Designation: F3393 – 24

Standard Specification for Zinc-Flake Coating Systems for Fasteners[1]

This standard is issued under the fixed designation F3393; 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 Zinc-flake coating systems are fluid dispersions of zinc-flakes, sometimes with the addition of aluminum flakes, which are non-electrolytically applied to steel substrates. The zinc-flake coating system shall be supplied without hexavalent chromium and can be water based or solvent based systems. Cohesion among the zinc-flakes and adhesion to the steel substrate is achieved through a matrix that is formed during the curing process.

1.2 This specification covers the classification, performance, and basic requirements for non-electrolytically applied zinc-flake coatings on unified inch and metric series threaded fasteners with minimum nominal diameters of 0.250 in. for inch series and 6 mm for metric.

1.3 This standard is a consolidation and replacement of three ASTM standards: Specifications F1136/F1136M, F2833, and F3019/F3019M.

1.4 *Units*—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.

1.5 *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.*

1.6 *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 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/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F788 Specification for Surface Discontinuities of Bolts, Screws, Studs, and Rivets, Inch and Metric Series

F1136/F1136M Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

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

F2660 Test Method for Qualifying Coatings for Use on F3125 Grade A490 Structural Bolts Relative to Environmental Hydrogen Embrittlement

F2833 Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type

[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.

F3019/F3019M Specification for Chromium Free Zinc-Flake Composite, with or without Integral Lubricant, Corrosion Protective Coatings for Fasteners
F3125/F3125M Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

2.2 *ASME Standards:*[3]

B1.1 Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
B1.2 Gages and Gaging for Unified Inch Screw Threads
B18.18 Quality Assurance for Fasteners

2.3 *ISO Standards:*[4]

ISO 965-1 ISO General Purpose Metric Screw Threads – Tolerances – Part 1: Principles and Basic Data
ISO 965-2 ISO General Purpose Metric Screw Threads – Tolerances – Part 2: Limits of Sizes for General Purpose External and Internal Screw Threads – Medium Quality
ISO 965-3 ISO General Purpose Metric Screw Threads – Tolerances – Part 3: Limit Deviations for Screw Threads
ISO 1502 ISO General Purpose Metric Screw Threads – Gauges and gauging
ISO 9227 Corrosion Tests in Artificial Atmospheres – Salt Spray Tests
ISO 10683 Fasteners – Non-Electrolytically Applied Zinc Flake Coating Systems
ISO 16047 Fasteners – Torque/clamp force testing

2.4 *Industrial Fasteners Institute:*[5]

IFI-144 Test Evaluation Procedures for Coating Qualification Intended for use on High Strength Structural Bolts

3. Classification

3.1 *Corrosion Resistance, Minimum Coating Thickness, or Minimum Coating Weight*—Unless otherwise agreed between the purchaser and the coating applicator, zinc-flake coating systems shall meet the minimum corrosion resistance and coating thickness or coating weight specified in Table 1.

NOTE 1—Bulk handling processes, including secondary operations such as automatic feeding, sorting, transportation, and storage can lead to reductions in corrosion protection depending upon the coating system and geometry of the coated part. This reduction in corrosion protection can also occur when topcoats that are sensitive to impact damage or abrasion are utilized. An agreement to reduce the minimum corrosion resistance requirement or increase the minimum coating thickness or minimum coating weight described in Table 1 may be made between the purchaser and the coating applicator.

3.2 *Appearance*—Zinc-flake coating systems shall be applied to the articles to be coated and have an appearance as specified in Table 2.

3.3 *Average Total Coefficient of Friction*—Zinc-flake coating systems shall have an average total coefficient of friction as specified in Table 3.

3.4 *Zinc-Flake Coating Systems*—Zinc-flake coating systems (base coat only, base coat(s) plus topcoat(s)), including coating thickness or coating weight shall be specified and agreed upon at the time of the order.

