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SUPERSEDING  
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FEDERAL SPECIFICATION

CLEANING METHODS FOR FERROUS SURFACES  
AND PRETREATMENTS FOR ORGANIC COATINGS

This specification was approved by the Assistant Administrator Office of Federal Supply and Services, General Services Administration, for the use of all Federal Agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers cleaning, surface conditioning and preconditioning methods for improving the corrosion resistance of ferrous metals. The application of chemical conversion and pretreatment coatings provides uniformly textured substrates for receiving and retaining paint, lacquer, etc. In addition, this specification covers suitable cleaning processes for nonferrous surfaces (see 6.1, 6.1.2).

1.2 Classification. This specification covers the following cleaning methods and surface pretreatment processes:

1.2.1 Surface cleaning shall be by any of the following methods as specified (see 6.4):

- Method I - Mechanical or abrasive cleaning (for ferrous surfaces only).
- Method II - Solvent (immersion, spray or vapor).
- Method III - Hot alkaline (immersion, spray or electrolytic) for ferrous surfaces only).
- Method IV - Emulsion (with or without added water).
- Method V - Alkaline derusting (for ferrous surfaces only).
- Method VI - Phosphoric acid (alcoholic, detergent or solvent type with detergent).

1.2.2 Chemical conversion and pretreatment coatings shall be of the following types as specified (see 6.4).

- Type I - Zinc phosphate.
- Type II - Iron phosphate.
- Type III - Organic pretreatment coating.
- Type IV - Non-aqueous iron phosphate.

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## 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

### Federal Specifications:

AA-1830 - Tape, Pressure-Sensitive Adhesive, Box Closure

### Federal Standard:

Fed. Test Method Std. No. 141 - Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing.

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Office Centers in Boston; New York; Philadelphia; Washington, DC; Atlanta; Chicago; Kansas City, MO; Ft. Worth; Houston; Denver; San Francisco; Los Angeles; and Seattle, WA.

(Federal Government activities may obtain copies of Federal specifications, standards, and handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

### Military Specification:

DoD-P-15328 - Primer, Pretreatment (Formula 117 for Metals).

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM).

- A 109 - Steel, Carbon, Cold-Rolled Strip.
- A 366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- B 117 - Salt Spray (Fog) Testing.
- B 633 - Electrodeposited Coatings of Zinc on Iron and Steel
- D 610 - Evaluating Degree of Rusting on Painted Steel Surfaces.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

**3. REQUIREMENTS**

**3.1 Material.** All material used shall be as specified herein, on the drawings, or of a quality consistent with good commercial practice (see 6.11)

**3.2 Preproduction approval (type I only).** Unless otherwise specified by the procuring agency, details of the proposed procedure, including chemicals and the equipment to be used by the contractor, shall be submitted in writing through the contracting office to the bureau or agency concerned and written approval received prior to the commencement of production (see 6.5). The exact designation of any material proposed for use, together with the name of the manufacturer, shall be stated. The proposed procedure shall include a detailed method of control including limits for time, temperature, concentration, and all other pertinent details. Six (4 in x 6 in) panels phosphatized by the proposed procedure shall be submitted. Actual test results, indicating conformance to the specified test requirements should be submitted by the contractor along with the phosphatized panels. No deviation from the approved process shall be permitted without prior written approval of the procuring agency concerned through the contracting officer. Approval of process, materials, and equipment implies no guarantee of acceptance of the results obtained in use (See 6.5.1.1).

