BS EN 4594:2013

BSI Standards Publication

Aerospace series — Paints and varnishes — Two component cold curing polyurethane finish — Supersonic erosion resistance

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Luft- und Raumfahrt - Beschichtungsstoffe - Zweikomponenten-Polyurethan-Decklack, raumtemperaturhärtend - Überschall-Erosionsbeständigkeit

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Contents

Foreword

This document (EN 4594:2013) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2013 and conflicting national standards shall be withdrawn at the latest by July 2013.

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Introduction

This standard has been prepared in accordance with AECMA TR 7000-9.

1 Scope

This standard specifies the requirements for a two component polyurethane, topcoat, with a medium degree of resistance to erosion by the effects of rain, available in a range of colours and levels of gloss, to be applied over a primer for aerospace applications on areas where rain erosion at supersonic speeds may be a problem e.g. leading edges and air intakes.

The properties specified in this standard are obtained on defined aluminium alloy test pieces prepared in accordance with EN 3837 Procedure A and EN 23270 and painted with primer to EN 2435. The ability of the material to be used for a specific application (e.g. alternative substrate, alternative primer, specific drying conditions etc.) shall be determined by supplementary tests to confirm that the requirements of this standard are met.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2334, *Aerospace series — Chromic-sulphuric acid pickle of aluminium and aluminium alloys*

EN 2379, *Aerospace series — Fluids for assessment of non-metallic materials*[1)]

EN 2435, *Aerospace series — Paints and varnishes — Corrosion resistant chromated two component cold curing primer*

EN 3837 (all parts), *Aerospace series — Paints and varnishes — Nature and method for surface preparation of test pieces in aluminium alloys*[1)]

EN 3840, *Aerospace series — Paints and varnishes — Technical specification*

EN 23270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

EN ISO 1513, *Paints and varnishes — Examination and preparation of test samples for testing (ISO 1513)*

EN ISO 2431, *Paints and varnishes — Determination of flow time by use of flow cups (ISO 2431)*

EN ISO 2811 (all parts), *Paints and varnishes — Determination of density (ISO 2811)*

EN ISO 2812-1, *Paints and varnishes — Determination of resistance to liquids — Part 1: Immersion in liquids other than water (ISO 2812-1)*

1) Published as AECMA Prestandard at the date of publication of this standard.

EN ISO 2813, *Paints and varnishes — Determination of specular gloss of non-metallic paint films at 20°, 60° und 85°(ISO 2813)*

EN ISO 2884-1, *Paints and varnishes - Determination of viscosity using rotary viscometers - Part 1: Cone-and-plate viscometer operated at a high rate of shear (ISO 2884-1)*

EN ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content (ISO 3251)*

EN ISO 3675, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method (ISO 3675)*

EN ISO 3679, *Determination of flash point — Rapid equilibrium closed cup method (ISO 3679)*

EN ISO 3680, *Determination of flash/no flash — Rapid equilibrium closed cup method (ISO 3680)*

EN ISO *9117-1, Paints and varnishes — Drying tests — Part 1: Determination of through-dry state and through-dry time (ISO 9117-1)*

EN ISO 9514, *Paints and varnishes — Determination of the pot life of multicomponent coating systems — Preparation and conditioning of samples and guidelines for testing (ISO 9514)*

EN ISO 11890-1, Paints and varnishes — *Determination of volatile organic compound (VOC) content — Part 1: Difference method (ISO 11890-1)*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 2781, *Rubber, vulcanized or thermoplastics — Determination of density*

ISO 7724 (all parts), *Paints and varnishes — Colorimetry*

3 Terms and definitions

Not applicable

4 Classification

Not applicable

5 Batch release and qualification testing

5.1 Batch release testing

For batch acceptance the tests marked with an * shall be performed.

5.2 Qualification tests

For product qualification, all tests mentioned in this standard, in the tables 1 to 4, shall be performed.

Table 1 — General requirements

Characteristic number	Characteristic	Requirements			
1.001	Material description	Two component cold curing polyurethane coating with high resistance to erosion by rain			
1.002	Formulation	Base — a base containing an hydroxyl functional resin, solvents and pigments to give the required colour and gloss and other ingredients to give rain erosion resistance Activator — a polyisocyanate activator solution Thinner — if required			
1.003	Preparation	These components shall be mixed in simple whole number proportions, by volume or by weight, in accordance with the manufacturer's instructions			
1.004	Technical specification	See EN 3840			
1.007	Visual colour	See EN 3840			
1.008	Freedom from defects	See EN ISO 1513			
1.009	Application and use	Dry film thickness of (250 ± 50) µm			
1.010	Storage stability	See EN 3840			
1.011	Shelf life	See EN 3840			
1.013	Drying conditions	EN 23270 for 7 days before testing unless otherwise specified			
1.093	Quality assurance	See EN 3840			
1.094	Designation	Polyurethane Finish Rain Erosion Resistant Coating EN 4594			
1.095	Packaging	See EN 3840			
1.096	Marking	See EN 3840			
1.097	Flash point	EN 3840			
		Test 7 EN ISO 3679 or EN ISO 3680			
			base	Activator[f]	Thinner[f]
		°C	≥ reference value[c]	≥ reference value[c]	≥ reference value[c]
1.098	Health and safety	See EN 3840			
1.999	Notes	[f] Test only if component is present. [c] The reference value is that established during qualification.			

