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15 September 2020
SUPERSEDING
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DETAIL SPECIFICATION

PHOSPHATE COATING, HEAVY, MANGANESE OR ZINC BASE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers two types of heavy phosphate coating for ferrous metals, applied by immersion. The coatings consist of a manganese phosphate or zinc phosphate base and, when specified, a supplementary treatment (see 6.1). For all types and classes, unless contraindicated on drawings or contract, materials containing hexavalent chromium should not be permitted on coated end items.

1.2 Classification. Coatings are of the following types and classes, as specified (see 6.2):

Type M	Manganese Phosphate Base.	
	Class 1	Supplementary preservative treatment or coating, as specified
	Class 2	Supplementary treatment with lubricating oil conforming to MIL-PRF-16173, Grade 3 or MIL-PRF-3150
	Class 3	No supplementary treatment
	Class 4	Chemically converted (may be dyed to color as specified) with no supplementary coating or coating as specified

Comments, suggestions, or questions on this document should be addressed to: Commander, U.S. Army CCDC, ATTN: FCDD-ACE-QSA, Picatinny Arsenal, New Jersey 07806-5000 or emailed to usarmy.pica.ccdc-ac.list.ardec-stdzn-branch@mail.mil. Since contact information can change, you may want to verify the currency of this information using ASSIST Online database at https://assist.dla.mil.

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Type Z	Zinc phosphate base
Class 1	Supplementary preservative treatment or coating, as specified
Class 2	Supplementary treatment with preservative conforming to MIL-PRF-16173, Grade 3 or MIL-PRF-3150
Class 3	No supplementary treatment
Class 4	Chemically converted (may be dyed to color as specified) with no supplementary coating or coating as specified

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-3150	-	Lubricating Oil, Preservative, Medium
MIL-PRF-16173	-	Corrosion Preventive Compound, Solvent Cutback, Cold-Application

(Copies of this document are available online at https://quicksearch.dla.mil/.)

2.3 Non-Government publications. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B117	-	Salt Spray (Fog) Testing
ASTM F519	-	Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals, Method For

(Copies of these documents are available online at https://www.astm.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been

obtained.

3. REQUIREMENTS

3.1 Preproduction inspection. Unless otherwise specified in the contract or purchase order (see 6.2), a preproduction inspection is required and shall be used to verify that the process complies with 3.2. Details of the procedure, chemicals, test methods and frequencies, and the equipment proposed to be used by the contractor shall be submitted in writing within 45 days after contract award to the procuring contracting officer (PCO) and written approval from the procuring activity will be received in 45 days or prior to production. The exact designation of all materials proposed for use, together with the names of the manufacturers, shall be stated. The proposed procedure 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 the specification. No deviation from the approved process shall be permitted without prior written approval of the procuring activity. Approval of process, materials and equipment implies no guarantee of acceptance of the results obtained in use. Regardless of the processes or materials approved, the phosphate coatings shall conform to all the applicable requirements of this specification.

3.2 Process. The phosphate coating shall be applied under the controls and in the stages described below. A single contractor shall perform all phases of the cleaning and coating process. Unless otherwise specified (see 6.2), phosphate coatings shall be applied after all machining, forming, welding, and stress relieving heat treatment have been completed, but prior to hydrogen embrittlement relief treatment.

3.2.1 Bath materials and controls. The bath materials and controls of the baths shall be in accordance with the following including the maintenance of Objective Quality Evidence (see 6.9):

a. The materials of the baths shall be capable of producing phosphate coatings conforming to all requirements herein for the type and class specified.

b. The bath concentration, temperature, and immersion time for parts shall be such that the phosphate coatings meet all the requirements of this specification.

c. The equipment shall be constructed of materials resistant to the action of the phosphating solutions and free from copper alloy fittings or brazing in contact with the solution.

d. Phosphatized parts shall not be allowed to dry between the phosphatizing solution treatment and the subsequent cold running water rinse. Fog sprayers or other means for prevention of drying shall be provided.