**3.3 Cleaning methods.**

**3.3.1 Removal of soils and corrosion products.** As a result of cleaning, the parts shall be thoroughly free of oil, grease, wax, dirt, scale, rust, and other foreign matter and shall show no visible signs of corrosion products when tested as in 4.2.3. The method or combination of methods used shall be selected to suit the properties of the metal and the degree of contamination present. Method I must be preceded by degreasing with Method II to assure a grease-free surface and should be followed by cleaning techniques such as air or brushing for the removal of dust and metal particles. Steels with a hardness of RC 40 or higher shall not be cleaned cathodically when electrolytic cleaning is employed in method III. Method VI is prohibited for use on steels of RC 40 or higher hardness, unless test data can substantiate that the combined phosphoric acid cleaning and phosphate coating treatment is not too severe for the steels being treated or should indicate that an adequate hydrogen embrittlement relief bake has been performed. Phosphoric, sulfuric or hydrochloric acid pickling shall not be used unless specifically approved or authorized by the drawing or specification for the item being processed.

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Pickling may not be approved for use on assemblies which may entrap acid, or when for any other reason acid pickling is considered inadvisable. If pickling chemicals are specified, the parts shall be thoroughly rinsed to insure residual acids are removed from the surface before subsequent processing (see 6.5).

3.3.2 Rinsing. Adequate rinsing shall be performed to remove any alkali or acid remaining from the cleaning operation. Special care shall be exercised in rinsing complex shapes. The water rinse, after the cleaning operation, shall be checked for contamination as measured by total alkali or total acid respectively. The rate of overflow of the rinse shall be so regulated that the total alkali contamination does not exceed 0.5 ml plus any total alkalinity correction factor in the water, or the total acid contamination does not exceed 0.5 ml (see 4.2.4). Conductivity devices could be used to automatically regulate the flow of rinse water according to rate of production.

3.3.3 Drying. Thorough drying shall be the final stage of each cleaning process, except where the cleaning treatment is to be followed immediately by a type I or type II chemical conversion process or chromic acid rinse. Care shall be exercised to assure complete drying in crevices, seams or other difficult to dry places, especially prior to painting.

#### 3.4 Processing requirements (Types I, II, and IV).

3.4.1 Cleaning. Cleaning shall be in accordance with 3.3.1.

3.4.2 Rinse after cleaning. Rinsing after cleaning shall be in accordance with 3.3.2.

3.4.2.1 Parts having a hardness greater than RC 40 shall not be subjected to phosphate treatment unless contractor demonstrates adequate stress relief and hydrogen embrittlement tests.

#### 3.4.3 Chemical conversion coating.

3.4.3.1 Type I. The properly cleaned articles shall be subjected to a balanced aqueous solution containing phosphoric acid, zinc, and accelerating agents until a uniform, insoluble, phosphate coating is produced. Dated records should be maintained for the chemical analyses and additions made to the solutions.

3.4.3.2 Type II. The properly cleaned articles shall be subjected to a balanced aqueous solution containing phosphoric acid or acid phosphate salts with or without the addition of accelerating agents until a uniform insoluble phosphate coating is produced.

3.4.3.3 Type IV. The properly cleaned articles shall be subjected to a balanced non-aqueous solution containing an approved solvent and phosphoric acid and shall be treated until a uniform phosphate coating is formed.

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**CAUTION:** Non-aqueous solutions containing hazardous chemicals such as chlorinated hydrocarbons shall be avoided when possible due to their toxicity and are not advised for general use unless special equipment and trained operators are employed. If such chemicals are used, control exhaust and maintain adequate ventilation so that the concentration of chlorinated hydrocarbon in the air does not constitute a health hazard.

3.4.4 Rinse after phosphating (Types I and II only). Phosphating shall be followed by a clean water rinse in order to remove residual salts and unreacted phosphating material.

3.4.5 Final rinse.

3.4.5.1 Final rinse (Type I and II only). The final rinse in type I and II processes shall be a chromic acid solution. The material, temperature, and concentration and other process controls including recommendations for replenishment and discarding shall be designated by the supplier of the final rinse chemicals (see 4.2.5).

3.4.5.1.1 Non-chromic acid or chromic/phosphoric final rinses are permitted when they meet the requirements of 3.5.6 and 3.5.7.

