Designation: D7396 – 14

Standard Guide for Preparation of New, Continuous Zinc-Coated (Galvanized) Steel Surfaces for Painting[1]

This standard is issued under the fixed designation D7396; 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 guide covers surface cleaning and various methods for treating new, continuous zinc-coated (galvanized) steel surfaces produced by either the hot-dip method or by electroplating. This guide is applicable to only surface preparation for application of liquid paint and coating products, and not for powder coating applications. This guide covers surfaces that have not been treated previously at the mill to provide temporary protection against staining by moisture other than by easily removed protective oils (see Appendix X1). For preparing surfaces of new or weathered items of zinc-coated steel produced by batch processing, refer to Practice D6386.

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 determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D4285 Test Method for Indicating Oil or Water in Compressed Air

D6386 Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

D6492 Practice for Detection of Hexavalent Chromium On Zinc and Zinc/Aluminum Alloy Coated Steel

2.2 *SSPC—The Society for Protective Coatings Standards:*[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. 16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steel, and Non-Ferrous Metals

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

3. Summary of Guide

3.1 This guide describes surface cleaning and treatment methods that provide galvanized surfaces suitable for painting, specifically so that an applied coating system can develop the adhesion necessary for satisfactory service life.

3.2 Eight methods of treatment (Note 1 and Note 2) are covered as follows:

3.2.1 *Method A*—Zinc Phosphate Treatment.

3.2.2 *Method B*—Chromate Treatment.

3.2.3 *Method C*—Aqueous Chromic-Organic Treatment.

3.2.4 *Method D*—Acid-Curing Resinous Treatment.

3.2.5 *Method E*—Annealing Heat Treatments.

3.2.6 *Method F*—Amorphous Complex-Oxide Treatment.

3.2.7 *Method G*—Abrasive Blast Cleaning.

3.2.8 *Method H*—Fluro-Titanic/Zirconic Polymer Treatment.

NOTE 1—Materials employed in these methods of treatment are available from a number of sources as proprietary compounds or methods. Selection may be made from available sources.

NOTE 2—The use of solvents containing volatile organic compounds to prepare or treat the surface of metal components contributes to air pollution in the same manner as the use of solvent containing paints and coatings. The user of this guide must determine the applicability of appropriate regulations governing the volatile organic compound content of the materials used in a shop application (Miscellaneous Metal Parts), field painting (Architectural), or specific process industry.

3.3 Variations in surface preparation produce end conditions that differ and hence do not necessarily yield identical results when paints are subsequently applied. Service conditions will

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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.

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

dictate the type of surface preparation to be selected, although the quality produced by any individual method may vary with different zinc coatings.

3.4 Galvanized surfaces are treated by using various methods and apparatus; satisfactory application may be made at the following locations:

	Mill	Plant	Field
Method A	Y	Y	Y
Method B	Y	Y	...
Method C	Y	Y	...
Method D	Y	Y	Y
Method E	Y	...	...
Method F	Y	Y	...
Method G	Y	Y	Y
Method H	Y	Y	...

3.5 This guide does not describe the cleaning necessary to provide a zinc-coated (galvanized) surface suitable for the application of the treatments. Many cleaning methods are applicable and the preferred method should be agreed upon between the purchaser and the supplier.

NOTE 3—Most producers of zinc-coated (galvanized) steel sheets and coils have adopted the practice of applying an inhibitor to the zinc surface to give temporary protection against staining by moisture during shipping or storage. Some of these inhibitors interfere with proper reaction of most of the treatments described in these methods, and an unsatisfactory surface for painting results. It is strongly recommended that the purchaser consult the supplier of the chemical treatment to be used as to the suitability of the zinc surfaces for treatment by any of these methods.

3.6 *Surface Cleaning*—Galvanized surfaces must be clean and free of soluble salts, oil and grease before they are treated. Adhesion problems have been experienced with newly galvanized articles that have been water quenched or treated with chromate conversion coatings. These two post-galvanizing processes, water quenching and chromate conversion coating, are not recommended for galvanized articles that are to be treated before painting. The presence of chromate conversion coatings on the surface of the galvanized steel can be detected using Practice D6492.

