	30XMA	6	1171	1-PV-629-00557/R02	NONE
5	PLATE – 3	SA516GR70	4	5	1-PV-629-00557/R02	NONE
6	DISC – 5	SA516GR70	4	453	1-PV-629-00557/R02	NONE
7	BUSH – 7	SA516GR70	4	281	1-PV-629-00557/R02	NONE
8	TAB WASHER (VAR. 05)	SS 321	26	4	1-PV-629-00557/R02	NONE
9	BOLT M6	SA 105	8	7	1-PV-629-00557/R02	M6-6g
10	BOLT M10	SA 105	16	26	1-PV-629-00557/R02	M10-6g

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Sl. No.	Component	Material grade	Qty. (nos.)	Individual Weight (grams)	BHEL Drawing No.	Threads available on component
11	PIN	SA516GR70	4	1	1-PV-629-00557/R02	NONE
12	STUD M85	38XH3MOA	6	21779	1-PV-629-00557/R02	M85 x 3 – 6g
13	NUT M85	38XH3MOA	8	3427	1-PV-629-00557/R02	M85 x 3 – 7H
14	SLEEVE – 5	38XH3MOA	4	4886	1-PV-629-00557/R02	NONE
15	STUD	SA193GRB7	24	14320	1-PV-629-00557/R02	M80 M120-6g