e. The supplier of the phosphate coated parts shall maintain a permanent record (see 3.2.1g) of the history of each phosphating bath, showing all additions of chemicals to the bath, and the results of all analyses performed.

f. Control of the chemical content of the phosphate coating solutions shall consist of determination of free acid, total acid and ferrous iron. Unless otherwise specified (see 6.2), the frequency of testing for free acid, total acid and ferrous iron shall be made prior to starting production and every four hours thereafter. High production rates may require more frequent analysis to assure process control within established limits. See chemical supplier's recommendations for maintenance at high production rates.

g. Permanent records of bath controls shall be maintained for not less than one year (seven when specified, see 6.2) and made available to the Government upon request. Permanent records shall be defined as legible records typed in hard copy or in an electronic media acceptable to the procuring activity.

3.2.2 Degreasing. Degreasing shall be performed by solvent, vapor, alkaline or emulsion cleaning. When alkaline or emulsion cleaning is used, thorough rinsing and drying shall be performed prior to abrasive blasting.

3.2.2.1 Abrasive blasting. Abrasive blasting shall be used prior to heavy phosphating unless otherwise specified on the drawing or in the contract (see 6.2). Rust or scale shall be removed by dry, abrasive blasting using sand, steel grit, aluminum oxide, glass bead, plastic bead or other ceramic type abrasives under the following conditions:

a. Shall be free of oil, grease, dirt and other contamination prior to abrasive blasting.

b. Vibratory deburring shall not be used in lieu of blasting.

c. After blasting, abrasive residues shall be removed by a blast of dry compressed air.

d. Abrasive blasting shall be controlled and performed using a mesh size sufficiently fine to preserve the required RMS finish when specified. (See 6.2)

e. The phosphating operation shall follow abrasive blasting with no intervening processes.

3.2.2.2 Alternatives to abrasive blasting. When alternatives to abrasive blasting are specified on the drawing or in the contract prior to phosphating, cleaning operations shall be followed by thorough rinsing in clean water. Strong acids or alkaline solutions shall not be used prior to phosphating without subsequent surface conditioning to refine the crystal structure and remove the effect of such solutions on the surface reactivity and the phosphate coating process (see 6.5). Alternate cleaning methods may be used, when specified, provided they do not adversely affect coating weight, salt spray or hydrogen embrittlement properties.

3.2.3 Phosphating. The phosphate coating shall be applied by immersion under the following conditions:

a. Type M coatings shall be manganese base and type Z shall be zinc base. All materials used for coatings shall be approved by the procuring activity as specified in 3.1.

b. The bath concentrations, temperature and immersion time for parts shall be such that

the phosphate coating meets all the requirements of this specification.

3.2.4 Water rinsing. The cold water rinse shall be performed in accordance with the following:

a. Dip rinsing. A continuous overflow shall be maintained by the addition of fresh water. Items shall be immersed only as long as necessary to meet the requirements of this specification.

b. To control contamination, the flow of rinse water shall be adjusted or regulated (for example by conductivity meters) . This shall be done within a time limit relative to the rate of production as to assure no detrimental effect on the coatings produced.

c. Spray rinsing may be utilized provided the same end-product quality is maintained.

d. Immediately following the water rinse, all items (except class 4) shall be treated with a sealer rinse (see 3.2.5).

3.2.5 Chromic acid rinse. When required on drawings and or contract, in lieu of a non-chrome sealer rinse (see 3.2.6), the chromic acid rinse of classes 1, 2, and 3 shall be performed in accordance with the following:

a. The final rinse shall be hot 63 to 93°C (150 to 200°F) chromic acid or chromic phosphoric acid solution: approximately 300 grams chromic acid flake in 1000 liters (L) of water.

b. The final rinse shall be maintained at a pH of 2 to 4 by the addition of flake chromic acid or mixtures of chromic and phosphoric acids. The pH of the final rinse shall be checked at least every 8 hours.

c. The final rinse shall be checked by a standard free and total acid titration or pH reading as often as is necessary to assure that the bath remains within the limits set at all times during which it is in operation.

d. All rinses should be discarded whenever they become contaminated. The final rinse shall be checked at least every 8 hours and shall be discarded when the total acid reading rises to more than 7 times the free acid reading.

e. The item should remain in each rinse for a minimum of 60 seconds.

f. Following the chromic acid rinse, the item shall be thoroughly dried before application of a supplementary treatment, as applicable.

