Designation: D6386 – 10

StandardPractice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting[1]

This standard is issued under the fixed designation D6386; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This practice describes methods of preparing surfaces of new and weathered hot-dip galvanized steel for painting. Hot-dip galvanized steel is produced by the immersion of fabricated or unfabricated products in a bath of molten zinc, as specified in Specifications A123/A123M or A153/A153M. This practice covers surface preparation on iron and steel products and hardware that have not been painted previously. Galvanized surfaces may have been treated with protective coatings to prevent the occurrence of wet storage stain. This practice does not apply to sheet galvanized steel products nor to the coil coating or continuous roller coating processes. Sheet and coil surface preparation can be done in accordance with Practice D7396.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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 and health practices and to determine the application of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A123/A123M Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

B201 Practice for Testing Chromate Coatings on Zinc and Cadmium Surfaces

D7396 Guide for Preparation of New, Continuous Zinc-Coated (Galvanized) Steel Surfaces for Painting

E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods

2.2 *Society for Protective Coatings Specifications:*[3]

Surface Preparation Specification No. 1 Solvent Cleaning

Surface Preparation Specification No. 2 Hand Tool Cleaning

Surface Preparation Specification No. 3 Power Tool Cleaning

Surface Preparation Specification No. 7 Brush-Off Blast Cleaning

Surface Preparation Specification No. 11 Power Tool Cleaning to Bare Metal

Paint Specification No. 27 Basic Zinc Chromate-Vinyl Butyral Wash Primer

3. Summary of Practice

3.1 This practice describes the preparation methods that provide clean and suitable galvanized surfaces for painting, specifically so that an applied coating system can develop the adhesion necessary for a satisfactory service life.

3.2 The zinc coating is constantly in a state of change. From the time the steel part is removed from the galvanizing kettle, the exposed zinc coating interacts with the environment to form, first zinc oxides, next zinc hydroxides, and then zinc carbonates.[4] The process of complete conversion of the outer layer of zinc carbonates can take up to two years of exposure to the environment, depending on the local climatological conditions. During the first stage, known as newly galvanized steel, the exposed surface consists mainly of zinc metal with a small amount of zinc oxide. During the second stage, known as partially weathered galvanized steel, the exposed surface

[1] This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

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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.

[3] Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

[4] This interaction is described in "Duplex Systems," van Eijnsbergen, J.F.H., *Elsevier Science*, New York, NY 1994, and in *Zinc Handbook*, Porter, F., Marcel Dekker, Inc., New York, NY 1991.

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

consists mainly of zinc oxides and zinc hydroxides with some zinc carbonates. At the final stage, known as weathered galvanized steel, the exposed surface consists mainly of water-insoluble zinc carbonates, some zinc oxides, and rarely, zinc hydroxides. The surface preparation for each of these stages must be treated separately.

3.3 Variations in surface preparation produce end conditions that differ, hence they do not necessarily yield identical results when paints are subsequently applied. Service conditions will dictate the type of surface preparation to be selected, although the quality produced by any individual process may vary with different compositions of the zinc surface.

4. Significance and Use

4.1 This practice describes the procedures that can be used to prepare new and weathered zinc-coated surfaces on after-fabrication steel products for painting, and that can improve the bond of paint to the zinc surface.

5. Processes for Newly Galvanized Steel

5.1 *Newly Galvanized Steel*—The category of newly galvanized steel refers to zinc-coated steel that has no surface treatment after galvanizing, such as water quenching or chromate conversion coating, and has been galvanized within the previous 48 h. There also should be no visible signs of zinc oxide or zinc hydroxide, which first appear as a fine white powder.

5.2 *Surface Smoothing*—Hot-dip galvanized surfaces generally are relatively smooth after galvanizing. There may be some thick edges due to excess liquid zinc run-off during the galvanizing, or high spots in the coating due to included iron-zinc intermetallics (dross) or zinc oxide particles. These high spots and rough edges, such as the metal drip line, must be smoothed to avoid paint film gaps in the areas of the high spots.