3.4.5.2 Type IV. The final rinse in a type IV process shall be that of the dip or spray condensate before the item leaves the vapor zone.

3.5 General requirements.

3.5.1 Appearance.

3.5.1.1 Type I, zinc phosphate. Type I coating deposits shall be continuous, uniform in texture, evenly deposited and gray to black in color. The coating shall not be mottled in appearance nor show any smut, powder, corrosion products, or white stains due to dried phosphating solutions. There shall be a minimum number of contact marks from holders or racks. Non-uniformity of color due to heat treatment, composition of the basis metal, the degree of cold work performed on the basis metal or presence of brown or orange stains inherent from the acidified final rinsing process shall not be cause for rejection.

3.5.1.2 Type II, iron phosphate. Type II coating deposits shall be continuous, uniform in texture and evenly deposited. The coating shall be golden yellow to purple in color. There shall be no smut, powder, corrosion products, or white stains due to dried phosphating solutions. There shall be a minimum number of contact marks from racks or holders.

3.5.1.3 Type III, organic pretreatment. The dried organic pretreatment shall be smooth and uniform in appearance and free from discontinuities.

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3.5.1.4 Type IV, non-aqueous phosphate. Type IV coating deposits shall be continuous, uniform in texture and evenly deposited. The coating shall be light gray in color. There shall be a minimum number of contact marks from racks or holders.

3.5.2 Phosphate coating weight (Types I, II and IV only) (not applicable to incidental nonferrous metal). When tested as in 4.2.6, type I minimum coating weight shall be 150 mg/sq ft (1600mg/m<sup>2</sup>) for spray processes and 300 mg/sq ft (3.2g/m<sup>2</sup>) for dip processes. Type II minimum weight shall be 25 mg/sq ft (300mg/m<sup>2</sup>) and type IV shall be 100 mg/sq ft. (1100mg/m<sup>2</sup>). Unless otherwise specified, the coating weight shall be tested at least every four hours.

3.5.3 Film thickness (type III only). The dry film thickness shall be 0.0003 to 0.0005 inch when tested as in 4.2.7.

3.5.4 Application of organic coating. The organic coating shall only be applied to thoroughly dried surfaces immediately after pretreatment. If the dried surface shows any rusting or soiling, it must be reworked prior to painting. The temperature of the metal surface shall be controlled to eliminate blistering, poor adhesion or unsightly film results (see 6.13, 6.15).

3.5.5 Paint thickness. For all tests requiring painted test specimens, the paint dry film thickness (see 4.2.7) on all surfaces shall be as specified for the end item. When the paint thickness is not covered in the end item specification, the drawing or paint specification requirement in the order cited shall be followed.

3.5.6 Paint adhesion (all methods and types). Painted specimens shall show satisfactory paint adhesion when tested as in 4.2.8. Unsatisfactory adhesion shall be indicated by exposure of bare metal or underlying phosphate pretreatment by any of the following conditions:

- (a) Any area exceeding 1/8 inch average diameter.
- (b) More than one area exceeding 1/16 inch average diameter.
- (c) More than five areas less than 1/16 inch diameter.

3.5.7 Salt spray resistance (all types). After pretreatment and painting, the specimens subjected to the salt spray test as in 4.2.9 for the number of hours prescribed in the applicable drawing, end item specification, paint specification, or one of the organic coatings listed in table I, para. 6.8, shall show no more than 1/8 inch creepage, blistering, or loss of adhesion of the paint from the scribe mark. At all other points there shall be no more than a trace of film failure (ASTM D 610), and not more than 5 scattered blisters none larger than 1 mm (3/64 inch) in diameter on a 4 by 6 inch test panel or equivalent area of test specimen or item. On items or specimens having an area less than 48 sq inch, a proportionately smaller number of failed areas will be permitted.