Table 2 — Physical and chemical characteristics

Characteristic number	Characteristic	Requirements			
2.008	Condition	1	EN ISO 1513		
		6	As received in original container		
	*	7	Shall be free from extraneous matter and show no skinning, gelling, hard settlement or other defect which will prevent satisfactory application to produce a defect free film		
2.009	Application properties and finish	1	None		
		3	EN 3837 — A_2	2024-T3 clad	
		4	EN 3837 — Process A	EN 2334 Pickle	
		5	EN 2435 primer + finish to this standard		
	*	7	Liquid paint shall result in an opaque even finish, free from runs, sags, wrinkling, pinholing or other defect		
2.106	Reactivity Pot life	–	EN 3840		
		1	Test 20 EN ISO 9514 followed by Test 8[a] EN ISO 2431 or Test 9[a] EN ISO 2884-1		
		6	base + activator + thinner		
	*	7	s or Pa s	≤ 2 × initial value after 30 min	
2.107	Viscosity	–	EN 3840		
		1	Test 8 EN ISO 2431[a] or Test 9 EN ISO 2884-1[a]		
		6	base + activator + thinner		
		7	s or Pa s	± 10 % [b c]	
2.104	Composition — Non volatile matter	–	EN 3840		
		1	Test 1 EN ISO 3251		
		7		base	activator
		–	%	± 2[b, c]	± 2[b, c]
2.104	Composition — Volatile organic compound (VOC) content	–	EN 3840		
		1	Test 49 EN ISO 11890-1		
		6	base + activator + thinner		
		7	g/l	≤ reference value[b, c]	
2.301	Density	–	EN 3840		
		1	Test 3 EN ISO 2811		
		6	Base		
	*	7	of ref. value	± 2 [b, c]	
2.301	Density	–	EN 3840		
		1	Test 4 EN ISO 3675		
		6	Activator + thinner		
	*	7		activator	thinner
		–	of ref. value	± 2[b, c]	± 2[b, c]

Table 2 (*continued*)

Characteristic number	Characteristic	Requirements		
2.106	Reactivity — Through-dry time	–	EN 3840	
		1	Test 23 EN ISO 9117-1 mass = 1 500 g	
		3	EN 3837 — A_2	2024-T3 clad
		4	EN 3837 Process A	EN 2334 Pickle
		5	EN 2435 primer + finish to this standard	
		6	EN 23270	
		7	h	≤ 16
2.999	Notes	[a] Test 8 shall be used for non-thixotropic paints and test 9 for thixotropic paints. [b] The deviation is that compared to the reference value. [c] The reference value is that established during qualification.		

Table 3 — Mechanical characteristics

Characteristic number	Characteristic	Requirements		
3.111	Optical properties colour	–	EN 3840	
		1	Test 30 ISO 7724	
		3	EN 3837 — A_2	2024-T3 clad
		4	EN 3837 Process A	EN 2334 Pickle
		5	EN 2435 primer + finish to this standard	
		6	EN 23270	
	*	7	ΔE	shall match the colour specified
3.111	Optical properties gloss 60°	–	EN 3840	
		1	Test 27 EN ISO 2813	
		3	EN 3837 — A_2	2024-T3 clad
		4	EN 3837 Process A	EN 2334 Pickle
		5	EN 2435 primer + finish to this standard	
		6	EN 23270	
	*	7	Gloss units	shall match the gloss specified

Table 4 — Environmental characteristics

Characteristic number	Characteristic	Requirements		
4.306	Ultimate tensile elongation	1	ISO 37	
		3	PTFE sheet or similar material	
		4	Finish only applied	
		5	Free film of finish, allowed to condition for a further 8 h after removal from substrate	
		6	EN 23270	
	*	7	%	≥ 400
4.110	Density of dried film	1	ISO 2781	
		3	PTFE sheet or similar material	
		4	Finish only applied	
		5	Free film of finish, allowed to condition for a further 8 h after removal from substrate	
		6	EN 23270	
	*	7	g/ml	≤ 1,3
4.501	Resistance to fluids	–	EN 3840	
		1	Test 35 EN ISO 2812-1	
		3	EN 3837 — A_2	2024-T3 clad
		4	EN 3837 Process A	EN 2334 Pickle
		5	EN 2435 primer + finish to this standard, panel cut to substrate with a knife immediately before testing	
		6	Tri-n-butyl phosphate for 100 h at 70 °C	
	*	7	No blistering, softening, lifting or other film defect	
4.320	Rain erosion resistance	1	Whirling arm test rig [a]	
		3	EN 3837 — A_2	2024-T3 clad
		4	EN 3837 Process A	EN 2334 Pickle
		5	EN 2435 primer + finish to this standard	
		6	EN 23270	
	*	7	< 50 g/m^2 erosion; no pitting of the film after 4 × 15 min runs	
999	Notes	[a] Velocity 223 m/s, artificial rain 25 mm/h, impact angle 90°, drop diameter 2 mm.		

6 Designation

EXAMPLE

Description block	Identity block
POLYURETHANE FINISH RAIN EROSION RESISTANT COATING	**EN 4594**

Number of this standard

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