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COMMONWEALTH OF AUSTRALIA

AUSTRALIAN DEFENCE STANDARD

DEF (AUST) 9001A

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DEF (AUST) 9001
Dated 23 JUL 08

ADF AIRCRAFT EPOXY/POLYURETHANE PAINT COATING SYSTEM

SPECIFICATION

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DOCUMENT MANAGEMENT INFORMATION

This page lists the ownership and area responsible for providing final technical approval for the standard or specification. It also lists the implementation document(s) that call up the standard or specification and identified all specifications and standards referenced in this document. The information below will need to be reviewed for currency and applicability at the 5 year review cycle as stated in the Defence Standardisation Manual (STANMAN).

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Implementation Document(s):

| Document Number | Title |
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| AAP 7021.004-1 | Aircraft Finishing Schemes, Materials and Processes |

Referenced Document(s):

| Document Number | Title |
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| ASTM B 117 | Standard Test Method for Salt Spray (Fog) Testing. |
| ASTM D 185 | Standard Test Method for Coarse Particles in Pigments, Pastes, and Paints. |
| ASTM D 522 | Standard Test Method for Mandrel Bend Test of Attached Organic coatings. |
| ASTM D 523 | Standard Test Method for Specular Gloss. |
| ASTM D 870 | Standard Practice for Testing Water Resistance of Coatings Using Water Immersion. |
| ASTM D 1200 | Standard Test Method for Viscosity by Ford Viscosity Cup. |
| ASTM D 1210 | Standard Test Method for Fineness of Dispersion of Pigment-Vehicle systems. |
| ASTM D 1364 | Standard Test Method for Water in Volatile Solvents. |
| ASTM D 1640 | Standard Test Method for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature. |
| ASTM D 2244 | Standard Test Method for Calculation of Colour Differences from Instrumentally Measured Colour coordinates. |
| ASTM D 2247 | Standard Test Method for Testing Water Resistance of Coatings in 100% Relative Humidity. |
| ASTM D 3359 | Standard Test Methods for Measuring Adhesion by Tape Test |

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| ASTM D 3432 (1996) | Standard Test Method for Unreacted Toluene Di-isocyanates in Urethane Prepolymers. |
| ASTM D 3924 | Standard Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials |
| ASTM D 3960 | Standard Test Method for Determining Volatile organic Content of Paints and Related coatings. |
| ASTM D 5402 | Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs. |
| ASTM D 6905 | Standard Test Method for Impact Flexibility of Organic Coatings. |
| ASTM G 155 | Standard Practice of Operating Xenon Arc Light Apparatus for Exposure of Non-metallic Materials. |
| Federal Standard 141 Test Method No. 6241.2 | Paint, Varnish, Lacquer and Related Materials; Method of Inspection, Sampling and Testing. |
| Federal Standard No. 595 B | Colours used in government procurement. |
| MIL-C-5541 | Chemical Conversion Coatings on Aluminium and Aluminium Alloys. |
| MIL-PRF-5606 | Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance. |
| MIL-PRF-23377 | Primer Coating, Epoxy. |
| MIL-PRF-23699 | Lubricating Oil, Aircraft Turbine Engines. |
| MIL-PRF-83282 | Hydraulic Fluid, Fire Resistant Synthetic, Hydrocarbon Base. |
| MIL-PRF-85285 | Coating, Polyurethane, High Solids. |
| MIL-R-81294 | Remover Paint, Epoxy, Polysulphide and Polyurethane Systems. |
| AS 1580 | Methods of Tests for Paints, Varnishes, Lacquers and Related Materials. |
| AS 2700 | Selection, Use and Maintenance of Respiratory Protective Devices. |
| ISO 2808 | Paint and Varnishes – Determination of Film Thickness. |
| ISO 4623 | Colour Standards for General Purposes. |
| ISO 4623-2 | Paint and Varnishes – Determination of resistance to Filiform Corrosion. |
| | Aluminium Alloy, Plate and Sheet. |
| SUSDP Schedule No 23 | Standard for the Uniform Scheduling of Drugs and poisons No. 2318 – Appendix I. |
| DEF(AUST) 9013 | Acceptance and Rejection Criteria, for Primers, Coatings and Allied Products for Surface Finishing Systems for use on Aircraft and Components |

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Revision Note

This document supersedes DEF(AUST)9001 Dated 23 JUL 08

Historical Record

DEF(AUST) 9001 (original issue) Dated 23 JUL 08

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ANNEXES

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**ADF AIRCRAFT EPOXY/POLYURETHANE PAINT COATING
SYSTEM**

SPECIFICATION

Specific inquiries regarding the application of this Standard to Requests for Tender or contracts should be addressed to the Ordering Authority named in the Request for Tender, or to the Quality Assurance Authority named in the contract, as appropriate.