3.5.8 Relief of hydrogen embrittlement. Parts having a hardness of Rockwell C40 or greater shall be heat treated after phosphating for 8 hours at 210-225°F (99-107°C) or must be held for 240 hours at room temperature to relieve any embrittlement due to hydrogen (see 6.14).

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3.5.9 Hydrogen embrittlement relief test. Adequate verification tests must be performed on all parts having a hardness greater than RC40. Treated parts shall not reveal any developing cracks upon subsequent inspection. Parts having a hardness of RC48 or higher shall not be subjected to phosphating.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to the prescribed requirements.

#### 4.2 Test methods.

4.2.1 Tests shall be conducted as required in this specification. The right is reserved to make any additional tests deemed necessary to determine that the process meets the requirements of this specification.

4.2.2 Test specimens. Test specimens shall be prepared from actual production items or parts thereof, or if size is prohibitive, from scrap parts of the same kind and finish (from the same manufacturing lot if possible) which have been rejected for causes other than phosphating, material composition, heat treatment or any combination thereof. Standard panels may be used when authorized by the contracting officer. Specimens need not be identical in shape or size but shall be stamped, etched, or otherwise indelibly marked for identification as a test specimen. Standard panels, when used, shall be not less than 3 by 6 inches in size. If standard panels are used in lieu of test specimens for ferrous surfaces, the steel shall conform to Cold Rolled Carbon Steel Strip, ASTM A 109 or commercial quality Cold Rolled Carbon Steel Sheets, ASTM A 366 having a Rockwell "B" hardness of 55 to 75, and a surface roughness of 30 to 45 microinches (arithmetical average) as rolled; for aluminum surfaces use of aluminum alloy 2014 or 2024 panels is considered acceptable; for zinc coated surfaces, the panels shall conform to SC3, type I of ASTM B 633. All test specimens of standard panels shall be processed through all the cleaning, phosphating, painting, and drying steps along with the items being processed.

4.2.3 Removal of soils and corrosion products. Following the final rinse at least two test specimens, at the conclusion of a maximum of each 4 hours production, shall be dried and examined visually for rust, corrosion products, and soils. If the surface shows signs of soils or corrosion products, all items processed since last acceptance shall be rejected and corrective action taken. After corrective action, testing shall be continued at least once every hour until there is no sign of soils or corrosion products. Testing frequency shall then revert to two test specimens at the conclusion of a maximum of each 4 hours production.

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4.2.4 Rinsing. The water rinses after the cleaning operation shall be tested for contamination (see 3.3.2), in order to evaluate and maintain the necessary level of dilution.

4.2.4.1 Total alkali contamination test. Take a 10 ml sample of the rinse solution, dilute to 50 ml with distilled water and add 5 drops of Bromcresol Green Indicator. Slowly add testing solution (N/10 HCl) from a burette until the color of sample changes from blue-green to pale yellow. This is the end-point and the number of ml of acid testing solution used is the total alkali contamination.

4.2.4.2 Total acid contamination test. Take a 10 ml sample of the rinse solution, dilute to 50 ml with distilled water and add 5 drops of phenolphthalein indicator. Slowly add alkaline testing solution (N/10 NaOH) from burette until the first permanent pink color is produced. This is the end-point and the number of ml of alkaline testing solution used is the total acid contamination.

4.2.5 Final rinse. The final rinse shall be tested, replenished and discarded in accordance with procedures designated by the suppliers of the final rinse chemicals.