3.4.1 Zinc-flake coating systems can be supplied with or without a topcoat.

NOTE 2—Topcoats, either organic or inorganic, provide additional performance enhancing characteristics such as corrosion resistance, colored appearance, integral lubricant for friction control, chemical resistance, abrasion resistance, and UV resistance. A topcoat may not be required to fulfill a specified average total coefficient of friction requirement if the zinc-flake coating contains integral lubricant.

3.4.2 Zinc-flake coating systems shall be applied via the dip-spin, dip-drain, rack dip-spin, or spray methods. Special application techniques may be necessary to avoid excessive or insufficient coating thickness and part sticking. For guidance in determining the dimensional accommodations of zinc-flake coating systems in the pitch, major, and/or minor diameter refer to ASME B1.1 Section 7 and ISO 965.

NOTE 3—The dip-spin, dip-drain, rack dip-spin, or spray application of zinc-flake coating systems may lead to non-uniform local coating thickness that typically does not impair thread fit.

3.4.3 Zinc-flake coating systems may require a peak metal temperature up to 671 °F (355 °C) for proper curing conditions of the coating; however, the curing temperature shall not exceed the tempering temperature of quenched and tempered fasteners. The curing temperature shall not alter the mechanical or physical properties of the coated articles.

NOTE 4—Prior to installation, contact with liquids, condensation, dust, or any other conditions that are detrimental to the coating system should be avoided.

4. Surface Preparation

4.1 Surface cleaning may consist of vapor, thermal, alkaline, or other degreasing methods intended to remove

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

[4] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[5] Available from Industrial Fasteners Institute, 6363 Oak Tree Boulevard, Independence, OH 44131, https://www.indfast.org.

TABLE 1 Minimum Corrosion Resistance, Minimum Coating Thickness, or Minimum Coating Weight

Classification Code	Minimum Corrosion Resistance	Minimum Coating Thickness	Minimum Coating Weight
A	240h	0.00016 in. - 4µm	0.0430oz/ft^2 – 13g/m^2
B	480h	0.00020 in. - 5µm	0.0524oz/ft^2 – 16g/m^2
C	600h	0.00025 in. - 6µm	0.0688oz/ft^2 – 21g/m^2
D	720h	0.00030 in. - 8µm	0.0754oz/ft^2 – 23g/m^2
E	1000h[A]	0.00050 in. - 12µm	0.0800oz/ft^2 – 24g/m^2
F	1200h	0.00060 in. - 15µm	0.1180oz/ft^2 – 36g/m^2
G	As Agreed Upon	As Agreed Upon	As Agreed Upon

[A] A minimum corrosion resistance of 1000 h may require up to 1008 h of testing as the assessment of corrosion is typically performed in 24 hour intervals.

TABLE 2 Appearance

Classification Code	Appearance
1	Silver / Gray
2	Black
3	Other Colors (As Agreed Upon)

TABLE 3 Average Coefficient of Total Friction Range and Test Program

Classification Code	Average Coefficient of Total Friction (μ_{tot})[A]
M	0.09 (±) 0.03
N	0.12 (±) 0.03
R	0.15 (±) 0.04
S	0.19 (±) 0.05
T	0.26 (±) 0.06
W	As Agreed Upon

[A] The results for all tested samples must lie within the permissible range

organic soils. Thermal degreasing shall be performed at temperatures that do not negatively alter the mechanical or physical properties of the articles to be coated. Electrochemical cleaning shall not be performed.

4.2 Surface preparation methods intended to remove inorganic soils may include mechanical descaling (for example, shot blasting) or chemical descaling (for example, acidic cleaning, see 4.3) that is then followed by pretreatment with a chemical conversion coating (for example, zinc-phosphate). Prior to mechanical or chemical descaling, surface preparation in accordance with 4.1 shall be performed for articles that require removal of organic soils.

4.3 Acidic cleaning processes (for example, acid pickling) increase the risk of Internal Hydrogen Embrittlement (IHE) for high strength fasteners. To reduce the risk of Internal Hydrogen Embrittlement (IHE), the acidic cleaning process shall contain suitable inhibitor(s) and be performed utilizing minimum cleaning cycle times.

