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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3095

Issued FEB 2001

Paint, Gloss, Airline Exterior System

FOREWORD

This specification is taken directly, and is a restatement in AMS format of the Association of European Airlines (AEA) document "Unified Specification for Future Aircraft Paint Finishes - Airline Exterior Paint System". This in turn is based upon the AEA document, "Aircraft Exterior Finishes, Performance Characteristics of the Ideal Exterior Paint Scheme". See 8.1.

1. SCOPE:

1.1 Form:

This specification defines requirements for a high gloss paint system for use on civil aircraft.

1.2 Application:

This high gloss paint system may be used on external surfaces of civil aircraft, but usage is not limited to such applications. This standard may also be used as a basis for special coatings such as anti-erosion, anti-slip, semi-gloss and matt coatings.

1.3 Classification:

Specific classes are not defined. The supplier shall define the paint system (see 3.1). Typically it consists of a combination of the following types of products:

Pretreatment
Primers, undercoats and fillers
Intermediate coats, such as a selective strippable coat
Top coats
Clear coats

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1.4 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 4037	Aluminum Alloy, Sheet and Plate 4.4Cu 1.5Mg 0.60Mn Solution Heat Treated
AMS 4041	Aluminum Alloy, Sheet and Plate 4.4Cu 1.5Mg 0.60Mn Alclad 2024 and 1-1/2% Alclad 2024, -T3 Flat Sheet; 1-1/2% Alclad 2024-T351 Plate
MA4872	Paint Stripping of Commercial Aircraft - Evaluation of Materials and Process

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 3960	Volatile Organic Content (VOC) of Paints and Related Coatings

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-PRF-85285	Coating, Polyurethane, High-Solids
FTMS 141	Method 4331 – Spraying Properties

2.4 ISO Publications:

Available from American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036-8002, and International Organization for Standardization (ISO), 1, rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland.

ISO 1512	Paints and Varnishes - Sampling
ISO 1513	Examination and Preparation of Samples for Testing
ISO 1514	Standard Panels for Testing
ISO 1517	Surface Drying Test (Ballotini Method)
ISO 1518	Scratch Test
ISO 1519	Bend Test (Cylindrical Mandrel)
ISO 2409	Cross Cut Test
ISO 2812-1	Resistance to Liquids, Part 1 - General Methods
ISO 2813	Specular Gloss of Non-metallic Paint Films at 20 Degrees, 60 Degrees and 85 Degrees
ISO 3270	Paints and Varnishes and Their Raw Materials - Temperatures and Humidities for Conditioning and Testing
ISO 3678	Print-free Test
ISO 4617	Paints and Varnishes - List of Equivalent Terms
ISO 4618	Paints and Varnishes – Vocabulary
ISO 4628-1/-2	Evaluation of Degradation of Paint Coatings - Designation of Intensity, Quantity and Size of Common Types of Defect Part 1 General Principles and Rating Schemes Part 2 Designation of Degree of Blistering
ISO 6272	Falling Weight Test
ISO 6860	Bend Test (Conical Mandrel)
ISO 7253	Resistance to Neutral Salt Spray
ISO 7724	Paints and Varnishes - Colorimetry
ISO 9117	Determination of Through-Dry State and Through-Dry Time
ISO 11507	Exposure of Coatings to Artificial Weathering, - Exposure to Fluorescent UV and Water

2.5 AECMA Specifications:

Available from European Association of Aerospace Industries, Gulledelle, 94-b.5, B-1200 Brussels, Belgium.

EN 2090	Aluminum Alloy 2024-T3 - Clad Sheet and Strip
EN 3665	Paints and Varnishes - Filiform Corrosion Test
EN 3997	Aluminum Alloy 2024-T3 - Unclad Sheet and Strip

2.6 DIN Publications:

Available from Deutsches Institut fuer Normung, Burggrafenstrasse 6, D-10787 Berlin, Germany.

DIN 6175 Farbtoleranzen fuer Automobillackierungen; Unilackierungen (Tolerances For Automotive Paints; Uni-paints)

2.7 Definitions:

Definitions of terms and expressions used for paints as given in ISO 4617 and ISO 4618 shall apply, with the exception of those defined below:

PAINT SYSTEM: The exterior coating for a civil aircraft consisting of one or more coats of specific material as necessary to fulfill the requirements of this specification and any chemical pre-treatment required.

APPROVING AUTHORITY: Either the user or user's delegated organization.

BATCH: Quantity of one component of a product with the same composition and resulting from the same production run.

VOLATILE ORGANIC CONTENT (VOC): VOC is composed of one or more volatile organic compounds, containing at least elements of carbon and hydrogen or in which hydrogen is partially or completely replaced by halogens, oxygen, sulfur, phosphorus or nitrogen, and with the exception of carbon monoxide, carbon dioxide and carbonates, and which has a vapor pressure of 1.3 kPa (10 mm Hg) or more, at 20 °C (68 °F).