4.2.6 Phosphating controls.

4.2.6.1 Phosphate coating weight (types I, II, and IV only). Three test specimens (see 4.2.2), at the conclusion of a maximum of each 4 hours of phosphate processing shall be selected by the inspector for the test. The clean, dry specimens shall be accurately weighed and the surface area of each calculated. The phosphate coatings shall be completely removed by immersion in a 5 percent (by weight) chromic acid solution at 165°F for 15 minutes, rinsed, dried and weighed. This process shall be continued until constant weight is attained. A new chromic acid solution shall be used for each repeat immersion. The coating weight shall be determined from the formula:

$$\text{Coating weight} = \frac{(\text{Initial weight in gms} - \text{Final weight in gms}) \times 144,000}{(\text{mg/ft}^2) \quad \text{Total surface area in square inches}}$$

$$\text{g/m}^2 = \frac{(\text{Initial weight in grams} - \text{final weight in grams})}{\text{Total surface area in square inches.}}$$

Four hours production shall be considered acceptable provided the average coating weight of the 3 specimens equals or exceeds the minimum coating weight required for the applicable type and not more than one sample falls below the minimum. The sample falling below the minimum shall be within 10 percent of the minimum requirement. If 2 or more specimens fail to comply with the minimum coating weight, the four hours production shall be reworked and corrective action taken until production is again acceptable. When determining the surface area of irregularly shaped objects, consideration and care should be taken to correctly determine the surface area of both the inner and outer surfaces of the test piece.



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4.2.6.2 Free and total acid process controls. A free and total acid titration control shall be conducted after every four hours of processing as verification for compliance with suppliers' recommendation.

4.2.7 Film thickness. Film thickness shall be measured by a suitable instrument (see 6.9) which has been standardized on the same surface as that over which the organic finish has been applied. The number of specimens tested and basis for acceptance shall be as specified in 4.2.6.1.

4.2.8 Paint adhesion. Unless otherwise specified, a minimum of two test specimens (see 4.2.2) from each day's production shall be run through all steps of the regular production process including painting. Adhesion on the painted test specimens should generally be determined within 1 to 24 hours drying time for single coat applications. A two coat paint system should be tested within a maximum of 72 hours drying time. Press a 2 inch length of a somewhat longer piece of pressure-sensitive adhesive tape (3/4 inch width) conforming to commercial item description A-A-1830, firmly onto a flat or cylindrical surface of the item, rubbing out all air bubbles under the tape. Allow approximately 10 seconds for the test area to return to room temperature. Grasp a free end of the tape and at a rapid speed strip it from the item by pulling the tape back upon itself at 180 degrees (in such a manner that the tape is folded back to back during the procedure). Observe for bared areas where the paint is removed. Disregard flecks of paint on tape where the underlying metal or phosphate coating is not visibly exposed. If any test specimen indicates failure all items processed since last acceptance shall be rejected and corrective action taken.

4.2.9 Salt spray resistance. Prior to initiation of production, or whenever a change in production or paint occurs, or when required by the procuring activity, a minimum of three test specimens (see 4.2.2), shall be run through all steps of the regular production process including painting. The specimens shall be dried and baked for the time and at the temperature specified in the applicable paint specification. The painted specimens shall be scored lengthwise using a sharp knife. In instances where more than one metal is used, each metal shall be scored. The specimens shall then be exposed to the 5 percent salt spray specified in ASTM B 117 for the number of hours specified in the end item, drawing, or paint specification in the order cited.<sup>1/</sup> For the purpose of this test the significant surface on cylindrical items shall be an area 60° on either side of a scribe mark. Production shall not be initiated until results of the salt spray test are received, except at the contractor's risk.

During production, one specimen (see 4.2.2) from each day's production shall be subjected to the salt spray test specified above, until five consecutive days' production have successfully passed the test. Sampling may then be reduced to one sample twice per week. If failure occurs, all items processed since last acceptance shall be rejected and corrective action taken. Sampling shall revert to one specimen from each day's production until five consecutive days' production have again successfully passed the test.

<sup>1/</sup>As an alternate method one of the organic coatings listed in table I, para. 6.8 may be used.

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4.2.10 Hydrogen embrittlement relief test. The test for the effectiveness of the procedures used to control embrittlement lies in the subsequent service use of the material (see 3.5.9, 6.4).