NOTE 5—While non-electrolytically applied zinc-flake coating systems do not generate hydrogen during the coating application process, surface preparation processes which incorporate the use of acid cleaners (for example, acid pickling) may lead to hydrogen adsorption.

4.3.1 Acidic cleaning processes shall not be utilized for steel fasteners having an ultimate tensile strength greater than 173 ksi / 1193 MPa or products with a specified core hardness greater than 39 HRC (385 HV), unless specified by the purchase order.

5. Ordering Information

5.1 Orders for materials in accordance with this specification shall include the following information (where applicable):

5.1.1 Quantity and description of parts, according to a standard or a drawing.

5.1.2 Minimum Corrosion Resistance, Minimum Coating Thickness, or Minimum Coating Weight (see Table 1).

5.1.3 Appearance (see Table 2).

5.1.4 Average Coefficient of Total Friction Range and Test Program (see Table 3 and 7.7).

5.1.5 Preferred surface preparation method (see Section 4).

5.1.6 Any applicable processing restrictions (for example, no acidic cleaning).

5.1.7 Part Sampling Plans, Inspection Plans, Testing (including any special testing), and Test Reports shall be as agreed upon between the purchaser and the coating applicator prior to processing.

5.1.8 When the parts to be coated are Specification F3125/F3125M structural fasteners with minimum tensile strength 150 ksi / 1040 MPa, this shall be declared in the inquiry and order (see A1.5).

5.1.9 Any additions or modifications to this specification shall be agreed upon between the purchaser and the coating applicator.

6. Coating System Requirements

6.1 *Corrosion Resistance*—The coating system shall be capable of withstanding exposure to salt spray for the minimum hours specified in Table 1.

6.2 *Cathodic Protection*—The coating shall not exhibit red corrosion after exposure to neutral salt spray testing for a minimum of 72 h when scratched to the base metal with a sharp cutting tool having a nominal width of 0.02 ± 0.005 in. (0.5 ± 0.13 mm).

6.3 *Coating Appearance*—When viewed without magnification, the coating shall have a uniform appearance and be free from uncoated areas, discontinuities, and excess coating which affects fit, form, or part function.

6.4 *Adhesion*—When an adhesive tape with 25 mm width and minimum adhesive strength of 6 N is firmly pressed by hand on to the surface and is subsequently pulled off rapidly and perpendicularly to the surface, the coating shall not be peeled off the base metal. Small amounts of the coating left sticking to the tape are acceptable.

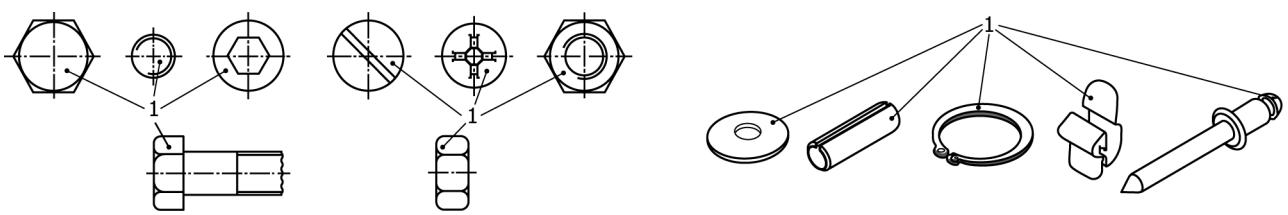

FIG. 1 Reference Areas for Coating Thickness Measurement

6.5 *Coating Thickness / Coating Weight*—The coating thickness or coating weight shall meet the minimum thickness or coating weight specified in Table 1. Unless otherwise defined, the thickness measurements shall be taken on the reference areas indicated in Fig. 1 and/or significant surfaces as defined by Terminology F1789.

6.6 *Average Coefficient of Total Friction*—The agreed upon coating system shall meet the applicable average coefficient of total friction in Table 3, or as agreed upon between the purchaser and the coating applicator.