3.2.6 Non-chrome sealer rinse. When required on drawings and contracts in lieu of a chromic acid rinse, non-chrome sealer shall be applied and controlled IAW the manufacture's recommendations.

3.3 Stress Relief. Unless otherwise specified (see 6.2), parts with a surface or through

hardness of Rockwell C 39 or greater and that have been machined, ground, cold formed, or cold straightened after heat treatment shall be thermally stress relieved prior to phosphate coating. The stress relief treatment shall consist of a heat treatment at 177 to 204°C (350 to 400°F) for a minimum of four hours. Carburized parts shall be stress relieved at 104°C to 155°C (225°F 275°F) for a minimum of 8 hours. Overhauled parts are not required to be stress relieved, this requirement was fulfilled during original manufacturing.

3.4 Hydrogen embrittlement relief heat treatment. For coating types Z and M on steels with a hardness of Rockwell C of 39 or greater, the embrittlement relief treatment shall consist of a heat treatment at 98 to 107°C (210 to 225°F) for a minimum of eight hours, or rest at room temperature for 120 hours prior to use (see 4.7.2).3.5 Weight of phosphate coatings. The weight of phosphate coatings, prior to application of any supplementary treatment, shall conform to the following:

a. Type M shall be a minimum of 16 grams per square meter (g/m^2) (11 g/m^2 when specified (see 6.2))

b. Type Z shall be a minimum of 11 g/m^2

3.6 Accelerated corrosion resistance. The phosphate coated item, free of supplementary treatment, shall be subjected to a salt spray (fog) test. It shall show no evidence of corrosion for the period of time shown in table I (see 4.7.5.1).

3.7 Supplementary treatments. Supplementary treatments shall be applied after completion of the phosphating process. Items receiving supplementary treatment shall be either centrifuged or permitted to drain sufficiently to remove all surplus from the surfaces. Unless otherwise specified (see 6.2), the supplemental oil coating weight shall be sufficient to meet the salt spray requirements of 3.7.2 and 3.7.4.

3.7.1 Types M and Z, class 1. The supplementary treatment for class 1 of types M and Z shall be as specified (see 6.2). Unless otherwise specified, weight of oil per unit area does not apply.

TABLE I. Accelerated corrosion resistance requirement (free of supplementary coating).

Coating system		Exposure time, minimum
Type	Class	Salt spray, hours
M	1	1.5
	2	1.5
	3	1.5
	4	24
Z	1	2
	2	2
	3	2
	4	24

3.7.2 Type M, class 2. The supplementary treatment for class 2 of type M shall be treated with lubricating oil conforming to MIL-PRF-3150 or MIL-PRF-16173, Grade 3. Unless otherwise specified, (see 6.2), the weight of oil per unit area shall be such that items shall show no signs of corrosion when subjected to the salt spray test for a minimum of 48 hours.

3.7.3 Type M, class 4 systems. Type M, class 4 shall be manganese base phosphate coatings that have been chemically converted by reaction with a reagent containing an inorganic salt. When specified (see 6.2), items shall receive supplementary treatment or be dyed to a specific color after chemically converting the phosphate coating. Class 4 coatings shall show no signs of corrosion when subjected to the salt spray test when subjected to a minimum of 72 hours only if supplementary treatment is applied.