OEM: Original Equipment Manufacturer

UNIFIED SPECIFICATION: Is an alignment and updating of the current OEM specifications as much as possible with those characteristics detailed in the AEA document "Aircraft Exterior Finishes, Performance Characteristics of the Ideal Exterior Paint Scheme". See 8.1.

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

The paint system shall consist of the minimum number of products and coats, including pre-treatment, as shall be necessary to achieve the performance requirements detailed in this standard. Composition of these products is not specified. For guidance on composition, see 8.1.

3.2 Properties of Liquid Paint:

A summary of paint system product requirements is shown in Table 1.

TABLE 1 - Properties of Liquid Paint

	Property	Requirement	Test Panel and Paint System	Conditioning	Test Method
1)	Quality	3.2.1	Paint components	As received in original containers	ISO 1513
2)	Application Properties and Finish	3.2.2	2024-T3 clad test panels 1/	ISO 3270	FTMS 141 Method 4331
3)	VOC, g/l	Equal to reference value. 2/	Paint components	Mixed, prepared for use.	ASTM D 3960 and Table 2
4)	Pot Life	4 hours, min, in accordance with 3.2.4	Paint components	Mixed, prepared for use.	
5)	Drying Time	Pigment coat: 8 hours, max 3/	2024-T3 clad test panels 1/	ISO 3270	
5.1)	Tack Free Time	Topcoats: 2 hours, max			ISO 1517
5.2)	Print Free Time	Primers: 2 hours, max Topcoats: 6 hours, max			ISO 3678 Use 1000 grams (2.2 lb) weight
5.3)	Through Dry Time	Topcoats: 24 hours, max			ISO 9117 Use 1500 grams (3.3 lb) needle weight
6)	Shelf Life	3.2.5	Paint components	In original containers	

1/ Surface preparation and paint system applied shall be in accordance with 5.2 and 5.2.4.

2/ VOC reference value is that agreed upon during qualification by purchaser and manufacturer. For recommended values, see 3.2.3.

3/ In a multi-coat paint system, the coat containing color pigment shall be capable of application over the undercoats which compose the system, and be surface dry within 8 hours.

3.2.1 Quality: Paint components taken from original or laboratory containers as received shall be free from extraneous matter and show no skinning, gelling, hard settlement or other objectionable properties which will prevent satisfactory application to produce a defect free film.

3.2.2 Application Properties and Finish: Paint film shall show an opaque even finish with good levelling, free from runs, sags, wrinkling, pinholing, streaking or other defects.

3.2.3 Volatile Organic Content: Maximum recommended VOC values for compliant coatings are as shown in Table 2:

TABLE 2 - Volatile Organic Content

Product Category	Type	VOC - g/l, max (excluding water)
Pretreatment primer	Wash primer	780
Primers, undercoats and fillers	2 (or 3) component polyurethane and epoxy	350
Intermediate coat	Selective strippable coat	780
Top coat	2 (or 3) component	420
Clear coat	2 (or 3) component	520

Note: VOC values quoted are taken from UK EPA Guidance Note for "Coating and Recoating of Aircraft and Aircraft Components" PG6/40(94).

3.2.4 Pot Life: Test panels shall be prepared from paint that has been held four hours after mixing components from their original containers. When tested, the dry film shall conform to the requirements of Table 3.

3.2.5 Shelf Life: After 24 months from date of manufacture, at 0 to 30 °C (32 to 86 °F), and, unless otherwise agreed upon by manufacturer and supplier, components in their original containers shall conform to the requirements of Table 3.

3.3 Tests on the Dry Film:

The dry film of the paint system on test panels shall conform to Table 3.

TABLE 3 - Properties of Dry Film

Property	Requirement	Test Panel and Paint System	Conditioning	Test Method
1) Gloss	90 units, min	2024-T3 clad test panels 1/	ISO 3270	ISO 2813 60° meter
2) Initial Color	ΔE^*_{ab} max compared to reference color type in 4.6.1	2024-T3 clad test panels 1/	ISO 3270	ISO 7724 5.3
3) Adhesion – Cross Hatch	Grade 0	2024-T3 clad test panels 1/	ISO 3270	ISO 2409 Tape: 3M 250 (not older than 6 months from date of manufacturing)
4) Impact (reverse)	92 cm-kg (80 inch-lb), min. No cracking or loss of adhesion.	2024-T3 clad test panels 1/	ISO 3270	ISO 6272
5) Flexibility – Conical Mandrel	12 mm (0.5 inch) from 3 mm (0.12 inch) diameter end, min. No peel, no damage, no cracking.	2024-T3 clad test panels 1/	ISO 3270	ISO 6860
6) Flexibility - Cylindrical Mandrel	100 mm (4 inches), min. No peel, no damage, no cracking.	2024-T3 clad test panels 1/	-55 °C ± 2 (-65 °F ± 4)	ISO 1519
7) Water		2024-T3 clad test panels 1/	ISO 2812-1, method 1 14 days at 23 °C ± 2 (73 °F ± 5)	
a) Blistering	D max. 2/S max. 1 (i.e. microblistering)			ISO 4628 1/2
b) Grade	1, max			ISO 2409
c) Penetration	No penetration to the substrate.			ISO 1518 Use 1200 g (2.6 lb) needle weight