7. Test Methods

7.1 *Adhesion*—Adhesion of the coating shall be tested in accordance with Test Method D3359 Test Method A (with an X-Cut) and visually rated to classify the adhesion result.

7.2 *Corrosion Resistance Testing*—The coating system shall be tested in accordance with Practice B117 or ISO 9227 and be capable of withstanding exposure to salt spray testing for the minimum hours specified in Table 1. Unless otherwise agreed upon, red corrosion visible to the unaided eye shall have a rating of Grade 6 or higher per Practice D610 on significant surfaces (see Terminology F1789 for definition) at the conclusion of the specified exposure period. The corrosion resistance test shall be conducted on the part(s) a minimum of 24 h after application of the coating system. The test shall be performed on parts in the "as-coated" condition and prior to any subsequent processes including, but not limited to, sorting, packaging, and assembly.

NOTE 6—The duration and results of artificial corrosion resistance, such as neutral salt spray (fog) test environments, may have little correlation to the service life in which the actual coated article will be used. The duration and results of artificial corrosion resistance testing should not be used as a direct guide for predicting the service life of the actual coated article unless a direct correlation has been established.

7.3 *Coating Thickness*—Coating thickness shall be tested in accordance with Test Method B499 magnetic induction (see Note 7), Practice E376 eddy current; or Test Method B568 X-Ray Spectrometry (see Note 8). For referee purposes, microscopic examination in accordance with Test Method B487 shall be used.

NOTE 7—Coating thickness test results determined by magnetic induction may be influenced if the parts have undergone magnetic particle inspection.

NOTE 8—Coating thickness test results measured by X-Ray spectrometry are limited to the thickness of the zinc-flake base coat only. The thickness of the topcoat layer is not measured by X-Ray spectrometry. In addition, coating thickness results determined by X-Ray spectrometry may be influenced if the parts have been processed with a chemical conversion coating containing zinc.

7.4 *Coating Weight*—The coated parts shall be weighed and the coating shall be chemically or mechanically removed. Once the coating is removed down to the base metal, the parts shall be re-weighed and the weight difference calculated. The weight difference shall be divided by the surface area of the stripped parts and the resulting calculation is the coating weight of the coating system.

NOTE 9—Coating deposition may be established by methods described in 7.3 or 7.4.

7.5 *Hydrogen Embrittlement*—When specified in the purchase order, testing shall be conducted in accordance with Test Methods F606/F606M or F1940. In the event that the coating curing process leads to a reduction in test specimen hardness, testing shall be conducted alternatively in accordance with Test Method F1624.

7.6 *Thread Acceptability*—The coating system shall not have an adverse effect on the normal installation and removal practices as determined by the proper GO thread gages.

7.6.1 Prior to application of the coating system, external threads may be produced undersized and internal threads may be produced oversized to accommodate additional coating thickness or coating weight provided the finished fastener after coating meets all specified mechanical requirements agreed upon in the purchase order.

7.6.2 Where mechanical properties are not specified, oversizing or undersizing of threads is subject to the approval of the purchaser.

NOTE 10—For reference, see Specification F788, Section 6.5.1.4 and ISO 10683 Annex A – Section A.2 for additional acceptance criteria that may be specified in the purchase order or as agreed upon between the purchaser and coating applicator.

7.7 *Average Total Coefficient of Friction*—Testing shall be performed in accordance with ISO 16047 or as specified in the purchase order and agreed upon between the purchaser and the coating applicator. The results of testing shall be kept on file and submitted to the purchaser when required. Test Program A is the default requirement. Test Program B shall be agreed upon at the time of the order.

NOTE 11—If unspecified in the purchase order, the default test nuts or bolts and washers should have dimensional and material strength properties that correspond to the parts to be tested. The mating nuts or bolts and washers are plain steel, uncoated and degreased in accordance with ISO 16047, Sections 7.2, 7.3 or 7.4. Type HH test washers may be used in accordance with ISO 16047, unless specified by the purchase order.