3.7.4 Type Z, class 2. Type Z, class 2 coatings shall be treated with corrosion preventative conforming to MIL-PRF-3150 or Grade 3 of MIL-PRF-16173. Unless otherwise approved (see 6.2), the weight per unit area of corrosion preventive shall be such that items shall show no signs of corrosion when subjected to the salt spray test for a minimum of 72 hours.

3.7.5 Type Z, class 4 systems. Type Z, class 4 systems shall be zinc base phosphate coatings which have been chemically converted by reaction with a reagent containing an inorganic salt. When specified (see 6.2), items shall receive supplementary treatment or be dyed to a specific color after chemically converting the phosphate coating. Class 4 coatings shall show no signs of corrosion when subjected to the salt spray test for a minimum of 72 hours only if supplementary treatment is applied.

3.8 Dimensions of coated items. Items shall comply with dimensional requirements of the drawings prior to application of the phosphate coating. After coating, items shall comply with the dimensional requirements of the drawings, with allowance for the phosphate coating buildup. (For interference in close fits, see 6.6).

3.9 Surface texture. Unless otherwise specified, items shall comply with the finish or surface roughness requirements on the drawing prior to application of the phosphate coating. Surfaces for which the roughness characteristics can be obtained by special mechanical/chemical operations shall be so specified on the drawing or in the contract.

3.10 Workmanship. Phosphate coatings shall be evenly deposited, and shall have a uniform crystalline texture with a pattern not readily visible to the unaided eye and shall not produce any evidence of etching or intergranular attack of the base metal. Coatings shall be gray to black, and shall not have a mottled appearance. They shall be free of white stains (due to dried phosphating solution), rust, and fingerprints. However, brown or orange stains caused by chromic acid mix and non-uniformity of color due to heat treatment, degree of cold work, or composition of the base metal shall not be cause for rejection.

4.0 VERIFICATION.

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Preproduction inspection. (see 4.4)
b. Conformance inspection. (see 4.5)

4.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed under the following conditions:

a. Temperature: Room ambient 18 to 35°C (65 to 95°F)
b. Altitude: Normal ground
c. Vibration: None
c. Humidity: Room ambient to 95 percent relative, maximum

4.3 Sampling.

4.3.1 Preproduction sample. When specified (see 6.2), preproduction samples of the item or items to be phosphate coated shall be coated using the methods and procedures approved in accordance with 3.1. The number of items shall be as specified (see 6.2). The sample items shall be subjected to the preproduction inspection detailed in 4.4 at an activity as specified (see 6.2). Acceptance of the preproduction sample shall be based on no defects.

4.3.2 Lot size. Unless otherwise specified (see 6.2), a lot shall consist of phosphated items treated under approved process control ranges, during one shift, in the same processing baths, and to be submitted for acceptance at one time. Where continuous or conveyor equipment is used, a lot shall consist of a maximum of four consecutive hours of production.

4.3.3 Conformance inspection. All items shall meet all requirements of section 3. The inspections set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specific at in shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.3.4 Process control. Sampling for process control testing shall be subject to the approval of the procuring activity. The sampling plan shall be sufficient to demonstrate adequate control of the process and conformance of products processed to the requirements of this specification or other quality assurance provisions (QAPs), as specified. Coating weight shall be tested with each four hour production run (see paragraph 3.2.1.f). Corrosion testing shall be performed at a minimum once per month (see paragraph 3.6).

4.3.5 Hydrogen embrittlement relief. Testing to determine the adequacy of the treatment for hydrogen embrittlement relief shall be performed by the vendor or contractor at a frequency of 90- 120 days to assure that the embrittlement relief treatment is adequate.

4.4 Preproduction inspection. The preproduction inspection shall consist of obtaining approval as specified in 3.1 of procedure, chemicals, and equipment proposed to be used during production and when specified (see 6.2), the test and examinations specified in table II.

