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.

Designation: F3019/F3019M – 19

Standard Specification for Chromium Free Zinc-Flake Composite, with or without Integral Lubricant, Corrosion Protective Coatings for Fasteners[1]

This standard is issued under the fixed designation F3019/F3019M; 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 non-electrolytically applied zinc-flake composite corrosion protective coating systems for fasteners (See Note 1).

NOTE 1—The coating systems do not contain hexavalent chromium, lead, cadmium, or mercury.

1.2 This specification is intended for corrosion protection of inch and metric series threaded fasteners with minimum nominal diameters of 0.250 in. for inch series and [6.00 mm] for metric as well as for non-threaded fasteners such as washers and pins.

1.3 This coating system may be specified to consist of a zinc-flake basecoat, or a zinc-flake basecoat and topcoat (See Note 2).

NOTE 2—For threaded fasteners, the coating system will typically consist of a zinc-flake basecoat and topcoat.

1.3.1 The basecoat is a zinc-rich material containing aluminum flakes dispersed in a compatible liquid medium. The zinc-flake basecoat may be specified to contain integral lubricant.

1.3.2 Topcoats may be organic or inorganic in composition depending upon the specified requirements.

1.3.2.1 Organic topcoats consist of polymer resins, aluminum, dispersed pigments, and are colored in their applied state.

1.3.2.2 Inorganic topcoats consist of water-dispersed silicate compounds and are transparent in their applied state.

1.3.2.3 Topcoats contain integral lubricants and are applied in conjunction with zinc-flake basecoats to form a coating system with enhanced performance attributes such as increased corrosion resistance, total coefficient of friction properties, chemical resistance, and color.

1.4 These zinc-flake basecoats and topcoats are applied by conventional dip-spin, dip-drain, or spray methods to fasteners which can be handled through a cleaning, coating, and curing operation. The maximum curing temperature is 482 °F [250 °C].

1.5 The friction properties of the coating system may be determined by a standard test to verify process control or by a part specific test which requires the purchaser to establish and communicate technical criteria.

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *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]

B117 Practice for Operating Salt Spray (Fog) Apparatus

B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

B499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on

[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.

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[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.

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

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Magnetic Basis Metals
B568 Test Method for Measurement of Coating Thickness by X-Ray Spectrometry
D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
D3359 Test Methods for Rating Adhesion by Tape Test
E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric) F0606_F0606M
F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric)
F788 Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
F1624 Test Method for Measurement of Hydrogen Embrittlement Threshold in Steel by the Incremental Step Loading Technique
F1789 Terminology for F16 Mechanical Fasteners
F1940 Test Method for Process Control Verification to Prevent Hydrogen Embrittlement in Plated or Coated Fasteners

2.2 *International Organization for Standardization (ISO)*[3]
ISO 16047 Fasteners – Torque/clamp force testing

3. Classification

3.1 The coating systems are classified into four (4) grades according to the requirements provided in Table 1. The process application parameters and cure temperatures shall be in accordance to the recommendations of the coating system manufacturer.

3.1.1 *Grade 1*—requires application of the zinc-flake basecoat only. No topcoat is applied in Grade 1. Appearance of the coating in the applied state is silver/grey.

3.1.2 *Grade 2*—requires application of the zinc-flake basecoat containing integral lubricant for friction modification. No topcoat is applied in Grade 2. Appearance of the coating in the applied state is silver/grey.

3.1.3 *Grade 3*—requires application of the zinc-flake basecoat and organic topcoat. The organic topcoat contains integral lubricant for friction modification. Options for coating color and average total coefficient of friction (μ_{tot}) are provided in Table 1.

3.1.4 *Grade 4*—requires application of the zinc-flake basecoat and inorganic topcoat. The inorganic topcoat contains integral lubricant for friction modification. Appearance of the coating in the applied state is silver/grey. Options for average total coefficient of friction (μ_{tot}) are provided in Table 1.

3.2 Regardless of the process or materials used, the zinc-flake basecoat and organic/inorganic topcoats shall conform to all of the applicable requirements of this specification.

4. Ordering Information

4.1 Orders for materials in accordance with this specification shall include the following information:

4.1.1 Quantity of parts,

4.1.2 Grade of coating (See Table 1),

4.1.3 For Grade 3, color code of the coating,

4.1.4 For Grades 3 and 4, friction code of the coating when applicable,

4.1.5 Corrosion resistance requirement expressed in test duration hours,

4.1.6 Maximum coating thickness, if applicable,

4.1.7 Acid free processing certification, if applicable,

4.1.8 Part sampling plan,

4.1.9 Certification and test report requirements, and

4.1.10 Any additions to the specification as agreed upon by the purchaser and the supplier.

[3] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

TABLE 1 Coating System Classification

Grade	Coating System		Color Code	Finished Appearance	Friction Code	Average Total Coefficient of Friction (μ_{tot})[A]
	Basecoat	Topcoat				
1	Zinc-Flake	None	...	Silver / Grey	...	...
2	Zinc-Flake w/Integral Lubricant	None	...	Silver / Grey	...	0.14±0.03
3	Zinc-Flake	Organic	B	Black	L2	0.14±0.03
					L3	0.17±0.03
			D	Dark Blue	...	0.17±0.03
			G	Green	...	0.17±0.03
			K	Light Blue	...	0.17±0.03
			R	Red	...	0.17±0.03
			S	Silver	L2	0.14±0.03
					L3	0.17±0.03
			Y	Yellow	...	0.17±0.03
4	Zinc-Flake	Inorganic	...	Silver / Grey	L1	0.11±0.02
					L2	0.14±0.03
					L3	0.17±0.03

[A] The average result of the Total Coefficient of Friction (μ_{tot}) as determined in accordance to ISO 16047 shall lie within these limits when tested per 6.5.1 Program A. Friction values are applicable to a minimum sample set of ten tested fasteners.

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