TABLE 3 - Properties of Dry Film (Continued)

	Property	Requirement	Test Panel and Paint System	Conditioning	Test Method
8)	Fluid Resistance - Hydraulic fluid Skydrol LD4, Hyjet IV-A or equivalent	No blisters; minor defect within 1.5 mm (1/16 inch) of scribe allowable. No penetration to the substrate.	2024-T3 clad test panels 1/, scribed to metal substrate immediately before immersion 30 days at 23 °C ± 2 (73 °F ± 5)	ISO 2812-1, method 1;	ISO 1518 Use 1200 g (2.6 lb) needle weight
9)	Corrosion Resistance – Filiform	3 mm (1/8 inch) max creep from scribe	2024-T3 clad, and 2024-T3 unclad test panels 1/	EN 3665	EN 3665 1000 hours
10)	Corrosion Resistance – Salt spray	3 mm (1/8 inch) max creep from scribe	2024-T3 clad, and 2024-T3 unclad test panels 1/	ISO 7253	ISO 7253 3000 hours
11)	Artificial Weathering	Gloss retention: 80% min of initial value	2024-T3 clad test panels 1/	ISO 11507, 1000 hours, UVB 313, light 4 hours, humidity 4 hours	ISO 2813 60° meter
		Color retention: ΔE^*_{ab} 4 units max compared to initial value			ISO 7724
12)	Washability (Cleaning efficiency)	Gloss retention: 95% min of initial value	2024-T3 clad test panels 1/	Cleanability test in accordance with MIL-PRF-85285	ISO 2813 60° meter
13)	Strippability	95% removal min in 7 hours. In the case of selective removal, no permanent degradation of remaining coat.	2024-T3 clad test panels 1/, except panel size: approx. 300x300 mm (12 x 12 inches)	96 hours at 70 °C ± 2 (158 °F ± 5)	5.4
14)	Restoration	Shall conform to requirements of Table 3			5.5
15)	Heat stability	No peeling, cracking, or damage after bend test 180° around 25 mm (1 inch) mandrel; color change accepted	2024-T3 clad test panels 1/	100 hours at 150 °C ± 2 (302 °F ± 5)	ISO 1519, ISO 3270

1/ Surface preparation and paint system applied shall be in accordance with 5.2 and 5.2.4.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

Before shipment the manufacturer in order to ensure conformity to the composition and performance established during type approval, shall test a representative sample of each batch of the material, taken in accordance with ISO 1512.

NOTE: The Quality Assurance Authority may take samples of the material and its ingredients at any stage of manufacture or from any portion of the consignment for inspection.

4.2 Approval:

4.2.1 Qualification sample shall be approved by approving authority before use.

4.2.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production product which are essentially the same as those used on the approval sample. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample product. Production product made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.3 Reports:

The supplier of the product shall furnish with each shipment a certificate of conformity. This certificate shall include the purchase order number, lot number, AMS 3095, manufacturer's identification, and quantity.

4.4 Resampling and Retesting:

If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.

4.5 Rejections:

Coating compound not conforming to this specification, or to modifications authorized by the purchaser, will be subject to rejection.

5. TEST METHODS:

5.1 Standard Conditions:

All tests shall be carried out in conformance with the temperature and relative humidity specified in ISO 3270 unless otherwise specified.

5.2 Preparation of Test Specimens:

Test panels shall be prepared and coated as follows:

5.2.1 Use test panels made from unabraded aluminum sheet, measuring 150 x 100 mm (6 x 4 inch) and 0.8 mm (0.03 inch) thick unless otherwise specified, conforming to EN 2090 or AMS 4041 Aluminum alloy 2024-T3 clad, or EN 3997 or AMS 4037 Aluminum alloy 2024-T3 unclad as specified in Tables 1 and 3.

5.2.2 Detergent degrease the panels as follows: Remove protective oil or grease either by vapor degreasing or solvent washing according to ISO 1514. Lightly abrade with fine grade Scotchbrite or equivalent and rinse with solvent. Allow to dry.

5.2.3 Apply other pre-treatment if specified by the manufacturer of the coating system in accordance with the manufacturer's instructions.