4.5 Quality conformance inspection. The quality conformance inspection shall consist of the tests and examinations specified in table II. The stress and hydrogen embrittlement test shall be performed for each lot only when specified by the procuring activity (see 6.2). Records of bath controls and history shall be maintained by the contractor and made available to the Government upon request as specified in 3.2.1 e and g.

4.6 Examinations.

4.6.1 Process examination. The phosphate coating process shall be subject to examination at the discretion of the procuring activity to verify conformance with 3.2.

4.6.2 Coated item examination. Samples selected in accordance with 4.3 shall be examined for compliance with the requirements of 3.8, 3.9 and 3.10. Dimensional and surface roughness measurements after application of the coating need be made only when specified (see 6.2). Adhesion shall be verified on each lot after phosphating by wiping a representative surface with a dry white lint free cloth. If any black or grey residue is removed from the component and left on the white cloth, halt processing.

4.7 Test specimens. Test specimens shall be in accordance with the following:

a. If the size, shape or cost of the coated item is such that tests cannot reasonably be performed on the item, separate representative test specimens may be utilized. These test specimens shall be supplied by the contractor. Such test specimens shall be cut from scrap items or made from the same alloy, heat treated in the same manner, and surface finished by the same process as the items they represent. The specimens shall have an external surface area of at least 10 square centimeters (cm^2).

b. The test specimens shall be distributed randomly and processed concurrently with the items.

c. If reused, the test specimens shall be mechanically resurfaced to remove residuals or shall be used only once and then discarded.

4.7.1 Process control tests. Process control tests shall be performed at the frequency established in accordance with 4.3.4 to verify conformance with 3.2.1 through 3.2.5. The contractor's procedures shall be used as approved per 3.1.

4.7.2 Hydrogen embrittlement testing. Unless otherwise specified, testing to determine the adequacy of the hydrogen embrittlement relief treatment shall be performed in accordance with the following:

a. For parts that are surface or through hardened at Rockwell C 39 and above, testing shall be performed in accordance with ASTM F519 using Type 1a cylindrical specimens to represent the parts. Phosphated specimens shall be subjected to a sustained tensile load equal to 75 percent of the ultimate notched tensile strength of the material. The steel, 4340 at Rockwell C51-54, is acceptable for worse case situations unless otherwise specified on the drawing or in the contract.

b. Unless otherwise specified (see 6.2) the specimens shall be held under the load for a minimum of 200 hours and then examined visually under 10x magnification and an illumination of 1100 lux (lx) for cracks. The production parts covered by the test period shall be rejected if any coated specimen develops any crack or breaks as a result of the test.

TABLE II. Preproduction and quality conformance inspection.

Test or examination	Requirement	Method	Preproduction inspection	Quality conformance Inspection
Bath materials and controls	3.2.1	4.6.1 & 4.7.1	X	X
Degreasing	3.2.2	4.6.1 & 4.7.1	X	X
Abrasive blasting	3.2.2.1	4.6.1 & 4.7.1	X	X
Phosphating	3.2.3	4.6.1 & 4.7.1	X	X
Water Rinse	3.2.4	4.6.1 & 4.7.1	X	X
Non-chrome rinse	3.2.6	4.6.1 & 4.7.1	X	X
Chromic acid rinse	3.2.5	4.6.1 & 4.7.1	X	X
Stress relief	3.3			
Hydrogen embrittlement relief	3.4	4.7.2	X	(See note)
Weight of phosphate coating	3.5	4.7.3	X	X
Accelerated corrosion resistance	3.6	4.7.5	X	X
Supplementary treatments	3.7	4.7.4	X	X
Dimensions of coated items	3.8	4.6.2	X	X
Surface texture	3.9	4.6.2	X	X
Workmanship	3.10	4.6.2	X	X

Note: The hydrogen embrittlement test shall be performed on each lot only when specified (See 6.2).