7.7.1 *Test Program A*—Testing shall be performed using M10-1.5 surrogate test bolts processed with the coated articles. With this test program, it is recommended that friction testing be performed at a frequency which demonstrates control of the coating application process.

7.7.2 *Test Program B*—The use of surrogate bolts is not permitted in this test program. Samples for friction testing are selected from the production lots which have been coated. When necessary, a facility with the capability to perform the test may be designated as agreed upon between the purchaser and coating applicator.

NOTE 12—Required materials of test hardware, fixturing specific to the part, and capable instrumentation which are needed to conduct testing per Program B may not be readily available at every test facility or coating applicator.

8. Sample Inspection and Testing Reports

8.1 Samples for inspection may be taken in accordance with Practice F1470, ASME B18.18, or as agreed upon between the purchaser and the coating applicator.

8.2 The party responsible for providing a test report for the coated fastener shall be the organization that supplies the coated article(s) to the purchaser.

8.3 Test reports may include, but are not limited to, the test methods described in Section 7. Reports shall be made available upon request after the coating process as agreed upon between the purchaser and the coating applicator at the time of the order (see 5.1.7).

9. Disposition of Non-Conforming Lots

9.1 The disposition of non-conforming lots shall be in accordance with Guide F1470 Section titled "Disposition of Non-Conforming Lots".

10. Keywords

10.1 coating; corrosion; dip-drain; dip-spin; embrittlement; fasteners; flake; friction; non-electrolytically; protection; resistance; rust; spray; topcoat; zinc

ANNEX

(Mandatory Information)

A1. REQUIREMENTS FOR HIGH STRENGTH STRUCTURAL FASTENERS AND ASSEMBLIES, 150 KSI / 1040 MPA

A1.1 Prior to publication of F3393-20, three coating systems, plus two sub-variants of these coating systems had been previously evaluated per IFI-144 and are currently permitted by Specification F3125/F3125M for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies. These coating systems have been identified and referenced by grade or designation in three corresponding ASTM standard specifications, namely Specification F1136/F1136M, Specification F2833, and Specification F3019/F3019M. The three coating systems are also commercially known and commonly referenced in the structural bolting industry by their trade names, which are not listed in this document in compliance with ASTM regulations. Given that F3393 is intended as a consolidation and replacement of Specification F1136/F1136M, Specification F2833, and Specification F3019/F3019M, it is necessary to be able to distinguish between coating systems that were previously evaluated and are permitted for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies and coating systems that are not permitted. Consequently, this mandatory Annex A1 has been included:

A1.1.1 To provide guidance on how to differentiate F3393 coating systems that were previously evaluated and are permitted for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies per Specification F3125/F3125M, and F3393 coating systems that have not been evaluated and are not permitted by Specification F3125/F3125M for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies.

A1.1.2 To specify the requirements for F3393 coating systems to be evaluated and permitted in the future for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies per Specification F3125/F3125M (for example, Grades A490, A490M, and F2280).

NOTE A1.1—To verify that a F3393 coating system is qualified and permitted for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies, a copy of the technical report pertaining to each coating system that has been evaluated, or a summary reference document listing the permitted coating systems, may be obtained through the Research Council on Structural Connections (RCSC), www.boltcouncil.org.

A1.2 To be permitted for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies, a F3393 coating system shall be evaluated in accordance with IFI-144 which includes both *performance tests* and *acceptance tests*.

A1.3 Performance tests in IFI-144 are intended to measure a specific performance of the coating system (for example, corrosion resistance) and do not have a pass/fail requirement.

A1.4 Acceptance tests in IFI-144 are intended as acceptability criteria (for example, hydrogen embrittlement). The testing shall notably demonstrate that the F3393 coating system being evaluated satisfies the requirements specified in IFI-144 relative to both Internal Hydrogen Embrittlement (IHE) and to Environmental Hydrogen Embrittlement (EHE). IFI-144 specifies the following test methods:

A1.4.1 Test Method F1940 for Internal Hydrogen Embrittlement (IHE) evaluation of the coating *process*.