5.2.4 Paint Application: Prepare and apply the coatings in accordance with the manufacturer's instructions. Allow to dry in a vertical attitude with free access of air for 7 days unless otherwise specified before testing.

5.3 Test Method for Measurement and Comparison of Color:

5.3.1 Prepare and apply panels in accordance with 5.2 and 5.2.4.

5.3.2 Measure X_{10}, Y_{10}, Z_{10} tristimulus values using a colorimeter according to ISO 7724/2 for the panel under test and the reference color standard

5.3.3 Calculate L*, a*, b* for both the panel under test and the reference color standard in accordance with ISO 7724/1. Note: Most colorimeters will automatically calculate such values.

5.3.4 Calculate ΔE^*_{ab} for the difference between the panel under test and the reference color standard in accordance with ISO 7724/3. Note: Most colorimeters will automatically calculate such values.

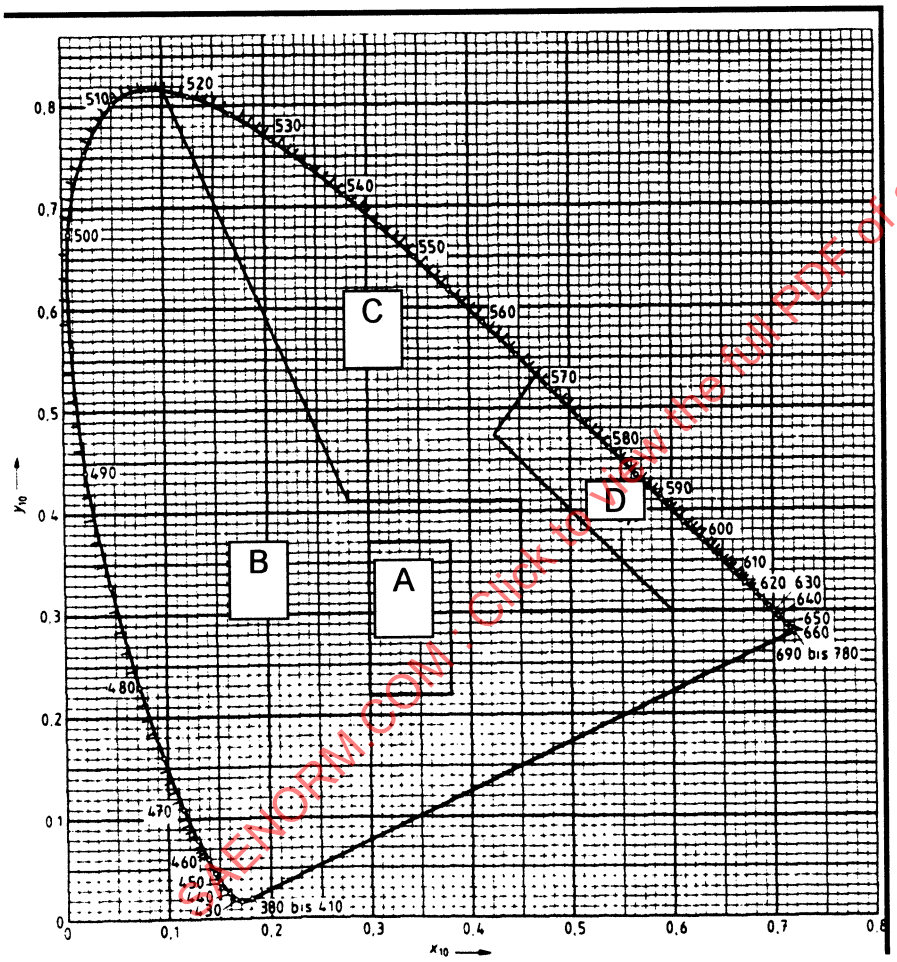
5.3.5 Calculate x_{10} and y_{10} for the panel under test, using Equation 1:

$$x_{10} = \frac{X_{10}}{X_{10} + Y_{10} + Z_{10}} \qquad \text{(Eq. 1)}$$

$$y_{10} = \frac{Y_{10}}{X_{10} + Y_{10} + Z_{10}}$$

5.3.6 Plot x_{10} and y_{10} on the graph in Figure 1 and determine for which area the color corresponds.

5.3.7 Select the corresponding ΔE appropriate to the color under test and use in accordance with the requirements in the table below:



Area on Graph	Color Area	Allowable ΔE^*_{ab} for Aerospace
A	Whites and off whites	0.45
B	Greens, blues and purples	0.75
C	Yellows	1.05
D	Reds	1.35

NOTE: Further explanation of the derivation of allowable ΔE^*_{ab} for aerospace is given in 8.2.

FIGURE 1 - CIE Chromaticity Diagram - Color Difference Tolerances