4.7.3 Weight per unit area of phosphate coatings.

4.7.3.1 Type M coatings. Weight per unit area of phosphate coatings prior to supplementary treatment shall be determined in accordance with the following:

a. Weigh the coated test specimen to the nearest mg; remove the coatings by immersion for a minimum of 15 minutes in a 50 gram per liter (g/L) chromic acid stripping solution at approximately 74°C (165°F); rinse in clean, running water; dry and reweigh.

b. Repeat this procedure until a constant weight is obtained.

c. If a supplementary treatment is present, it shall be removed prior to testing by immersion in a solvent such as petroleum ether. The coating weight shall be

calculated as follows:

d. Calculation: Weight per unit area of phosphate coating.

$$W\ (g/m^2) = \frac{\text{(initial weight in grams – final weight in grams)}}{\text{Total area in square meters}}$$

4.7.3.2 Type Z coatings. Weight per unit area of type Z coatings, prior to supplementary treatment, shall be determined in accordance with the following:

a. Weigh the coated test specimen to the nearest mg; remove the coatings by immersion at the room temperature for a minimum of 10 minutes in a stripping solution conforming to table III. (If desired, the chromic acid stripping solution described in 4.7.3.1a may be used.)

b. Rinse in clean, running water, dry and reweigh.

c. Repeat the procedure until a constant weight is obtained.

d. If a supplementary treatment is present, it shall be removed prior to testing as described in 4.7.3.1c. The coating weight shall be calculated as described in 4.7.3.1d.

TABLE III. Stripping solution for type Z coatings.

Material	Nominal Quantity
Sodium hydroxide	125 g
Tetrasodium ethylenediaminetetraacetic acid (4NaEDTA)	125 g
Water to make	1000 ml

4.7.4 Weight of supplementary treatment. Weight per unit area of supplementary treatment shall be determined in accordance with the following:

a. Age the test samples for a minimum of 16 hours at room temperature or dry at approximately 51.5°C (125°F) for a minimum of 3 hours. Cool in a desiccator and weigh accurately.

b. Completely remove the supplementary treatment by immersing in successive baths of petroleum ether or naphtha.

c. Rinse the sample in isopropyl alcohol, dry, and reweigh.

d. Determine the weight of the treatment per unit area using the following calculation:

e. Calculation: Weight per unit area of supplementary treatment

$$W\ (g/m^2) = \frac{\text{(initial weight in grams – final weight in grams)}}{\text{Total area in square meters}}$$

4.7.5 Accelerated corrosion resistance. Accelerated corrosion resistance shall be determined in accordance with 4.7.5.1.

4.7.5.1 Salt spray (fog). Accelerated corrosion resistance by salt spray (fog) shall be performed in accordance with the following:

a. Subject the samples to a 5 percent salt spray test as described in ASTM B117

b. Exposure times for coatings tested prior to supplementary treatment shall be in conformance with table II.

c. Exposure time of coatings tested after application of supplementary treatment shall be in accordance with 3.7.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or purchase order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the Managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The “heavy” phosphate coating covered by this specification are intended as a base for holding/retaining supplemental coatings which provide the major portion of the corrosion resistance. “Light” phosphate coatings used for a paint base are covered by other specifications such as TT-C-490. Heavy zinc phosphate coating may be used when paint and supplemental oil coatings are required on various parts or assemblies.

6.1.1 Type M. Type M coatings are more resistant than type Z to alkaline environments. Type M coatings should not be exposed to temperature in excess of 121 °C (250 °F). Except for special purpose applications, phosphate coatings should be used with a suitable supplementary treatment. Each class for type M is described below:

a. Class 1 allows the procuring activity to specify a suitable supplementary treatment

depending upon the particular application.

b. Class 2 covers coatings impregnated with MIL-PRF-3150 lubricating oil or MIL- PRF-16173, Grade 3 rust preventive. This class may be specified for general purpose applications in which a moderate degree of corrosion resistance is required during storage, to prevent wear, and assist in the "breaking-in" of bearing surfaces. Supplemental oil may be removed from phosphate coated items by contact with absorbing material.

