



Product Engineering

ZINC FLAKE PROTECTIVE COATINGS, CHROMIUM FREE (240 HOUR SALT SPRAY) (500 HOUR HIGH PERFORMANCE SALT SPRAY)

(Printed Copies are Uncontrolled)

Process Standard

PS-106

Date: 2024-02-09
Writer: Ryan Schuler
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RATIONALE:

- Added option for 500-hour high performance salt spray.

1. Scope

This Standard defines the technical requirements for non-electrolytically applied zinc-flake coatings for corrosion protection on fasteners, springs, and other products. These coatings are applied by dip-spin, dip-drain, or spray methods. They can be applied to all standard hardware but are especially preferred for high hardness and high strength components that can be susceptible to hydrogen embrittlement. These coatings are RoHS compliant and shall contain no hexavalent chromates, lead, cadmium, or mercury.

These coatings shall be specified on the basis of color or performance as follows:

PS-106A	Silver/Gray	240 Hour Salt Spray
PS-106B	Black	240 Hour Salt Spray
PS-106D	Silver/Gray High Performance	500 Hour Salt Spray

This standard has restrictions due to the application process. This standard is not intended for use with the following:

- Threaded fasteners smaller than 5/16 inch or 8 mm diameter unless otherwise stated
 - It is recommended to use a coating other than dip spin for fine threaded fasteners and fasteners that have recessed heads.
- Washers, shims, and spacers smaller than 3/8 inch or 10 mm inner diameter
 - Washers, shims, and spacers may have slight nesting, parts sticking together due to the dip spin application process
 - Washers, shims, and spacers should be validated for custom design options.
- Snap rings smaller than 1 inch or M25
- Fasteners that have moving parts (lynch pins, wirelock pins, grease fittings, ect)

Table 1: PS-106 Allowable Sizing Chart

Hardware Type	≤ M6 ≤ (1/4)	M8 (5/16)	M10 (3/8)	M12 (1/2)	M16 (5/8)	M20 (3/4)	M24 (15/16)	≥ M25 ≥ (1)
Threaded Fasteners	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Washers, shims, spacers	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Snap Rings	No	No	No	No	No	No	No	Yes

2. Referenced Documents

ASTM B117.....Standard Practice for Operating Salt Spray (Fog) Apparatus

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

ASTM B499.....Standard Test Method for Measurement of Coating Thickness by the Magnetic Method: Nonmagnetic Coatings on Magnetic Base Metals

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ASTM B568.....	Standard Test Methods for Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B571.....	Standard Practice for Qualitative Adhesion Testing of Metallic Coatings
ASTM E376.....	Standard Test Methods for Measurement of Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
ISO 16047	Fasteners - Torque/Clamp Force Testing
ISO 9227	Corrosion Tests in Artificial Atmospheres - Salt Spray Tests
ISO 10683	Fasteners- Non-Electrolytically Applied Zinc Flake Coating

3. Requirements

- Coating thickness shall be a minimum of 0.0003 inches (8 µm) on all significant surfaces. For a definition of significant surfaces, see the [Coating Finish / Significant Surfaces](#) section of this standard.
- Coating processes used may be single or multiple layer finishes. It is permissible to have a base material, such as zinc phosphate, as a pre-treatment. The primary coating shall be zinc rich flake and may contain other metals such as aluminum, or be constructed with other metallic or organic topcoats.
- The coating shall exhibit good adhesion to the substrate and itself and show no tendency to flake or peel when tested in accordance with ASTM B571.
- All fasteners shall be supplied with coating or supplemental lubricant so that the total friction coefficient, μ_{tot} , is 0.18 ± 0.03 except for North America which shall be 0.15 ± 0.03 .
- Testing shall conform with ISO 16047 using a coated surrogate bolt/screw, plain uncoated nut, and plain uncoated ISO 16047 HH test washer with other requirements as follows:
 - Coated surrogate bolt/screw is a M10-1.5 x 50-60 mm Hex Head Cap Screw Cl 10.9 per ISO 4014
 - Plain uncoated test fasteners shall be cleaned with acetone in an ultrasonic cleaner for a minimum of 5 minutes.
 - Test shall be driven from the head of the surrogate bolt/screw
 - Test shall be completed to 75% of the surrogate bolt/screw proof load
- All plated components shall be able to pass a 240-hour minimum (500-hour for high performance) salt spray test per ASTM B117 or ISO 9227 and ISO 10683. Compliance to this standard is defined by the absence of visible red corrosion products on all significant surfaces. White corrosion products represented by a light frost may form on test pieces, but this is not considered to constitute failure on test. Records of salt spray corrosion tests shall be available upon request.

