



SURFACE VEHICLE RECOMMENDED PRACTICE

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Superseding J1974 JUN1993

Decorative Anodizing Specification for Automotive Applications

RATIONALE

The Materials, Processes, and Parts Council has not found users for this Recommended Practice, nor is there technical expertise to determine if updates are necessary. Therefore this standard has been Stabilized.

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1. SCOPE

This SAE Recommended Practice is aimed at ensuring high-quality products of anodized aluminum automotive components in terms of durability and appearance. Decorative sulfuric acid anodizing has been well developed over the last several decades in the aluminum industry. Exterior and interior performance demonstrated that parts processed to this document meet long-term durability requirements.

Since the treatment of processing variables is outside the scope of this document, it is important for applicators of this coating to develop an intimate knowledge of their process, and control all parameters that affect the quality of the end product. The use of techniques such as statistical process control (SPC), capability studies, design of experiments, process optimization, etc., are critical to produce material of consistently high quality.

1.1 Form

Detailed in this SAE Recommended Practice are interior and exterior bright or electrolytically colored anodized aluminum automotive components in the form of seat trim, dashboard, window or side body mouldings, bumpers, wheels, rocker panel, etc.

1.2 Application

This document defines performance requirements for bright or electrolytically colored anodized aluminum finishes including interior and exterior applications. The automotive parts can be fabricated from bare coiled sheet, flat sheet, or extruded shapes. Preanodized coiled sheet may be applicable for selected applications. Alloy selection is governed by finish requirements, forming characteristics, and mechanical properties.

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2. REFERENCES

2.1 Applicable Documents

The following ASTM methods form a part of this specification to the extent specified herein. The latest version of the single copy document shall apply.

2.1.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

- ASTM B 137 Measurement of Weight of Coating on Anodically Coated Aluminum
- ASTM B 368 Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)
- ASTM B 487 Measurement of Metal and Oxide Thicknesses by Microscopical Examination of a Cross Section
- ASTM B 680 Seal Quality of Anodic Coatings on Aluminum by Acid Dissolution
- ASTM B 681 Measurement of Thickness of Anodic Coatings on Aluminum and of Other Transparent Coatings on ASTM Opaque Surfaces, Using the Light-Section Microscope
- ASTM D 2197 Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion
- ASTM E 430 Measurement of Gloss of High Gloss Surfaces by Goniophotometry
- ASTM G 23 Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

3. DEFINITIONS

3.1 GLOSS

Degree to which a surface simulates a perfect mirror in its capacity to reflect light.

3.2 HAZE

Diffuse scattering of reflected light in directions adjacent to the direction of specular or mirror reflection.

3.3 PICKUP

A mixture of aluminum fines, lubricant, and aluminum oxide generated from roll coating during the deformation process.

3.4 SIGNIFICANT SURFACES

These are defined as surfaces that are visible when the finished component is assembled onto the vehicle and is observed in normal viewing position. Nonvisible surfaces, when designated by the customer, are significant.

3.5 STRINGERS

Usually a mixture of magnesium and aluminum oxides that results from inadequate molten metal treatment.

3.6 SYMBOLS AND ABBREVIATIONS

μm	Micrometer or micron
mil	0.001 Inch
g/m^2	Grams per Square Meter
mg/dm^2	Milligrams per Square Decimeter
g/cm^3	Grams per Cubic Centimeter
MJ/m^2	Megajoules per Square Meter
$^{\circ}\text{F}$	degrees Fahrenheit
$^{\circ}\text{C}$	degrees Celsius
ASTM	American Society for Testing and Materials
A.D.T.	Acid Dissolution Test
CASS	Copper Acidified Salt Spray

4. TECHNICAL REQUIREMENTS

4.1 Quality

4.1.1 Substrate Preparation

The substrate surface finish can affect the anodized appearance. Suitable precautions in forming, cleaning, and chemical brightening must be taken to assure a satisfactorily finished part.

4.1.2 Surface Appearance

Samples representing typical production parts should be used to define the appearance levels established by automotive companies in cooperation with anodizers and aluminum companies.

Anodized surfaces shall have the following general physical appearance:

- a. Free of physical defects such as scratches, etc.
- b. Acceptable levels of stringers, pickup, etc.
- c. Color, gloss, and haze requirements as per master samples

4.2 Tolerances

4.2.1 Coating Thickness/Weight

For automotive bright trim components, the most critical requirement is anodic coating thickness/weight. The coating thickness/weight has a direct impact on the appearance and durability. Thinner coatings generally give brighter appearance but less durability as compared to thicker coatings. Field exposure has shown that properly applied clear finishes provide durability while maintaining acceptable appearance. Despite the lack of similar long-term field service experience, the black electrolytic finish appears to provide adequate durability based on several years of experience.

The anodizing thickness/weights listed in Table 1 shall be met on all areas of the significant surfaces.