4.2.10.1 Applicable control test(s) for hydrogen embrittlement can be selected by analogy to the particular service in which the processed article will be used. Such test(s) should be specified by the processing agency or can be agreed upon by contractor and purchaser.

4.2.10.2 Unless otherwise specified, testing for determination of the adequacy of treatment for the relief of hydrogen embrittlement shall be performed by the processor at a frequency he established will assure freedom from failure caused by hydrogen embrittlement by his procedure for each type of material processed.

4.2.10.3 When specified, a simple bend test may be sufficient. A sample shall be bent with the phosphate coated surface away, over a mandrel until its two legs are parallel. The mandrel should have a diameter equal to or greater than the thickness of the sample. Examination at 4X magnification shall show no evidence of cracking.

## 5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery is not applicable to this specification.

## 6. NOTES

6.1 Cleaning methods. The cleaning methods and chemical conversion coatings covered in this specification are suitable for use as rust removers and preventatives for ferrous parts and as metal conditioners for ferrous metals prior to application of paints.

6.1.1 Ferrous surfaces. Cleaning methods are intended primarily for ferrous metal cleaning, rust removing, descaling, or surface etching purposes in conjunction with chemical pretreatment processes. Method I (abrasive blasting) is generally recommended to remove heavy rust and mill scale on metals with thicknesses greater than 1/8 inch and, when specified, may be coated without being given a conversion coating. Method VI (phosphoric acid) may be used to remove light to moderate rusting but is not considered an acceptable substitute for a chemical pretreatment process. The selection of the cleaning process is dependent on the type and amount of soil and corrosion products on the items.

6.1.2 Nonferrous surfaces. Certain cleaning processes in this specification may also be used on nonferrous surfaces, for example: solvent cleaning, vapor degreasing and emulsion cleaning. Care should be exercised to insure cleaning materials used have no detrimental effects on the items being cleaned. In addition, this specification covers ferrous metal items containing small areas of zinc or aluminum surfaces or accessory fabricated parts of zinc or aluminum requiring treatment.

## 6.2 Chemical conversion and pretreatment coatings.

6.2.1 Type I. Type I process is intended primarily for use as a general all purpose pretreatment prior to painting on tanks, trucks, sedans, ammunition and other items, as specified and is generally recommended where extreme climatic exposure is anticipated.

6.2.2 Type II and IV. Types II and IV processes are intended primarily for use where metal parts are to be formed (assembled) after painting and for other end items as specified.

6.2.3 Type III. Type III is intended for use where size and shape preclude the use of types I, II or IV and where items containing mixed metal components are assembled prior to treatment.

6.3 Safety precautions. All safety requirements stated herein apply in addition to any applicable federal, state and local rules or requirements. Chemical suppliers or manufacturers instructions and insurance underwriters instructions shall be followed to insure safe handling practices and appropriate regulations governing chemicals (see para 3.4.3.3).

6.4 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Method and type required (see 1.2).
- (c) Approval (see 3.2).
- (d) Process (see 3.2).
- (e) Sampling and inspection (see 4.1).
- (f) Hydrogen embrittlement relief test (see 3.5.9, 4.2.10)

## 6.5 Preproduction approval (type I only).

6.5.1 Army. Coatings prepared for subsequent paint application or other applications require detailed information of the proposed procedure, chemicals and equipment to be used as well as six preproduction phosphatized panels (4 in x 6 in) (see 6.5.3). Preproduction submittal and approval shall be as specified by the Contracting officer.