3.6.1 *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 the American Galvanizers Publication, *Wet Storage Stain*,[4] for description of these conditions. The alkaline solution is nominally 2 to 5 % sodium compounds, with small additions of emulsifying, chelating, or sequestering agents, or combinations thereof. This solution can be applied through immersion in a tank filled with the solution, by spraying, or by brushing 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 (140 to 185°F). After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding. Whenever galvanized steel is rinsed, heated drying to accelerate the complete removal of water from the surface is desirable.

3.6.2 *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 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. Whenever galvanized steel is rinsed, heated drying to accelerate the complete removal of water from the surface is desirable.

3.6.3 *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 or salts, as specified in SSPC Surface Preparation Specification 2 or 3.

4. Significance and Use

4.1 This guide describes procedures that can be used to prepare new zinc-coated surfaces for painting and improve the bond of paint to the zinc surface.

5. Processes

5.1 *Method A, Zinc Phosphate Treatment*—This conversion-coating method consists of reacting the zinc surface in a zinc acid phosphate solution containing oxidizing agents and other salts for accelerating the coating action. The zinc surface is converted to a crystalline phosphate coating of the proper texture to inhibit corrosion and increase the adherence and durability of the paint film. Such treatments are recommended for product finishes and may be carried out by immersion, spray, or brush application.

5.2 *Method B, Chromate Treatment*—This treatment consists of a dip or spray with a dilute solution of a mixture of chromium trioxide and other acids, with the proper accelerator, for a period from 5 to 30 s at room temperature to 55°C (130°F) to provide a thin amorphous chromate coating that increases corrosion resistance and paint adhesion.

5.3 *Method C, Aqueous Chromic-Organic Treatments*—Certain water-soluble resins, when properly formulated with chromium compounds, may be applied to zinc surfaces by roller coat or other suitable means, such as dip and squeegee rolls. This may be done over a wide temperature range provided the film is properly baked or cured, or both, as required by the paint system to be applied. The resultant coating provides a corrosion-resistant film that increases the adhesion of applied paint films.

5.4 *Method D, Acid-Curing Resinous Treatment (Vinyl Wash Primer)* (See SSPC-Paint No. 27)—This surface treatment is based on the application of an acid-curing resinous film of approximately 8 to 13-μm (0.3 to 0.5-mil) thickness. The treatment is based on three primary components: a hydroxyl-containing resin, a pigment capable of reacting with the resin and an acid, and an acid capable of insolubilizing the resin by reacting with the resin, the pigment, and the zinc surface. The film is usually applied by spray, but may be applied by brush, dip, or roller coater. Under normal conditions it will dry sufficiently for recoating within 30 min, and within 8 h it will not be softened by organic solvents commonly used in paint

[4] *Wet Storage Stain* (1997), available from American Galvanizers Association, 6881 South Holly Circle, Suite 108 Centennial, Colorado 80112, http:\\www.galvanizeit.org.

coatings. The film has good adhesion to the metal substrate and promotes good adhesion of most subsequent organic coatings to itself. Two types of this treatment are available: (*1*) two-package material to be used the day it is mixed and (*2*) one-package material that has package stability and does not require daily preparation.

NOTE 4—It may be difficult to control the dry film thickness within the parameters of this specification when applied by brush, roller, or dip coater.

5.5 *Method E, Annealing Heat Treatments*—Under the controlled conditions obtainable in a mill, hot-dip galvanized surfaces may be converted and alloyed with the base metal to change the surface character of the zinc coating and make it more receptive to paint. This surface can be further improved by treating in accordance with Methods A, B, C, or D.