WARNING

This specification may call for the use of substances and test procedures that may be injurious to health if adequate precautions are not taken. It refers to technical suitability only and in no way absolves the supplier or user from statutory obligations relating to health and safety at any stage of manufacture or use.

1. INTRODUCTION

- 1.1** This specification is approved for use within the Australian Defence Organisation (ADO) and is available for use by all departments, agencies and contractors of the ADO.
- 1.2** This specification supersedes DEF(AUST) 9001 (original issue) 23 JUL 08.
- 1.3** This specification meets or exceeds the requirements of the following specifications:
- (a) Performance Specification MIL-PRF-85285, *Coating, Polyurethane, Aircraft and Support Equipment.*
 - (b) Performance Specification MIL-PRF-23377, *Primer Coatings, Epoxy, High-Solids.*

2. SCOPE

- 2.1** This specification covers the requirements of a paint coating system whereby the primer and topcoat are manufactured by the one manufacturer as a system to ensure maximum compatibility for the protection of ADF aircraft from corrosion. The paint system covered by this specification consists of:
- (a) an epoxy primer coating which is corrosion inhibiting and chemical and solvent resistant, and
 - (b) a polyurethane finishing paint coating which is flexible and durable.

3. PRECEDENCE

- 3.1** In the event of a conflict between the requirements of this specification, and the references cited herein, the requirements of this specification take precedence. Nothing in this specification overrides applicable laws and regulations, unless a specific exemption has been obtained.

4. DEFINITIONS

- 4.1 Quality Assurance** - Quality Assurance is all those planned and systematic actions necessary to provide confidence that goods and services will satisfy the contracted requirements for quality.
- 4.2 Procurement Authority** – For the purposes of this document, Procurement Authority (also referred to as the Sponsor for the purposes of this instruction) is an organisation which initiates a procurement requirement on behalf of end users. The Procurement Authority would normally be the manager of an item of supply (Item Manager).
- 4.3 Certificate of Conformance.** Certificates of Conformance are formal certification that the goods supplied are authentic, their origin traceable, that they meet the specification and conditions contained in the original order, and that this is certified by a responsible member of the supplier's quality control organisation.
- 4.4** All other terminology used in this specification is in accordance with the definitions contained in the Handbook of Australian Paint Standards Part 1.

5. ACRONYMS

- 5.1 DGTA** – Directorate General Technical Airworthiness.
- 5.2 ADF** – Australian Defence Force.
- 5.3 MSDS** - Material Safety Data Sheets.
- 5.4 VOC** - Volatile Organic Compound.

6. TOXICITY

- 6.1** Paint and primer formulations complying to this DEF(AUST) specification shall meet the toxicity requirements listed in Appendix I of Standard for the Uniform Scheduling of Drugs and Poisons published by the Australian Commonwealth Department of Health and Ageing.
- 6.2** The manufacturer shall certify that the materials will not have an adverse effect on the health of personnel when it is used for its intended purpose and under the precautions specified in the MSDS..

7. CLASSIFICATION

7.1 Primer

7.1.1 The primer coating will be of the following types and classes, as specified:

7.1.1.1 **Classes.** The primer will be available in two VOC classes:

- (a) CLASS I - Conventional primer having a VOC > 340 g/l.
- (b) CLASS II - Low VOC primer having a VOC < 340 g/l.

7.1.1.2 **Types.** The primer will be available in two types:

- (a) TYPE I - Standard.
- (b) TYPE II - Low infrared reflectance.

7.2 Polyurethane Finishing Paint

7.2.1 The Polyurethane Finishing Paint coating will be of the following types and classes as specified:

7.2.1.1 **Classes.** The Polyurethane Finishing Paint will be available in two VOC classes:

- (a) CLASS I - Conventional paint having a VOC > 420 g/l.
- (b) CLASS II - Low VOC paint having a VOC < 420 g/l.

7.2.1.2 **Types.** The Polyurethane Finishing Paint will be available in three types according to their infra-red (IR) values as specified in Annex B:

- (a) TYPE I - Standard.
- (b) TYPE II - Low infrared reflectance (IRR).
- (c) TYPE III - High near infrared reflectance (NIRR).

8. PRIMER COATING REQUIREMENTS

8.1 Description

8.1.1 The primer coating shall be a cold curing, two component epoxy coating providing good flexibility with corrosion inhibiting and chemical and solvent resistant properties. The primer coating shall provide excellent adhesion to bare and pre-treated aircraft metal surfaces and to the polyurethane finishing coat system of this specification.

8.2 Colour

8.2.1 The primer coating shall be made available in the following colours:

- (a) TYPE I - The natural colour of the corrosion inhibiting pigments used.
- (b) TYPE II - The colour of the low infrared reflecting pigments.