6.5.1.1 Type I. The Army Materials and Mechanics Research Center is the agency responsible for Army preproduction approval. Unless otherwise specified, phosphatized test panels and technical information shall be submitted through the Contracting officer to: Army Materials and Mechanics Research Center, Watertown, MA 02172-0001. The following submittal is required prior to approval:

- a. Reference this specification and revision for compliance.
- b. Designated contractor's name, contract number, component or part number proposed for treatment and destination of material

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- c. Process Procedure Proposal shall indicate chemicals and equipment used for processing. Suppliers product profile or technical data instructives for bath make-up and limiting/optimum operating conditions shall be included for verifying procedure validity.
- d. The title page of the Contractor's detailed procedure shall indicate the following: company name, date, identification code or manufacturing process number, and the total number of pages.
- e. The contractor shall prepare six (4 inch x 6 inch) phosphatized panels (see 4.2.2) using the proposed phosphate coating procedure and shall indicate the test results of a representative panel coating weight from one of the panels tested in accordance with para 4.2.6.1. The contractor shall save three of these phosphatized panels for the designated procuring laboratory, so that panels can be evaluated for conformance to para 3.5.1.1 and 3.5.2.

6.5.2 Activities other than Army. Preproduction approval will not be required for proposed processes for applying crystalline phosphate base coatings under type I treatments on ferrous surfaces that correspond to the procedure outlined and described in 6.5.3. Unless otherwise specified, procedures, chemicals and equipment for type I treatments which do not correspond to the procedures in 6.5.3 will require preproduction approval of the procuring agency.

6.5.3 Procedure (method of application of phosphate coating) (applicable to type I only). The phosphate coating shall be applied in a minimum of five stages. Additional stages may be added at the option of the contractor provided that the five basic stages are retained. The minimum requirements for either spray or dip application are as follows:

Stage 1, cleaning. The cleaning method used shall be in accordance with one of the methods of 1.2.1 or a combination thereof.

Stage 2, rinse. A clean hot water rinse (125°-180°F) with a constant overflow maintained by the continuous addition of fresh water entering from the bottom and/or by spraying fresh water on the parts leaving the rinse.

Note. This stage is not necessary when cleaning method I (abrasive blasting) and/or II (solvent) is used.

Stage 3, phosphating. The properly cleaned articles or items shall be subjected to the phosphating solution (see 3.4.3.1) for at least the time required to secure the designated coating weight suggested for type I spray or dip processes in accordance with para 3.5.2.

The equipment used shall be constructed of materials resistant to the action of the phosphating solution and shall not contain copper alloy fittings or brazing where they may come in contact with the solution.

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The phosphating bath should be operated at temperatures and concentrations designated by the suppliers. Dated records should be maintained noting the periodic analyses and additions to the solutions. Fog sprays should be provided on both dip tanks and spray equipment to prevent the solution from drying on the work surface prior to the subsequent water rinse.

Stage 4, water rinse. A clean water rinse with a constant overflow maintained by the continuous addition of fresh water entering from the bottom.

Stage 5, acidified rinse. A final chromic, chromic-phosphoric or other acidified rinse should be prepared and maintained in accordance with the suppliers' recommendations (see 3.4.5.1). Such treatment is beneficial to the removal of unreacted chemical residues and provides a protective coating or seal which improves corrosion resistance. Care should be taken to maintain rinse strengths which will not stain or hinder the coating.

Follow manufacturer's suggestions for acidified rinse. Experiment with conditions (time, temperature and agitation) required for optimum seal.

Improper rinsing techniques have a detrimental effect on items requiring subsequent paint. Although the harmful effect on the paint coating may not be apparent immediately, it can result in early failure of the paint by blistering or flaking from a scratch and the rapid spread of corrosion products.

After treatment, the phosphated parts shall not be handled with bare hands, oily or contaminated gloves.

Organic finishing of prepared surfaces should not be delayed as contamination from ambient sources may occur causing a reduction in adhesion of the organic coating. Recommended practice calls for application within 24 hours of pretreatment.

6.6 Type II. The properly cleaned articles or items should be treated (see 3.4.3.2) until a phosphate coating is produced which is insoluble in water and has a color varying from golden yellow to purple. The article or items should be exposed to the phosphating solution in a spray process for at least one minute or 3 minutes in an immersion process. The article should then be rinsed in clean water, followed by a second rinse in an acidified solution (see 3.4.5.1) and dried.

