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## Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners<sup>1</sup>

This standard is issued under the fixed designation F 1137; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.03 on Metal Coatings on Threaded Fasteners.

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### 1. Scope

1.1 This specification covers the basic requirements for ~~three seven~~ grades of corrosion-protective coatings protection for fasteners. Grade ~~I~~ 0A consists of a zinc phosphate coating with no additional sealer (dry), Grade 0B consists of a zinc phosphate coating with a dry organic sealer, Grade 0C, Grade 0D, and Grade I consist of a zinc phosphate coating with supplemental protective oil type compound, and Grades II and III consist of a zinc phosphate with a supplemental zinc-rich epoxy resin coating (Grade II includes a clear organic topcoat).

1.2 This specification is intended primarily for fasteners such as nuts, clips, washers, and other ferrous threaded and non-threaded fasteners that require corrosion protection.

1.3 These coatings may or may not have a decorative finish.

### 2. Referenced Documents

2.1 *ASTM Standards:*

~~B 117 Test Method of 117 Practice for Operating Salt Spray (Fog) Testing Apparatus~~<sup>2</sup>

D 2247 Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity<sup>3</sup>

D 3359 Test Methods for Measuring Adhesion by Tape Test<sup>3</sup>

~~E 122 Practice~~

~~F 1470 Guide for Choice of Sample Size to Estimate a Measure of Quality Fastener Sampling for a Lot or Process Specified Mechanical Properties and Performance Inspection~~<sup>4</sup>

### 3. Classification

3.1 The zinc phosphate treatment and subsequent protective coatings are classified into ~~three seven~~ grades according to the requirements shown in Table 1. Phosphate bath concentrations, temperatures and immersion times recommended by the chemical manufacture should be followed.

### 4. Ordering Information

4.1 Orders for material under this specification shall include the following information:

4.1.1 Quantity of parts;

4.1.2 Grade required (see Table ~~1~~ 1), and

4.1.3 Any additions agreed upon ~~by~~ between the purchaser and the supplier.

### 5. Requirements

5.1 *Appearance*—Unless otherwise agreed upon between the purchaser and the producer, the color of the protective coating shall be as-coated gray for Grades 0A, 0B, 0C, and 0D, black for Grade I, and metallic gray for Grades II and III. In addition, Grades II and III shall be free from tears, sags, and excess coating that may affect appearance or performance, or both.

5.2 *Adhesion*—The coating for Grades II and III shall show no evidence of blistering nor other appearance changes after exposure to humidity testing for 96-h minimum. It shall show no more than 3.0-mm peel-back from intersection of lines scribed and tape tested immediately after a 10-min recovery period following exposure, and no other peeling in area under the tape.

<sup>2</sup> Annual Book of ASTM Standards, Vol 03.02.

<sup>3</sup> Annual Book of ASTM Standards, Vol 06.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol ~~14.02~~ 01.08.

**TABLE 1 Classification and Performance Requirements of Protective Coatings**

Grade No.	Zinc Phosphate, g/m <sup>2</sup>	Supplemental Coating	Coating Thickness, μm	Salt Spray, h
<del>Grade I</del>	11, min	none	see 5.5	72 <sup>A</sup>
Grade 0A	11, min	none	see 5.5	72 <sup>A</sup>
Grade 0B	11, min	sealer	see 5.5	72
Grade 0C	11, min	protective oil-type compound	see 5.5	24
Grade 0D	11, min	protective oil-type compound	see 5.5	72
<del>Grade I</del>	26–32	<del>protective oil-type compound</del>	See 5.5	168
Grade I	26–32	protective oil-type compound	see 5.5	168
<del>Grade II</del>	13–16	<del>zinc-rich<sup>A</sup> resin flake</del>	15–25	240
Grade II	13–16	zinc-rich <sup>B</sup> resin flake	15–25	240
<del>Grade III</del>	13–16	<del>zinc-rich resin powder<sup>B</sup></del>	10–20	400
Grade III	13–16	zinc-rich resin powder <sup>C</sup>	10–20	400

<sup>A</sup> Zinc rich resin to contain 60 % minimum metallic zinc flake by volume with 14 to 16 % aluminum.