c. Class 3 covers coating without supplementary treatment. This class is intended for special purposes in which a supplementary treatment is not desired.

d. Class 4 covers chemically converted coatings, chemically converted with supplementary treatments that are suitable for use where corrosion protection is required in addition to other properties (see 1.2). This coating is recommended for use where a dyed or colored coating such as olive drab or black (non-reflective) coating is needed. The class 4 coating provides improved corrosion resistance; however, the supplementary coating provides most of the corrosion protection when used in conjunction with phosphate coatings. The class 4 coating provides an improved "break-in" coating and is recommended for reducing the sliding friction in preference to the class 2. The use of the class 4 coating reduces the variation in torque versus tension values usually found with threaded fasteners.

6.1.2 Type Z. Type Z coatings should not be used if contact with alkaline materials or exposure to temperatures above 93°C (200°F) is expected. Type Z coatings may be used to prevent galling in cold-extrusion and deep-drawing applications. Except for special-purpose application, type Z coatings should be used with a suitable supplementary treatment (see 1.2). Each class for type Z is described below:

a. Class 1 allows the procuring activity to specify a suitable supplementary treatment depending upon the particular application.

b. Class 2 covers coatings impregnated with grade 3 of MIL-PRF-16173 or MIL-PRF-3150. This class may be specified for general purpose application in which corrosion protection is the primary consideration.

c. Class 3 covers coatings without supplementary treatment. This class is intended for special purposes in which a supplementary treatment is not desired.

d. Class 4 covers chemically converted coatings with no supplementary treatment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type and class of coating (see 1.2)
c. When preproduction inspection is not required (see 3.1 and 6.3)
d. When phosphate coating (and any supplementary treatment) is not to be the final process (see 3.2)
e. When the frequency of bath sampling is the contractor's option (see 3.2.1f).

f. When abrasive blasting is not required as pretreatment (see 3.2.2.1)
g. When stress and hydrogen embrittlement relief are not required (see 3.3 and 3.4).
h. When type M coating weight should be 11 g/m^2 (see 3.5).
i. Supplemental treatment required for class 1 and weight of treatment (see 3.7.1).
j. The specific supplemental coating weight range where other than as applied to meet salt spray requirements (see 3.7).
k. Supplementary treatment and color of dye desired for type M or type Z, class 4 (see 3.7.3 and 3.7.5), when applicable.
l. Inspection conditions if other than as specified (see 4.2).
m. Assigned activity for preproduction inspection (see 4.3.1).
n. Number and type of preproduction samples required (see 4.3.1).
o. Specify lot size and sampling plans (see 4.3.2).
p. When stress and hydrogen embrittlement relief tests are required for each lot, frequency if not for each lot, exceptions and details of procedures (see 4.3.5 and 4.5).
q. When tests and examinations are required for preproduction inspection (see 4.4).
r. When surface roughness and dimensional measurements are required after coating (see 4.6.2).
s. Packaging requirements (see 5.1).

6.2.1 Contract data requirements. Any data required for delivery in connection with this document should be specified on a DD Form 1423 incorporated into the contract or purchase order. Such data will be delivered as identified on completed (numbered) DIDs (Data Item Descriptions/ DD1664).

6.3 Preproduction sample waiver. Preproduction samples submitted and approved on a recent contract may be accepted by the procuring activity in lieu of an additional preproduction sample inspection. When the preproduction sample is waived (see 6.2c), the procurement document should contain a statement specifying that the standards of workmanship exhibited by the previously approved preproduction sample will determine the minimum requirements of the current contract or purchase order.

6.4 Supersession data. Table IV shows a comparison of classification of coatings of this specification with that of coatings specified in previous editions of MIL-P-16232 and MIL-C-12968.

6.5 Surface finishes finer than 0.80 micrometers after phosphating. Abrasive blasting using too coarse a media grit size may alter the surface finish of parts with less than 0.80 micrometers. The grit size must be selected to be compatible with the surface finish requirement and it may be necessary to use 320 grit size or grade 1000 glass beads. Phosphate coatings should not be specified where highly polished surfaces are required after phosphating.