4. Coating Finish / Significant Surfaces

- The coating shall exhibit a matte finish and shall be free of flaking, blisters, nodules, pits and other irregularities.
- The coating shall cover all significant surfaces, where significant surfaces are defined by all areas that can be touched by a 0.75-inch (19mm) diameter sphere. Threads on fasteners are not classified as significant surfaces. The entire head area of screws and bolts and unthreaded bolt shanks are considered significant surfaces.

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- Coating thickness shall be determined in accordance with the test methods outlined in ASTM B499, magnetic induction; ASTM E376, eddy current; or ASTM B568, X-ray spectrometry. For reference purposes, microscopic examination in accordance with ASTM B487 or ISO 1463 shall be used.

5. Pre-Coating Cleaning Requirements

5.1 Alkaline Cleaning

Heated alkaline cleaning solution may be used for removing oils, light soil, or debris. Parts may be electro cleaned if they are anodic (positive polarity). Any part with hardness above 34 HRC shall not be cleaned cathodically (negative polarity).

5.2 Rust and Scale Removal

Preferred cleaning process for high tensile strength/high hardness parts or fasteners is tumbling, chemical, or a heated caustic cleaning solution.

5.3 Acid Cleaning

This is the least desirable method for cleaning hardened steel parts because it is a source of hydrogen for hydrogen embrittlement. If acid cleaning methods are used, inhibited solutions are required. Cleaning bath time shall be limited to less than 10 minutes total.

5.4 Zinc Phosphate

A fine crystalline coating of zinc-phosphate is the only approved pre-treatment process. The coating shall have a coating weight of 4 g/m² minimum.

5.5 Blast Cleaning

Grit or fine abrasive media blasting is not preferred, as it has a tendency to leave remnants of particles behind. Unless specific brand process requires a grit blast surfaces for application. Any process type equipment should also take precautions.

6. Supplemental Coatings / Lubricants

Supplemental sealants may be required in order to achieve the specified corrosion resistance.

A supplemental lubricant may be required on all threaded fasteners in order to achieve the specified 0.18 ± 0.03 total friction coefficient. This lubricant shall be suited to high-speed assembly. The preferred method of application shall be by dipping and drying. Lubricated surfaces shall not drip or be tacky to the touch.

Specific fasteners such as thread rolling or forming, and all metal locknuts require a wax application per specific Bobcat standard and referenced industry standard. These specific cases requiring a wax application will not achieve the specified total friction coefficient.

The total friction coefficient, μ_{tot} , and the method by which it is confirmed is described in the previous listed [Requirements](#) section.

7. Dimensions

For threaded components - the coating shall not have an adverse effect on normal installation and removal practices, as determined by the appropriate basic size "GO" thread gage or fit and function inspection method. For external threaded fasteners after coating, the torque applied to the "GO" screw ring gage shall

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not exceed $145d^3$ inch-pounds for inch series or $0.001d^3$ Nm for metric series, where d is the nominal thread diameter.

The maximum thickness of the coating which may be applied to threads on threaded fasteners is limited by the basic thread size: for external threaded fasteners, 3A tolerance for inch or tolerance h (6h or 4h) for metric series, and for internal threaded fasteners, 2B tolerance for inch or tolerance H (6H, 5H, or 4H) for metric series. Prior to the application of the coating system, external threads may be produced undersized and internal threads may be produced oversized to accommodate the coating thickness, provided the finished fastener after coating meets all specified mechanical requirements.

Note: Industry Standard Fasteners could be manufactured to the high end of the pitch diameter tolerance in combination with a coating on the high end of the thickness range may NOT gage but will accept a mating part for assembly. IFI-166, IFI-566, SAE J1061, ISO 6157-3, DIN 276- Part 19, European Std EN 26157-3.

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Coating Manufacturer/Applicator	Coating			
	PS-106A Metallic Silver/Gray	PS-106B Black	PS-106C Yellow ²	PS-106D Silver/Gray High Performance
NOF Metal Coatings North America 275 Industrial Parkway Chardon, OH 44024-1083 Phone: 440-285-2231 http://nofmetalcoatings.com/northamerica	Geomet® 321 Plus®	Geomet® 321 Plus® JL Black or P250 (Black)	Geomet® 321 S350 Yellow	N/A
The Magni Group 390 Park Street, Suite 300 Birmingham, MI 48009 Phone: 248-647-4500 http://magnicoatings.com	Magni 501 or 565N	Magni 501 Black or 575N	Magni 501 or 565 Gold	Magni 565N
Curtis Metal Finishing Company Sterling Heights, MI / Machesney Park, IL Phone: 586-939-2850 http://www.curtismetall.com	ZnCoat®	ZnCoat® P250 (Black)	ZnCoat® S350 Yellow	N/A
<i>Note 1: This list is not an exhaustive list. This is for reference only and not to be a driving factor in the coating product to be supplied.</i> <i>Note 2: Not for new design.</i>				