TABLE 1 - MINIMUM COATING THICKNESS AND WEIGHT REQUIREMENT FOR CLEAR AND ELECTROLYTIC BLACK FINISHES

	Thickness ¹ (Min)	Thickness ⁽¹⁾ (Min)	Coating Weight ²	Coating Weight ⁽²⁾
	Exterior	Interior	(Min) Exterior	(Min) Interior
Clear Finish	7.5 μm (0.3 mil)	2.5 μm (0.1 mil)	20 g/m^2	6 g/m^2
Electrolytic Black (Tin or Nickel Base)	15.0 μm ³ (0.6 mil)	7.5 μm ⁽³⁾ (0.3 mil)	40 g/m^2 ⁴	20 g/m^2 ⁽⁴⁾
Electrolytic Black (Cobalt Base)	7.5 μm ^{(3) 5} (0.3 mil)	7.5 μm ⁽³⁾ (0.3 mil)	20 g/m^2 ⁽⁴⁾	20 g/m^2 ⁽⁴⁾

4.2.2 Seal Quality - Test Method - ASTM B 680

The Acid Dissolution Test (A.D.T.) is based on the concept that the resistance to dissolution of the anodic coating in the phosphoric-chromic acid solution is indicative of the effectiveness of the sealing operation. The amount of anodic coating dissolved is expressed as a mass in mg/dm^2 or in an A.D.T. "rating" unit independent of coating thickness. In the automobile industry in North America, the A.D.T. "rating" unit is widely used. The maximum value for the "rating" unit is 6.0, which is equivalent to $20 \text{ mg}/\text{dm}^2$ based on a coating density of $2.62 \text{ g}/\text{cm}^3$.

The formulas used to determine the units, as well as interrelationship of the A.D.T. units for various coating thicknesses, are presented in Appendix A and B, respectively.

¹Coating Thickness—ASTM B 681; ASTM B 487

²Coating Weight—ASTM B 137

³Thicker coatings may be needed to meet requirements of color and gloss.

⁴Coating weight should be determined on an equivalent clear sealed coating prior to electrolytic coloring.

⁵Coating thickness requirements for bumper application using 7029 alloy, using a Cobalt based electrolyte must minimum of $15.0 \mu\text{m}$ (0.60 mil).

The following Acid Dissolution Test (A.D.T.) requirements must be met to achieve acceptable field durability:

- a. Clear Finish - 20 mg/dm² max (6 rating)
- b. Electrolytic Black - 20 mg/dm² max (6 rating)

4.2.3 Accelerated Corrosion - Test Method - ASTM B 368

The CASS test shall be carried out in strict accordance with ASTM B 368. Collection rates, ph, and specific gravity should preferably be run with every CASS test cycle.

The copper accelerated acetic acid salt spray or CASS test is presently the most widely used accelerated corrosion test in the automotive industry. The CASS test is not used to predict the number of years a part may last in service, but rather to evaluate the integrity of the metal finish. The CASS test does not have an exact correlation to years of corrosion protection in service. Failure to pass the test may be regarded as a probable indication of early failure in service.

The corrosion rating listed in Table 2 is required to maintain the high quality standards of the automotive industry and achieve acceptable field durability:

TABLE 2 - CORROSION RATING REQUIREMENT FOR CLEAR AND ELECTROLYTIC BLACK FINISHES

	Exterior	Interior
Clear Finish	no pitting or corrosion after 6 h	N/A
Electrolytic Black	no pitting or corrosion after 6 h	N/A

4.2.4 Optical Properties

The glossy appearance (brightness) of a high gloss metal finish can be determined in accordance with ASTM E 430. Acceptable levels of optical properties are to be established by automotive companies in cooperation with anodizers and aluminum suppliers. Master samples with representative optical properties are recommended for comparison.

4.2.5 New Alloys And/or New Processes

Additional tests have been suggested to qualify new alloys and/or new finishing processes for automotive applications of decorative anodized products.

4.2.5.1 Scratch Resistance - ASTM D 2197 (suggested apparatus is Pacific Balanced Beam Scrape-Adhesion and Mar Tester, Model SG-8101)

For information purposes, some typical scratch widths on an anodized surface using a 500 g weight with loop stylus SG-8102 are as follows:

- a. AA-5657-H25 is 500 to 600 μm
- b. AA-5252-H25 is 400 to 500 μm
- c. AA-7029-T6 is 200 to 300 μm

4.2.5.2 Heat

Finish should not craze or show signs of physical damage at a metal temperature up to 90 °C (194 °F).

4.2.5.3 Weatherometer - ASTM G 23 - Method 3 (Carbon-Arc Type)

Finish should not turn yellow, change color, fade, or show signs of chalking after 1000 h exposure at a black panel temperature of 63 °C (145 °F).

4.2.5.4 Outdoor Exposure (Exterior) - Direct Weathering in Florida

Samples to be exposed 5 degrees off horizontal facing south. Sample(s) will be examined at intervals 175 000 langley (or 7322 MJ/m² or approximately 12 months) and 350 000 langley (or 14 644 MJ/m² or approximately 24 months). No corrosion, color change, or color fading is allowed.

4.2.5.5 Outdoor Exposure (Interior) - Under Glass Exposure in Florida

Samples to be exposed under glass at 5 degrees off horizontal facing south. Sample(s) will be examined at intervals 175 000 langley (or 7322 MJ/m² or approximately 12 months) and 350 000 langley (or 14 644 MJ/m² or approximately 24 months). No corrosion, color change, or color fading is allowed.

PREPARED BY THE SAE DECORATIVE ANODIZING SUBCOMMITTEE
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STABILIZED BY THE SAE MATERIALS, PROCESSES AND PARTS COUNCIL

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