TABLE IV. Classification comparison.

MIL-DTL-16232G	DOD-P-16232F & MIL-P-16232E	MIL-P-16232D	MIL-P-16232C	MIL-P-16232B	MIL-P-16232A	MIL-C-12968
Type M, Class 1	Type M, Class 1	Type M, Class 1	Type M, Class 1	Type M, Class 1	-	Type A
Type M, Class 2	Type M, Class 2	Type M, Class 2	Type M, Class 2	Type M, Class 2	Type I	-
Type M, Class 3	Type M, Class 3	Type M, Class 3	Type M, Class 3	Type M, Class 3	-	-
Type M, Class 4	Type M, Class 4	Type M, Class 4A	Type M, Class 4A	-	-	-
	New Class 4	Type M, Class 4B	Type M, Class 4B	-	-	-
	deleted	Type M, Class 4C	-	-	-	-
	4A, B, C, D	Type M, Class 4D	-	-	-	-
		Type M, Class 4E	-	-	-	-
Type Z, Class 1	Type Z, Class 1	Type Z, Class 1	Type Z, Class 1	Type Z, Class 1	-	Type B, Class 1
Type Z, Class 2	Type Z, Class 2	Type Z, Class 2 \1	Type Z, Class 2 \2	Type Z, Class 2 \3	Type II	-
Type Z, Class 3	Type Z, Class 3	Type Z, Class 3	Type Z, Class 3	Type Z, Class 3	-	-
Type Z, Class 4	Type Z, Class 4	Type Z, Class 4A	Type Z, Class 4A	Type Z, Class 4	-	Type B, Class 2
	New Class 4	Type Z, Class 4B	Type Z, Class 4B	-	-	-
	deleted	Type Z, Class 4C	Type Z, Class 4C	-	-	-
	4A, B, C, D	Type Z, Class 4D	Type Z, Class 4D	-	-	-
		Type Z, Class 4E	Type Z, Class 4E	-	-	-

\1 Treated with MIL-PRF-16173, Grade 1 (or MIL-PRF-3150 for very small parts)
\2 Treated with MIL-PRF-16173, Grade 2
\3 Treated with MIL-PRF-16173, Grade 1

6.6 Dimensions of coated items. Table V gives expected thickness of phosphate coatings. If close fits are specified, buildup in thickness caused by the phosphate coating may result in apparent interference on assembly. Coatings are friable, however, and assembly may be accomplished by forced fitting, wiping, and otherwise removing the surplus coating. Nonferrous metal wire brushes should not be employed. Salt spray requirements are applicable to coated articles prior to removal of any coating in assembly operations. (Note: Coating weight is a requirement while thickness values are simply guidelines.)

TABLE V. Expected thickness of phosphate coatings.

Type	Thickness (µm)
M	5 to 10
Z	5 to 15

6.7 Production. Further production by the contractor prior to approval of the production sample will be at the contractor's risk.

6.8 Subject term (keyword listing).

Abrasive

Alkaline Chromic acid Corrosion
Hydrogen embrittlement

6.9 Objective Quality Evidence (OQE). Statements of fact, either quantitative or qualitative, pertaining to the quality of a product produced by the process described herein based on observations, measurements, or tests which can be verified. (Evidence will be expressed in terms of specific quality requirements or characteristics. These characteristics are identified in drawings, specifications, and other documents which describe the item, process, or procedure.)

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL

Custodians:
Army - AR
Navy - AS
Air Force - 11

Preparing activity:
Army - AR

(Project: MFFP-2019-007)

Review activities:
Army –MD, MR, SM
Navy - CH, MC, MS, OS, SH
Air Force - 84
DLA – GS

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the accuracy of the information above using the ASSIST Online database at https://assist.dla.mil/.