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Standard Specification for Chromates on Aluminum[1]

This standard is issued under the fixed designation B449; 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 U.S. Department of Defense.

1. Scope

1.1 This specification covers the requirements relating to rinsed and nonrinsed chromate conversion coatings on aluminum and aluminum alloys intended to give protection against corrosion and as a base for other coatings. This edition of the specification has been coordinated with ISO/DIS 10546 and is technically equivalent.

1.2 Aluminum and aluminum alloys are chromate coated in order to retard corrosion; as a base for organic films including paints, plastics, and adhesives; and as a protective coating having a low electrical contact impedance.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.*

1.5 *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]

B117 Practice for Operating Salt Spray (Fog) Apparatus

B602 Guide for Attribute Sampling of Metallic and Inorganic Coatings

B767 Guide for Determining Mass Per Unit Area of Electrodeposited and Related Coatings by Gravimetric and Other Chemical Analysis Procedures

D1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting

D3359 Test Methods for Rating Adhesion by Tape Test

2.2 *ISO Standards:*[3]

ISO 2409 Paint and Varnishes—Cross-Cut Test

ISO 3768 Metallic Coatings—Neutral Salt Spray Test (NSS Test)

ISO 3892 Conversion Coatings on Metallic Materials—Determination of Mass Per Unit Area—Gravimetric Method

ISO 4519 Electrodeposited Metallic Coatings and Related Finishes—Sampling Procedures for Inspection by Attributes

ISO/DIS 10546 Chemical Conversion Coatings—Rinsed and Nonrinsed Chromate Conversion Coatings—On Aluminum and Aluminum Alloys

2.3 *Federal Standard:*[4]

Fed. Std. No. 141 Paints, Varnish, Lacquer, and Related Materials; Methods of Inspection

2.4 *Military Specification:*[4]

MIL-DTL-5541 Chemical Films for Aluminum and Aluminum Alloys

3. Terminology

3.1 *Definitions:*

3.1.1 *nonrinsed*—chromate coatings that are dried immediately after the chromating step without receiving a water rinse.

3.1.1.1 *Discussion*—This special type of coating is typically used on long coils of aluminum sheet stock that receive an immediate subsequent paint or adhesive coating.

NOTE 1—Nonrinsed chromate coatings are finding increased usage on fabricated parts and castings.

3.1.2 *rinsed*—chromate coatings that are rinsed in water prior to drying.

[1] This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is 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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

3.1.2.1 *Discussion*—This type of coating is typically applied to extruded aluminum fabricated parts and castings.

4. Classification

4.1 Chromate finishes can be applied ranging in color from brown, thick coatings (Class 1) providing maximum corrosion protection to yellow, intermediate thickness coatings (Class 2) suitable as an organic film base or to colorless, thin coatings (Class 3) suitable for low electrical contact resistance. The yellow coatings vary from golden yellow to iridescent light yellow. Chromate-phosphate finishes (Class 4) can be applied ranging in color from green to iridescent light green. The Class 4 coatings comply with the requirements of MIL-DTL-5541.

4.2 Finishers can seldom guarantee to supply exact shades of color with chromate conversion coatings. If it is necessary to have exact shades of color, it is possible to dye chromate coatings having a coating mass greater than 0.4 g/m^2 to obtain a wide range of colors, but they can only be expected to give an order of added corrosion resistance similar to that provided by the undyed coatings. It should be noted that color and color uniformity will vary somewhat between one alloy and another and from a polished surface to an etched surface. Iridescence and variations in color density from one area of the surface to another are normal and shall not be considered a sign of poor quality.

4.3 The finishes are divided into four classes; their most important characteristics are listed in Table 1.

5. Surfaces Preparation

5.1 The surfaces of the parts to be chromated must be clean and free of any oxidation, scale, or soils such as metal turnings, grinding dust, oil, grease, lubricants, hand-sweat, or any other contamination detrimental to the chromating process. The parts must therefore, as far as necessary, be cleaned before chromating and if necessary be pickled. Fig. X2.1 shows the various processing step options.

6. Methods of Application of Chromate Coatings

6.1 Metallic material other than aluminum should not be treated with the parts to be chromated.

TABLE 1 Classification of Chromate Coatings

Class[A]	Appearance	Coating Mass per Unit Area, g/m^2	Corrosion Protection
1	yellow to brown	0.4 to 2	maximum corrosion resistance generally used as final finish
2	colorless to yellow	0.1 to 0.4	moderate corrosion resistance, used as a paint base and for bonding to rubber
3	colorless	<0.1	decorative, slight corrosion resistance, low electrical contact resistance
4	light green to green	0.2 to 5	moderate corrosion resistance, used as a paint base and for bonding to rubber

[A] No relationship exists between class numbers and degree of corrosion resistance. Class numbers have been assigned on the basis of traditional usage and for compatibility with national standards.

6.2 Chromate conversion coatings are normally applied by dipping: the coating may also be applied by inundation, spraying, roller coating, or by wipe-on techniques. The application method used should be taken from the operating instructions for the chromating process employed. Chromating solutions are usually acidic and may contain hexavalent chromium salts together with other salts that may be varied to affect the appearance and hardness of the film. The color of the film, and, therefore, the type of conversion coating, depends on the composition of the chromating solution, but it is also affected by the pH and temperature, the duration of the treatment, and the nature and surface condition of the alloy being treated.

6.3 These coatings receive a final water rinse. If the coating is meant to be a basis for additional coatings, the detail shall be subject to a rinse in deionized water with a conductivity less than 100t µS/cm. If hot water is used as the final rinse after the chromating process, it is essential that the time of rinsing should be kept as short as possible in order to prevent the dissolution of the hexavalent chromium. The drying of the coating shall be carried out at a temperature not exceeding 60°C to prevent cracking due to dehydration, which causes loss of adhesion and performance of the chromate coating.

6.4 Any additional subsequent treatments depend upon the purpose for which the chromated parts are intended.

7. Coating Requirements

7.1 *General*—Chromate conversion coatings harden with age by gradual dehydration. They should, therefore, be handled carefully for the first 24 h after treatment, and any tests (including corrosion tests) shall be deferred until the expiration of that period. The green chromate-phosphate coatings usually continue to improve in corrosion resistance after initial formation. They achieve their maximum corrosion resistance after 1 to 2 months at room temperature. It is not required to store parts for this purpose.

7.2 *Electrical Resistance*—Colorless, light yellow, or light green iridescent chromate layers of low mass per unit area increase the electrical resistance between an electrical contact and the aluminum to a very small extent. When measured at 9-V and a 2-A current the resistance should be less than 0.1 Ω. Highly colored brown, yellow, or green coatings show a marked increase in electrical contact resistance with increasing mass per unit area of the chromate layer and may reach resistances of 10 000 Ω or more.

7.3 *Adhesion*—The coatings shall be adherent and non-powdery. There are no practical tests for measuring the adhesion of a chromate conversion coating on aluminum. However, a practical evaluation of the adhesion can be made by measuring the adhesion of a secondary organic film applied to the chromated aluminum. When specified, the chromate conversion coating shall pass the organic coating adhesion test in Test Methods D3359 or the equivalent ISO 2409.

7.3.1 Class 4 coatings intended for use under MIL-DTL-5541 shall have their adhesion evaluated by Method 6301 of Fed. Std. No. 141.

7.3.2 Additional treatments applied under MIL-DTL-5541 can be found in Practices D1730, Methods 5, 6, and 7.