Designation: D1731 – 09 (Reapproved 2020)

Standard Practices for Preparation of Hot-Dip Aluminum Surfaces for Painting[1]

This standard is issued under the fixed designation D1731; 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 These practices describe procedures for the preparation of hot-dip aluminum surfaces for painting.

1.2 *This standard may involve hazardous materials, operations, and equipment. 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.*

1.3 *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]

D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products

2.2 *Military Standards:*[3]

MIL-DTL-5541 Chemical Conversion Coatings on Aluminum and Aluminum Alloys

MIL-C-15328 Specification for Acid Wash Primers

MIL-M-10578B Metal Conditioner and Rust Remover (Phosphoric Acid Type)

3. Types of Surface Preparations

3.1 Two types of surface preparations are covered as follows:

3.1.1 Solvent Cleaning, and

3.1.2 Chemical Treatments.

3.2 These two types cover several methods as described in Section 5. Variations in surface treatment produce end conditions which differ and which do not necessarily yield identical results when paints are applied. Service conditions will dictate the type of surface preparation that should be selected.

4. Solvent Cleaning

4.1 The surfaces may be prepared for painting by any of the methods for solvent cleaning described in 4.2 and 4.3.

4.2 *Method 1*—Manual swabbing or dip washing with a solvent such as mineral spirits or high flask solvent naphtha. It is extremely difficult to produce a clean metal surface by this method. Accumulated contaminants in the solvent or on the swab are frequently redeposited on the surface being prepared.

4.3 *Method 2*—Solvent spray cleaning in accordance with Method A, Procedure 1 of Practice D609.

4.4 *Method 3*—Vapor degreasing in special equipment in accordance with the latest revision of Method A, Procedure 2 of Practice D609, employing trichlorethylene or perchlorethylene vapor. Solvent cleaning does not disturb the natural oxide film on the metal and may prove adequate for some applications.

5. Chemical Treatment

5.1 The surfaces may be prepared for painting by any of the methods for chemical treatment (Note 1) described in 5.2 to 5.9:

NOTE 1—Materials and procedures 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. The hexavalent chromium methods given are not recommended as hexavalent chromium is a known carcinogen.

5.2 *Method 1, Alkaline Cleaners*—Etching alkaline solutions, such as caustic soda, should be avoided because of the possibility of dissolving away the aluminum coating thereby exposing the base metal. Since inhibited alkaline cleaners do not etch the surface, they can be used to remove grease, oil, and other organic solids from hot dip aluminum. After alkali cleaning, the surface should be thoroughly rinsed with clean water. Most often alkaline-cleaned surfaces are

[1] These practices are under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and are the direct responsibility of Subcommittee B08.07 on Conversion 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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

subsequently processed by one of the following methods, described in 5.3 – 5.9.

5.3 *Method 2, Alcoholic Phosphoric Acid Cleaners*—This treatment involves the use of an aqueous solution of phosphoric acid with alcohol or other organic solvents, together with wetting agents, emulsifying agents, etc. The solution may be applied by swabbing or dipping (preferably at a temperature of 70 to 90 °F (21 to 32 °C)). The solution should remain on the surface for several minutes, followed by thorough rinsing with clean water. A very thin phosphate film is formed which tends to protect the metal and promote paint adhesion.

NOTE 2—Materials meeting the requirements of the latest revision of U.S. Military Specification MIL-M-10578B may be used.

5.4 *Method 3, Acid Fluoride Deoxidizer*—This treatment includes the use of nitric or sulfuric acid with chromium trioxide and a fluoride. It provides a clean and uniform surface without undue roughening and is effective for removing inorganic soils and any film formed during the production of the hot dip aluminum. The deoxidizing solution is generally used at a temperature of 70 to 130 °F (21 to 54 °C) (depending on the alloy and the amount of film) and is followed by a water rinse.

NOTE 3—Before applying the treatments according to Chemical Treatment Methods 3, 4, 5, 6 and 7, the aluminum surfaces should be freed of grease, oil or other foreign material by means of the procedure described in Solvent Cleaning Method 3, Chemical Treatment Method 1 or any other suitable method.

5.5 *Method 4, Crystalline Phosphate Treatment*—This surface-coating method consists in reacting the aluminum surface in a 130 to 145 °F (54 to 63 °C) (approximately) zinc acid-phosphate solution containing oxidizing agents and other salts for accelerating the coating action. The aluminum surface is converted to a crystalline, phosphate coating of the proper texture adapted to inhibit corrosion and increase the adherence and durability of any applied paint film. The phosphate coating process may be carried out by immersion or spray application. The aluminum surface is converted to the phosphate coating by immersion in the processing solution for 30 s to 4 min, or by spraying the solution for 10 s to 2 min (Note 3).

5.6 *Method 5, Amorphous Phosphate Treatment* (*see Note 4*)—This process comprises treatment of clean aluminum surfaces in a 90 to 125 °F (32 to 51 °C) aqueous solution comprising phosphoric, hydrofluoric acids and chromium trioxide. The aluminum surface is converted to a thin, adherent, amorphous coating, iridescent green to gray green in color, depending upon the aluminum alloy treated, which inhibits corrosion and increases the adherence and durability of applied paint films. The coating process may be carried out by immersion or spray application. The time of treatment will vary from 15 to 45 s for the spray process and 30 s to 3 min for the immersion application (Note 3).

5.7 *Method 6, Carbonate Chromate Treatment* (*see Note 4*)—This process comprises treatment in a 160 to 180 °F (71 to 82 °C) dilute solution of sodium carbonate and potassium chromate for periods from 2 to 20 min, followed by a water rinse. The surface is then given a final treatment in a 150 to 160 °F (66 to 71 °C), 5 % potassium dichromate solution followed by a final rinse. The treatment produces a thin, adherent, conversion coating on the surface, increasing the corrosion resistance of the metal and promoting paint adhesion (Note 3).

5.8 *Method 7, Amorphous Chromate Treatment* (*see Note 4*)—This process comprises treatment of clean aluminum surfaces in aqueous chromium trioxide solutions containing suitable accelerating agents such as fluoride-containing materials. The aluminum surface is converted to an adherent, amorphous, mixed metallic oxide coating, iridescent golden to light brown in color, which increases the corrosion resistance and the adherence and durability of any applied paint film. The coating process may be carried out by immersion, spray or brush application, at 70 to 130 °F (21 to 54 °C), in from 15 s to 5 min contact time. It may be necessary to precede this treatment with a deoxidizer as described in Method 3 (see Note 3).

NOTE 4—Most of the treatments conforming to Chemical Treatment Methods 5, 6, and 7, comply with the requirements of the latest revision of U.S. Military Specification MIL-DTL-5541.

5.9 *Method 8, Acid-Bound Resinous Treatment* (*see Note 5*)—This surface treatment is based on the deposition of an acid-bound resinous film of approximately 0.3 to 0.5 mils (7.6 to 12.7 µm) in thickness on the aluminum surface in such a manner as to enhance the adhesion of subsequently applied paint coatings. 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 metal substrate. The aluminum surface should be pretreated by Solvent Cleaning Methods 1, 2 or 3 or Chemical Treatment Methods 1 or 2 prior to the application of this treatment. The film may be applied by brush, spray, or dip. Under normal conditions it shall dry sufficiently for recoating within 30 min. The film has good adhesion to the metal substrate and promotes good adhesion of most subsequent organic coatings to itself.

NOTE 5—Materials meeting the requirements of the latest revision of U.S. Military Specification MIL-C-15328 may be used to apply to Chemical Treatment Method 8.

6. Keywords

6.1 hot-dip aluminum; pretreatment for painting; surface treatments