A1.4.2 Test Method F2660 for Environmental Hydrogen Embrittlement (EHE) evaluation of *coated bolts*.

NOTE A1.2—IFI-144 references Test Method F1624 for Environmental Hydrogen Embrittlement (EHE) evaluation, however, since the publication of IFI-144 in 2004, Committee F16 has published Test Method F2660 to be used *instead* of Test Method F1624 to qualify *coated high strength structural bolts* for Environmental Hydrogen Embrittlement (EHE).

A1.4.3 Cyclic corrosion testing in accordance with a commercially developed test method with bolts under load for Environmental Hydrogen Embrittlement (EHE) evaluation of *coated bolts* is also specified and may be performed in addition to Test Method F2660 testing or instead of Test Method F2660 testing.

A1.4.4 Coated bolts used for Environmental Hydrogen Embrittlement (EHE) testing shall be high strength structural bolts especially heat treated to the upper limit of the hardness/strength tolerance specified in Specification F3125/F3125M, known as *specimen bolts*.

A1.5 A detailed report that includes all of the findings and results of the test evaluations specified in IFI-144 shall serve as

the basis of permitting the use of a coating system with Specification F3125/F3125M 150 ksi / 1040 MPa high strength structural bolts and assemblies.

A1.6 A *variant* of a coating system which has been previously qualified per IFI-144 and permitted for use with 150 ksi / 1040 MPa high strength structural bolts and assemblies per Specification F3125/F3125M, may be subjected to streamlined testing comprising only the acceptability criterial related to Internal Hydrogen Embrittlement (IHE) and Environmental Hydrogen Embrittlement (EHE) described in A1.4.

NOTE A1.3—A coating system may be classified as a *variant* if it is produced by the same chemical supplier and has the same F3393 classification code of the coating system that was previously qualified.

APPENDIX

(Nonmandatory Information)

X1. REFERENCE TO SPECIFICATIONS F1136/F1136M, F2833, AND F3019/F3019M

X1.1 This specification is intended to combine and replace three existing zinc-flake coating specifications. For reference purposes, the coating classification tables of these replaced zinc-flake coating system specifications are provided below (see Note X1.1.1)

X1.1.1 Not all of the classifications listed in the tables below have been tested and qualified to meet the requirements of Specification F3125/F3125M (see Annex A1).

TABLE X1.1 F1136/F1136M Coating Classifications

Grade No.	Topcoat Type	Coating Thickness		Coating Weight		Minimum SST Hours (h)
		Metric Average (μm)	Inch Average (mil)	Metric Average (g/m^2)	Inch Average (oz/ft^2)	
1	None	4 to 5	0.16 to 0.20	16 to 20	0.052 to 0.066	----
2	None	5 to 8	0.20 to 0.31	20 to 28	0.066 to 0.092	240
3	Clear Sealer	6 to 12	0.24 to 0.47	22 to 34	0.072 to 0.111	720
4	None	8 to 15	0.31 to 0.59	28 to 50	0.092 to 0.164	500
5	Lubricated Sealer	6 to 12	0.24 to 0.47	22 to 34	0.072 to 0.111	720
6	Pigmented Topcoat	8 to 15	0.31 to 0.59	23 to 40	0.075 to 0.131	500

TABLE X1.2 F2833 Coating Properties

Grade	Topcoat type	Total number of coating layers	Average Coating Thickness (mil)	Average Coating Weight (g/m^3)	Minimum SST hrs
1	Organic	2	0.47–0.59	32–40	840
2	Organic	3	0.47–0.71	32–51	1200
3	Organic/black	3	0.47–0.71	37–41	840
4	Inorganic	2	0.47–0.59	34–41	1000
5	Organic/various colors	2	0.47–0.59	32–39	840

TABLE X1.3 F3019/F3019M Coating System Classification

Grade	Coating System		Color Code	Finished Appearance	Friction Code	Average Total Coefficient of Friction (μ_{tot})
	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