<sup>B</sup> Zinc-rich resin to contain 60% minimum metallic zinc flake by volume with 14 to 16 % aluminum.

<sup>C</sup> Zinc rich resin to contain 80 % minimum metallic zinc powder by volume with trace aluminum.

5.3 *Corrosion Resistance*—These coatings shall be capable of withstanding neutral salt spray for the minimum h specified in Table 1 with no base metal corrosion on significant surfaces. Significant surfaces on threaded fasteners are defined as the exposed surfaces when the fasteners are installed in a normal manner (bolt head, nut head, face, etc.). On other surfaces where control of the coating cannot be obtained under normal processing such as holes, recesses, threads, etc., the above requirements do not apply.

5.4 *Coating Flexibility*—These coatings shall withstand the normal flexing encountered by spring clips, or swaged and flaired fasteners, without evidence of flaking or loss of adhesion to base metal. They shall also withstand normal handling and storage conditions.

5.5 *Thread Fit*—The maximum thickness of coating which may be applied to threads on threaded products is limited by the basic thread size (see 8.2). Threads may be produced undersize/oversize (before coating) to accommodate the coating thickness, providing the finished product (after coating) meets all specified mechanical properties. All undersize/oversize must be within permissible limits as agreed upon ~~by~~ between the supplier and the purchaser.

5.6 *Dry-to-Touch*—Grade 0C shall be evenly coated and dry-to-touch such that when held with filter paper or equivalent and applying hand pressure for 5 to 10 s, there shall be no visible staining of the filter paper when viewed without use of supplementary magnification. For referee purposes, this test shall be performed using a force of 10 N as measured with a load-indicating gage.

## 6. Sampling

6.1 The purchaser may request samples in accordance with ~~Practice E 122.~~ Guide F 1470.

## 7. Test Methods

7.1 The humidity test and adhesion test shall be conducted in accordance with Practice D 2247; and Test Methods D 3359, respectively, for Grades II and III.

7.2 The corrosion resistance shall be determined in accordance with ~~Test Method Practice B 117.~~

7.3 The coating thickness may be determined by microscopic examination of the cross-section taken perpendicular to the significant surface or by determining the coating mass (g/m<sup>2</sup>) by a weigh-strip-weigh method and then converting to a coating thickness (see note). Coating thickness, for referee purposes, shall be measured by microscopic examination.

NOTE 1—The weigh-strip-weigh method involves weighing the test specimen before and after stripping the deposit with a reagent which does not attack the base metal.

The formula used for measuring the thickness of a deposit by the weigh-strip-weigh method is:

$$T = \frac{W}{A \times D} \times 10^3$$

where:

*T* = thickness, μm,

$W$  = mass of deposit, g,  
 $A$  = area of deposit, m<sup>2</sup>, and  
 $D$  = density of coating, kg/m<sup>3</sup>.

7.4 The presence of clear topcoat for Grade II may be determined by the sulfamic acid drop test: One to two drops of 1 % sulfamic acid shall be dropped on the surface. In the absence of topcoat, the surface will turn black.

## 8. Inspection

8.1 Samples shall be taken in accordance with ~~Practice E 122.~~ Guide F 1470.

8.2 *Referee Inspection*—The following referee thread inspection procedure may be utilized if the specified “go” gage binds on the screw.

8.2.1 *Bolt or Screw*—Assemble a phosphate-plated test nut with a 2B or 6H class thread down the full length of the thread.

8.2.2 *Nut*—Assemble a phosphate-plated test bolt or screw with a 2A or 6g class thread for a minimum of one- $(\pm)$  diameter through the nut.

8.2.3 The test nut or screw/bolt must run freely for the total length without binding.

## 9. Rejection and Rehearing

9.1 Unless otherwise specified, any rejection based on tests specified herein and made by the purchaser shall be reported to the manufacturer as soon as practical after receipt of the product by the purchaser.

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