5.2.1 Zinc high spots, those that would cause paint film gaps such as the metal drip line, should be removed by cleaning with hand or power tools as described in SSPC Surface Preparation Specification No. 2 or No. 3. The zinc should be removed until it is level with the surrounding area, taking care that the base coating is not removed by the cleaning methods. After cleaning, the surface shall be inspected for conformance to the required zinc thickness in accordance with Specifications A123/A123M or A153/A153M utilizing a magnetic thickness instrument in accordance with Practice E376. Any item falling below the required zinc thickness, before or after removal of any high spots, shall be repaired in accordance with Practice A780.

5.3 *Surface Cleaning*—Hot-dip galvanized surfaces must be clean and free of oil and grease before they are painted. Adhesion problems have been experienced with newly galvanized articles that have been water quenched or treated with chromate conversion coatings. These two post-galvanizing treatments are not recommended for galvanized articles that are to be painted.

5.3.1 *Aqueous Alkaline Cleaning*—An alkaline solution, pH in the range of 11 to 12 definitely not greater than 13, can be used to remove traces of oil, grease, or dirt. An alkaline cleaner is unsuitable for removal of heavy build-up of zinc oxide or wet storage stain (see American Galvanizers Publications, *Wet Storage Stain*[5], for description of these conditions). See 5.4 for removal of zinc oxide layer. The alkaline solution nominally is 2 to 5 % sodium compounds, with small additions of emulsifying, chelating, or sequestering agents, or a combination thereof. This solution can be applied through immersion in a tank filled with the solution, sprayed, or brushed with a soft bristle brush, usually nylon and not steel or copper. When dipping or spraying, the solution works best in the temperature range from 60 to 85°C. After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding. Whenever galvanized steel is rinsed, it is desirable to use heated drying to accelerate the complete removal of water from the surface.

5.3.2 *Solvent Cleaning*—Typical cleaning solvents, such as mineral spirits or high-flash naphtha, can be used to remove oil and grease. The procedure to be used is as specified in SSPC Surface Preparation Specification No. 1. Proper rags or brushes should be used to wipe the galvanized parts. (**Warning**—These rags or brushes should be cleaned or recycled often since oil can accumulate on their surfaces and be transferred back to the galvanized part. Small parts may be dipped or cleaned in ultrasonic baths of solvents. After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding.)

5.3.3 *Hand or Power Tool Cleaning*—Hand or power tool cleaning may be used to clean light deposits of zinc reaction by products, such as wet-storage stain, as specified in SSPC Surface Preparation Specification No. 2 or No. 3.

5.4 *Surface Preparation*—Hot-dip galvanized surfaces have a layer of zinc oxide and zinc hydroxide that must be removed before paint will adhere to the zinc coating. Zinc coatings generally are relatively smooth and may be slightly roughened prior to painting. The following four methods may be used to prepare the galvanized surface for painting.

5.4.1 *Sweep Blasting*—Abrasive sweep or brush blasting, which uses a rapid nozzle movement will roughen the galvanized surface profile. The abrasive material must be chosen with care to provide a stripping action without removing excess zinc layers, removal of up to 25 microns (1 mil) is acceptable. One of the materials that has been used successfully is aluminum/magnesium silicate. Particle size should be in the range of 200 to 500 µm (8 to 20 mils). Other materials that can be used are soft mineral sands with a MOH hardness of five or less, organic media, such as corn cobs or walnut shells, corundum, and limestone. Depending on the value of hardness for the abrasive medium, blasting pressure may need to be determined for the appropriate nozzle to work-piece distance, geometry of the component, and blasting medium. For some all-alloy coatings, even the relatively low-pressure blast of 0.15 to 0.25 MPa (20 to 40 psi) can be too great, causing cohesion problems. Oil contamination of the compressed air will degrade paint adhesion to sweep-blasted hot-dip galvanized surfaces. Care is needed in averting this type of contamination.

[5] Available from American Galvanizers Association (AGA), 6881 South Holly Circle, Suite 108 Centennial, CO 80112, http://www.galvanizeit.org.