Designation: D 2092 – 95 (Reapproved 2001)ε1

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

This standard is issued under the fixed designation D 2092; 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.

ε[1] NOTE—Footnote 3 was corrected editorially in June 2001.

1. Scope

1.1 This guide describes eight methods of treating new zinc-coated (galvanized) surfaces produced by either the hot-dip method or by electroplating. This practice 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).

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:*

D 1193 Specification for Reagent Water[2]

2.2 *Steel Structures Painting Council Specification:*

Paint No. 27 Basic Zinc Chromate-Vinyl Butyrol Wash Primer[3]

3. Summary of Guide

3.1 This guide describes 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 surface preparation (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 standard 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, hence 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 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 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

[1] This guide 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.

Current edition approved April 15, 1995. Published June 1995. Originally published as D 2092 – 86. Last previous edition D 2092 – 86 (1993).

[2] *ASTM Book of Standards*, Vol 11.01.

[3] Available from The Society For Protective Coatings (SSPC), 2100 Wharton St., Suite 310, Pittsburgh, PA 15203–1951.

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 (see Appendix X2).

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 130°F (55°C) 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 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 115 to 160°F (45 to 70°C). 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*—This treatment method consists of mechanical etching or deformation of the galvanized surface using abrasive propelled with compressed air or water. Because of the soft nature of the galvanized metal zinc layer, it is critical that soft abrasives or reduced operating pressures, or both, be employed. Excessive operating pressures, high hardness abrasives, and long dwell times can result in removal of zinc coating thickness (see Appendix X3).

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.

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

APPENDIXES

(Nonmandatory Information)

X1. CLEANING OF ZINC SURFACES

X1.1 When zinc surfaces have been soiled in fabrication, they should be cleaned before finishing. Alkali and acid cleaners should not be used without consulting the supplier of the treatment. Organic solvents remove most soils, but do not remove water-soluble salts unless specially selected. Proprietary solutions designed to clean zinc surfaces are available.

NOTE X1.1—The use of solvents containing volatile organic compounds to prepare or clean 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 generic or proprietary materials used to clean zinc-coated surfaces, either in shop applications (Miscellaneous Metal Parts), field painting (Architectural), or specific process industry.

X2. IDENTIFYING THE PRESENCE OF AND REMOVING CHROMATE TREATMENTS USED AS WET-STORAGE (ALSO CALLED HUMID-STORAGE) STAIN INHIBITORS

X2.1 One of the inhibitors used by producers of zinc-coated steel is a hexavalent chromium solution. This treatment prevents Method D from working properly.

X2.2 If zinc-coated steel to be painted is galvanized to order, the order should prohibit the use of hexavalent chromium humid-storage stain treatments.

X2.3 Hexavalent chromium treatment can be removed from galvanized surfaces by one of the following three methods:

X2.3.1 Weathering the surfaces for six months.

X2.3.2 Abrading the surfaces by sanding.

X2.3.3 Brush-off abrasive blast cleaning.

X2.4 The presence of hexavalent chromium on galvanized surfaces can be determined by spot testing with diphenylcarbohydrazide solution. The spot test can also be used to evaluate the effectiveness of preparation to remove the treatment.

X2.5 Make the spot test solution as follows:

X2.5.1 Dissolve 0.5 g of 1,5-diphenylcarbohydrazide powder in a mixture of 20 mL acetone and 20 mL denatured ethanol. Heat the mixture in a warm water bath if necessary.

X2.5.2 Dilute 20 mL of concentrated phosphoric acid to 40 mL by slowly adding to 20 mL of reagent water conforming to Type IV of Specification D 1193.

X2.5.3 Add the dilute phosphoric acid to the acetone-alcohol solution.

X2.5.4 Store the solution away from light. Discard if it becomes discolored. Preferably make fresh solution as needed using proportionally smaller amounts of ingredients.

X2.6 Conduct the spot test as follows:

X2.6.1 Degrease the test spot on the galvanized surface.

X2.6.2 Place several drops of the test solution on the galvanized surface.

X2.6.3 If no color develops in the solution within 10 s, hexavalent chromium is not present.

X2.6.4 If solution droplets turn a pink to purple color, then hexavalent chromium is present.

X2.6.5 Conduct the spot test on several representative spots on each individual piece of galvanized steel.

X2.6.6 Test *every* piece of galvanized steel that is to be treated for painting.

X3. ABRASIVE BLASTING

X3.1 Typical abrasives might include soft mineral sands with a mohs hardness $\leq$5, or organic media, such as corn cobs or walnut shells.

X3.2 Typical operating pressures might be $\leq$60 psig measured at the blasting nozzle.