



Designation: F1137/F1137M – 19

Standard Specification for Phosphate/Oil Corrosion Protective Coatings for Fasteners¹

This standard is issued under the fixed designation F1137/F1137M; 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.

1. Scope*

1.1 This specification covers the basic requirements for six grades of corrosion protection for fasteners. Grade A consists of a heavy zinc phosphate coating with no additional sealer (dry), Grade B consists of a heavy zinc phosphate coating with a dry organic sealer, Grade C consists of a heavy zinc phosphate coating with supplemental dry-to-touch oil type compound, Grade D consists of a heavy zinc phosphate coating with supplemental protective oil type compound, Grade E consists of a grain-refined microcrystalline zinc phosphate with supplemental oil type compound, and Grade F consists of a manganese phosphate coating with supplemental oil type compound.

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 and lubrication.

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

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

F117 Practice for Operating Salt Spray (Fog) Apparatus

¹ This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.03 on Coatings on Fasteners.

Current edition approved June 15, 2019. Published June 2019. Originally approved in 1988. Last previous edition approved in 2018 as F1137/F1137M – 18. DOI: 10.1520/F1137_F1137M-19.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

3. Classification

3.1 The phosphate treatments and subsequent protective coatings are classified into six grades according to the requirements shown in **Table 1**.

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**), and

4.1.3 Any additions agreed upon 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 all grades.

5.2 *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.

5.3 *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 between the supplier and the purchaser.

5.4 *Dry-to-Touch*—Grades B and C 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

*A Summary of Changes section appears at the end of this standard

TABLE 1 Classification and Performance Requirements of Protective Coatings

Grade	Phosphate Treatment	Coating Weight		Supplemental Coating	Coating Thickness, μm	Salt Spray, h
		mg/ft^2	$[\text{g}/\text{m}^2]$			
Grade A	Heavy Zinc Phosphate	1000, min	[11, min]	none	see 5.3	72 ^A
Grade B	Heavy Zinc Phosphate	1000, min	[11, min]	sealer	see 5.3	72
Grade C	Heavy Zinc Phosphate	1000, min	[11, min]	protective oil-type compound (dry-to-touch)	see 5.3	24
Grade D	Heavy Zinc Phosphate	1000, min	[11, min]	protective oil-type compound	see 5.3	72
Grade E	Microcrystalline Zinc Phosphate ^B	185 min–650 max	[2 min–7 max]	protective oil-type compound	see 5.3	8
Grade F	Manganese Phosphate	370 min–1765 max	[4 min–19 max]	protective oil-type compound	see 5.3	24

^A When testing Grade A finished parts, a protective oil coating shall be added before salt spray testing.

^B Microcrystalline zinc phosphate crystals shall be refined such that a mean crystal size of 4–8 μm is obtained, with a preferred maximum crystal size of 10 μm . Isolated crystal sizes up to 15 μm are permitted, provided torque-tension performance is not degraded.

test shall be performed using a force of 10 N as measured with a load-indicating gauge.

6. Sampling

6.1 The purchaser may request samples in accordance with Practice F1470.

7. Test Methods

7.1 The corrosion resistance shall be determined in accordance with Practice B117.

7.2 The coating thickness may be determined by microscopic examination of the cross-section taken perpendicular to the significant surface. Coating thickness, for referee purposes, shall be measured by this method.

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

$$\frac{\text{Coating weight in mg}/\text{ft}^2 [\text{g} / \text{m}^2] = \text{Initial Weight in mg} [\text{g}] - \text{Final Weight in mg} [\text{g}]}{\text{Total Area in ft}^2 [\text{m}^2]}$$

7.3 The coating weight of the phosphate deposit shall be determined using the weigh-strip-weigh method (see Note 1). The formula used for measuring weight of a deposit by the weigh-strip-weigh method is:

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.

8. Inspection

8.1 Samples shall be taken in accordance with Practice F1470.

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 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.

10. Keywords

10.1 coating; corrosion; fasteners; protection; phosphate; resistance; rust