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Standard Specification for Non-hexavalent Chromium Conversion Coatings on Aluminum and Aluminum Alloys[1]

This standard is issued under the fixed designation B 921; 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 specification covers the requirements relating to rinsed and non-rinsed non-hexavalent chromium conversion coatings on aluminum and aluminum alloys intended to give protection against corrosion and as a base for other coatings.

1.2 Aluminum and aluminum alloys are conversion 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 *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 requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

B 117 Practice for Operating Salt Spray (Fog) Apparatus[2]

B 602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings[3]

D 1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting[3]

D 3359 Test Methods for Measuring Adhesion by Tape Test[4]

2.2 *ISO Standards:*

ISO 2409 Paint and Varnishes—Cross-Cut Test[5]

ISO 3768 Metallic Coatings—Neutral Salt Spray Test (NSS Test)[5]

ISO 4519 Electrodeposited Metallic Coatings and Related Finishes—Sampling Procedures for Inspection by Attributes[5]

2.3 *Federal Standard:*

Fed. Std. No. 141 Paints, Varnish, Lacquer, and Related Materials; Methods of Inspection[6]

2.4 *Military Specification:*

MIL-C-5541 Chemical Films for Aluminum and Aluminum Alloys[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *non-rinsed*—conversion coatings that are dried immediately after the conversion coating 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—Non-rinsed conversion coatings are finding increased usage on fabricated parts and castings.

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

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

4. Classification

4.1 A class one conversion coating provides for maximum salt fog corrosion protection to bare metal. A class two conversion coating is designed to give painted salt fog corrosion resistance and some bare salt fog corrosion resistance. A class three conversion coating provides little salt fog corrosion resistance, but low electrical contact resistance (see MIL-C-5541). Class four and five conversion coatings only provide for painted salt fog corrosion resistance.

4.2 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 conversion coated shall 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 conversion coating process. The parts shall therefore, as far as necessary, be

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[2] *Annual Book of ASTM Standards*, Vol 03.02.

[3] *Annual Book of ASTM Standards*, Vol 02.05.

[4] *Annual Book of ASTM Standards*, Vol 06.01.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

TABLE 1 Classification of Non-hexavalent Chromium Conversation Coatings

Class	Corrosion Protection
1	Maximum corrosion resistance generally used as a final finish
2	Moderate corrosion resistance, used as a paint base and for bonding to rubber
3	Decorative, slight corrosion resistance, low electrical contact resistance
4	Moderate corrosion resistance, used as a paint base and for bonding to rubber

TABLE 2 Relative Corrosion Resistance

Coating Class	Exposure Time, h[A]		
	Non-Heat-Treatable Wrought Alloys	Heat-Treatable Alloys and Cast Alloys with a Nominal Silicon Content <1 %	Cast Alloys with a Nominal Silicon Content >1 %
1	500	336	48
2	250	168	24
3	168	120	12
4	500	336	48

[A] The exposure times are indicative of the relative corrosion resistance of the various coating classes on the different alloys, but no direct relationship exists between performance in the neutral salt spray test and performance in service.

cleaned in a non-hexavalent chromium cleaner before conversion coating and, if necessary, be pickled.

6. Methods of Application of Conversation Coatings

6.1 Metallic material other than aluminum shall not be treated with the parts to be conversion coated.

6.2 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 shall be taken from the operating instructions for the conversion coating process employed. Conversion coating solutions are usually acidic and may contain various salts that may be varied to affect the appearance and hardness of the film. The type of conversion coating depends on the composition of the solution and may also be affected by the pH, temperature, duration of the treatment, and the nature and surface condition of the alloy being treated.

6.3 Those coatings receiving 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. Hot water shall be used only if allowed by the manufacturer of the conversion coating in question. The drying of the coating shall be carried out in accordance with the specifications of the manufacturer of the conversion or conversion coating in question.

6.4 Any additional subsequent treatments will depend upon the direction of the manufacture of the conversion or conversion coating in question.

7. Coating Requirements

7.1 *Electrical Resistance*—When specified, the electrical resistance shall be in accordance with MIL-C-5541.

7.2 *Adhesion*—The coatings shall be adherent and non-powdery. A practical evaluation of the adhesion can be made by measuring the adhesion of a secondary organic film applied to the conversion coating in question. When specified, the conversion coating shall pass the organic coating adhesion test in Test Methods D 3359 or the equivalent ISO 2409.

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

7.2.2 Additional treatments applied under MIL-C-5541 can be found in Practices D 1730, Methods 5, 6, and 7.

7.3 *Corrosion Resistance*—When subjected to the neutral salt spray test specified in Test Method B 117 or in the equivalent ISO 3768, three separate test specimens of the coating shall withstand exposure for the hours shown in Table 2 without giving evidence, to the unaided eye, of more than a total of 8 isolated spots or pits. None shall be larger than 1 mm in diameter. Each individual test specimen shall not have more than 5 isolated spots or pits, none larger than 1 mm in diameter on their respective surfaces. Spots within 10 mm of the edges of the panels are not counted.

7.4 *Test Specimens and Samplings*—Unless otherwise specified, the sampling plans of Test Method B 602 or the equivalent ISO 4519 shall be used to test the coatings.

7.4.1 Test specimens shall be of the same alloy and surface condition as the articles represented. Test specimens shall be 150 by 100 mm.

8. Keywords

8.1 conversion coating; non-hexavalent chromium conversion coating; non-rinsed; rinsed