8.3 Composition

8.3.1 Primer coatings shall consist of the following two parts:

- (a) Part A - Base component with solvent.
- (b) Part B - Cold curing agent.

8.3.2 Part A and B components shall be packaged separately and furnished in kit form. Kits shall be in the volumes of the defined mixing ratio as per manufacturer recommendations.

8.4 Infra-Red Reflectance (IRR)

8.4.1 The primer coating shall have an infra-red reflectance (IRR) limit as specified in Annex A when measured in accordance with Federal Standard 141 method 6241.2.

8.5 Physical and Functional Properties

8.5.1 All primers shall meet the physical and functional properties as specified in Annex A.

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9. POLYURETHANE FINISHING PAINT REQUIREMENTS**9.1 Description**

9.1.1 The finishing paint shall be a cold curing, two component polyurethane coating, providing good adhesion and flexibility when applied over the primer coating and tested in accordance with Annex B of this specification.

9.2 Colour

9.2.1 The polyurethane finishing paint shall be made available in a colour and gloss range that meets FS 595 B, BS 381 C and AS 2700 and the colour requirement of Annex B. The most frequently used colours are listed in the following table:

| Colour | Standard used to Define Colour | Gloss Level |
|---------------|---------------------------------------|--------------------|
| Ghost Grey | FS595B # 36375 | |
| Blue Grey | FS595B #35237 | |
| Dark Grey | FS595B # 36118 | Matt |
| Grey | FS595B # 36231 | Matt |
| Grey | FS595B # 26320 | Semi-gloss |
| Black | FS595B # 37038 | Matt |
| Black | FS595B # 17038 | Gloss |
| Dark Green | FS595B # 34079 | Matt |
| Light Green | FS595B # 34102 | Matt |
| Light Green | FS595B # 34159 | |
| Green (Grass) | FS595B # 14187 | Gloss |
| Blue | FS595B # 15045 | |
| Red | FS595B # 11136 | |
| Tan | FS595B # 30219 | Matt |
| Tan | FS595B # 34021 | |
| White | FS595B # 17875 | |
| Yellow | FS595B # 13538 | |
| Yellow | BS381C # 356 | |
| Oxford Blue | BS381C # 105 | |
| Azure Blue | BS381C # 104 | |
| Silver | FS595B # 17178 | |
| Yellow/Tan | FS595B # 23620 | Semi-gloss |
| Light Grey | FS595B # 26495 | Semi-gloss |
| Grey | FS595B # 25237 | Semi-gloss |

FS595B = US Federal Standard 595B colour standard

BS381C = British Standard 381C

9.3 Composition

9.3.1 The polyurethane finishing paint shall consist of a two-component system as follows:

- (a) Part A - Polyester base resin with solvent.
- (b) Part B - Aliphatic isocyanate prepolymer cold curing agent.

9.4 Gloss

9.4.1 The spectral gloss of the polyurethane finishing coating shall meet the respective requirements of Annex B when tested in accordance with ASTM D523 or AS 1580.602.2

9.5 Infra-Red Reflectance (IRR)

9.5.1 The polyurethane finishing paint shall have an infra-red reflectance (IRR) limit as specified in Annex B when measured in accordance with Federal Standard 141 method 6241.2.

9.6 Physical and Functional Properties

9.6.1 The polyurethane finishing paint shall meet the physical and functional properties as specified in Annex B.

10. TEST PANEL SAMPLES

10.1 Test Panels

10.1.1 Unless specified in quoted test methods, all test panels shall be 76 X 152 mm (or 3 X 6 inch). Test panels for the assessments listed in this DEF(AUST), where required, shall be made of:

- (a) Aluminium alloy unclad 2024-0 with a thickness of 0.5 mm for the bend test and impact flexibility test; and
- (b) Aluminium alloy clad 2024-T3 with a thickness of 1.2 mm for all other tests.

10.1.2 Test panels shall be pre-treated in accordance with MIL-C-5541 Class 1A Chemical Conversion Coating.

10.1.3 Environmental conditions for preparing test panel shall be in accordance with ASTM D 3924.

10.2 Primer Test Samples

10.2.1 The primer coating shall be prepared and applied to the test panel in the following sequence:

- (a) Thoroughly stir each component separately.
- (b) Mix the components of the primer in accordance with the manufacturer's instructions.
- (c) Dilute admixed primer with the recommended thinner as required.
- (d) Allow the admixed primer to stand prior to application, as per manufacturer's recommendations.
- (e) Apply the primer by conventional air spray to achieve a dry film thickness of $20 \pm 5 \mu\text{m}$.

10.2.2 Unless otherwise stated, the applied primer coating shall be allowed to age for a minimum of 14 days and a maximum of 28 days prior to testing.