6.7 Type IV. The properly cleaned articles should be treated (3.4.3.3) in a non-aqueous bath containing phosphoric acid by immersion or spray method of application for at least one minute. The articles shall be distillate rinsed while still resident in the vapor zone and will be dry and ready to paint on cooling.

6.8 For illustrative purposes only, table I contains examples of test requirements for specific paints, when applied over pretreatment coatings.

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TABLE I. Test requirements

Test	TT-E-516	TT-E-485	TT-P-636	TT-P-664
Dry film thickness, mils	0.9 - 1.1	0.9 - 1.1	0.9 - 1.1	0.9 - 1.1
Salt spray - dry at 120°F	24 Hours	24 hours	24 hours	24 hours
Exposure time, hours	48	144	144	192
Adhesion - air drying time hours	1	1	1	1

6.9 The following instruments for measuring paint thickness have been found to be satisfactory:

Aminco - Brenner Magnegage - American Instrument Company, Silver Spring, Maryland

Elcometer - Distributed by - Gardner Laboratory, Inc., Bethesda, Maryland 20014

"G.E." gage - General Electric Company, Schenectady, New York

Lea gage - Lea Manufacturing Company, Waterbury, Connecticut

6.10 After application of chemical conversion coating or cleaning method, changes in appearance are to be expected. Types I, II, and IV phosphate coatings leave a chemical deposit. Cleaning methods leave the metal surface substantially bare. Alcoholic phosphoric acid and phosphoric acid containing a solvent and detergent (method VI) discolor the surface. Hot phosphoric acid with a detergent (method VI) etches the surface.

6.11 Paragraph 3.1 of Revision B, TT-C-490 stated that an alternative for the type III wash primer could be authorized. This alternative is also acceptable under revision C. When authorized, a pretreatment primer conforming to DoD-P-15328 may be used for the type III organic pretreatment coating.

6.12 Cleaning material should be maintained at a concentration, temperature range and treatment time sufficient to remove all visible soils and corrosion products. The concentration of material should be measured and adjusted periodically (not less than once each shift) on the basis of established control procedures for applicable type. The bath should be discarded when the contamination is such that the concentration can not be adjusted with additional material. Table II lists examples of specification materials which may be used.

TABLE II. Specification material applicable to each cleaning method

Cleaning method	Specification
Method I	---
Method II	O-T-236
	O-T-634
	P-D-680
	TT-T-291
	MIL-C-15074
	MIL-D-26847
	MIL-T-81533
Method III	P-C-436
	P-C-437
	P-C-535
Method IV	MIL-C-11090
	MIL-C-43616
Method V	MIL-C-14460
Method VI	MIL-C-10578

6.13 In general, metal temperatures should be lower than 130°F for cellulose lacquers and 160°F for enamels unless the coating material has been specially formulated for the purpose. Temperatures from 60°F to 120°F are the most satisfactory (see 3.5.4). The temperature of the surface must not exceed 225°F prior to painting, because heating above this temperature tends to dehydrate the phosphate crystal and deteriorates the basis coating.

6.14 Hydrogen embrittlement relief. All lots of material subject to a sustained load in service exceeding 25 percent of the base metal yield strength should be treated for hydrogen embrittlement (see 3.5.8).

6.15 Application of organic coatings over bare untreated ferrous surfaces is not a recommended practice. Organic coatings should be applied to surfaces prepared with a chromate or phosphate treatment.

TT-C-490C

**Custodians:**

Army - MR

Navy - YD

Air Force - 20

**Review activities:**

Army - MI, ER, AV, EA, AR, AL, AT, ME

Navy - AS

Air Force - 70,80,82,99

**User activities:**

Army - SM, ME, AL

Navy - MC, OS, SH

**Preparing activity:**

Army - MR

**Civil Agency Interest:**

GSA

**Project No. MFFP-0130**

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