5.6 *Method F, Amorphous Complex-Oxide Treatment*—This surface treatment method consists of reacting the zinc surface in an alkaline solution containing heavy metal ions for a period of 5 to 30 s at 45 to 70°C (115 to 160°F). The surface of the zinc is converted to a nonmetallic, amorphous, complex-oxide coating that inhibits corrosion and increases the adhesion and durability of paint finishes. The treatment can be carried out by immersion or spray application.

5.7 *Method G, Abrasive Blast Treatment*—Abrasive sweep or brush blasting in accordance with procedures described in SSPC SP 16 for the surface preparation methods only uses a rapid nozzle movement roughening the galvanized surface profile. The abrasive material must be chosen carefully to provide a stripping action that removes the oxide reaction products without excessive removal of the zinc. One of the materials successfully used is aluminum/magnesium silicate. Particle size should be in the range of 200 to 500 micrometers (8 to 20 mils). Other materials that can be used are soft mineral sands with a Mohs hardness of 5 or less, organic media such as corncobs or walnut shells, corundum, and limestone. For reactive steel with all-alloy coatings which may have compromised adhesion, even the relatively low-pressure blast of 0.15 to 0.25 MPa (20 to 40 psi) can be too great, causing adhesion problems. Care must be taken to leave zinc layers intact. Oil contamination of the compressed air will degrade adhesion to sweep-blasted hot-dip galvanized surfaces (Test Method D4285). Care is needed in averting this type of contamination. The purpose of sweep blasting is to deform, not remove the galvanized metal. Any area falling below the required zinc thickness, before or after sweep blasting, shall be repaired in accordance with Practice A780. Sweep blasting of zinc shall be not less than 110 m^2/h (1200 ft^2/h) using these abrasive materials. The substrate shall be maintained at a temperature of at least 3°C (5°F) above the dew point temperature.

5.8 *Method H, Fluro-Titanic/Zirconic Polymer Treatment*—This treatment method is a chromium free analog of the solutions commonly employed under Method C. It consists of a combination of poly(acrylic acid) with copolymer resins and 0.01 to 0.1 M H_2TiF_6 or H_2ZrF_6. The solution can be applied to the galvanized steel surface by spray, dip, squeegee or roller coating. The excess solution is spun-off or otherwise removed from the metal surface, resulting in a dry in-place surface treatment. The finished surface consists of a complex oxide polymer matrix bound to the zinc metal.

5.9 *Coating Application Time Frame*—Blow down prepared surface with clean, compressed air following surface preparation. In some atmospheric conditions, such as high humidity or high temperature or both, the formation of zinc oxide on the freshly prepared surfaces will begin very quickly. Zinc oxide formation is not visible to the unaided eye; therefore, in any atmosphere, painting should be started within an hour after surface preparation.

6. Keywords

6.1 acid-curing resinous treatment; amorphous complex-oxide treatment; annealing heat treatment; chromate; chromate test; chromic-organic treatment; galvanize; phosphate; pretreatment; surface treatment; zinc

APPENDIX

(Nonmandatory Information)

X1. IDENTIFYING THE PRESENCE OF AND REMOVING CHROMATE TREATMENTS USED AS WET-STORAGE (ALSO CALLED HUMID-STORAGE) STAIN INHIBITORS

X1.1 One of the inhibitors used by producers of zinc-coated steel is a hexavalent chromium solution. This treatment prevents some of the treatment methods from working properly.

X1.2 If zinc-coated steel to be painted is galvanized to order, the order should prohibit the use of hexavalent chromium humid-storage stain treatments.

X1.3 Hexavalent chromium treatment can be removed from galvanized surfaces by one of the following three methods:

X1.3.1 Weathering the surfaces for six months.

X1.3.2 Abrading the surfaces by light sanding.

X1.3.3 Brush-off abrasive blast cleaning.

X1.4 The presence of hexavalent chromium on galvanized surfaces can be determined by spot testing using the procedure in Practice D6492.

SUMMARY OF CHANGES

Committee D01 has identified the location of selected changes to this standard since the last issue (D7396–08) that may impact the use of this standard. (Approved December 1, 2014.)

(1) Added references and improved language in various sections.