10.3 Polyurethane Finishing Paint Test Samples

- 10.3.1 Prepare test panels in accordance with paragraphs 10.1-10.2 and air dry primer coated test panel for not less than 2 hrs and not more than 24 hrs. Environmental conditions for test panel shall be in accordance with ASTM D 3924.
- 10.3.2 Polyurethane finishing paint shall be prepared and applied to the test panels by:
- (a) Thoroughly stirring each component separately;
 - (b) Mix both the components of the polyurethane paint in accordance with the manufacturer's instructions;
 - (c) If required, dilute admixed paint with the recommended thinner;
 - (d) Allow the admixed paint to stand prior to application, as per manufacturer's recommendations, and
 - (e) Applying the paint by conventional air spray to achieve a dry film thickness of $50 \pm 10 \mu\text{m}$.
- 10.3.3 Unless otherwise stated, the applied coating shall be allowed to age for a minimum of 14 days and a maximum of 28 days prior to testing.

10.4 Compatibility

- 10.4.1 Primer and polyurethane finishing paint types and classes shall have the following compatibility:
- (a) The TYPE I finish paint can be used with either TYPE I or II primers.
 - (b) The TYPE II finish paint must be used with TYPE II primer.
 - (c) The TYPE III finish paint must be used with the TYPE I primer.
 - (d) CLASS I primer must be used with CLASS I finishing paint.
 - (e) CLASS II primer must be used with CLASS II finishing paint.

11. USEABLE SHELF LIFE

- 11.1 Products supplied against this specification shall comply with the useable shelf life requirement defined in DEF(AUST) 9013 Acceptance and Rejection Criteria.

12. CONFORMANCE

12.1 Requalification

- 12.1.1 The paint products supplied against this DEF(AUST) shall be identical, within manufacturing tolerances, to the product certified by the manufacturer. Where there has been a change to the formulation of the paint product, the new product shall be requalified against this DEF(AUST).

12.2 Quality system of Manufacturer

- 12.2.1 The manufacturer of the paint products certified under this DEF(AUST) shall have an accreditation to ISO 9001 covering the design, manufacture and testing of epoxy and polyurethane paints, and if requested shall provide documented evidence of laboratory tests proving product conformance with the requirements of this DEF(AUST).

12.3 Certificate of Conformance

- 12.3.1 The supplier shall provide a certificate of conformance for all products supplied against this specification.

- 12.3.2 The Certificate of Conformance shall certify that the products have been tested and conform to the requirements of this specification, and as a minimum shall contain the following information:
- (a) Purchase/contract order number,
 - (b) Invoice number and date of dispatch,
 - (c) Batch number,
 - (d) Product number,
 - (e) Date of manufacture,
 - (f) Product expiry date, and
 - (g) Description of product.
- 12.3.3 If required by the procurement authority, the supplier of products manufactured to this specification shall provide documented laboratory evidence conducted by an independent testing laboratory of conformance to all requirements of this specification.

12.4 Waivers

- 12.4.1 Where a product varies from the specification requirements, a waiver may be considered by the procurement authority in accordance with the following procedures:
- (a) The Supplier shall supply the procurement authority with testing results conducted by an independent laboratory of the supplier/manufacturers choosing, that is accredited to perform tests required by this specification for the tests requiring a waiver.
 - (b) The procurement authority may forward the testing results to the sponsors of this specification for guidance and recommendations in interpreting the test results.

13. RESPONSIBILITY FOR COMPLIANCE

- 13.1 All items shall meet all requirements of paragraphs 8, 9, 10 and 11 of this Specification. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the specification. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorise submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

14. PREPARATION FOR DELIVERY

14.1 Packaging

- 14.1.1 Packaging shall comply with the provisions of DEF(AUST) 1000 *ADF Packaging*.
- 14.1.2 As well as the manufacturer's standard labelling for the product, the following information shall be clearly stated on the product container:
- (a) Conformance to this specification,
 - (b) Type of coating,
 - (c) Class,
 - (d) Type,
 - (e) Colour name and number,

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- (f) Gloss level,
- (g) DOM (Date of Manufacture),
- (h) Shelf Life, and
- (i) Batch Number.

**TEST METHODS AND REQUIREMENTS OF PHYSICAL AND FUNCTIONAL
PROPERTIES FOR CLASS I AND CLASS II PRIMER COATINGS**

The following tests shall apply to both classes of primer coatings. Where there is a variance required for a particular test between classes, the requirement is restated with the variance.

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 and 10.2 | REQUIREMENTS |
|--|---|---|
| Condition in Container | The components, after standing without agitation for a minimum of 14 days at ambient temperature, shall be mixed by hand by vigorous stirring. | Within 5 minutes of stirring, primer shall be smooth, homogeneous and pourable. The material shall be free of grit, seeds, lumps, abnormal thickening or livering and shall not exhibit pigment floatation or excessive settling. In addition, the containers shall exhibit no deformation due to internal pressure. |
| Degree of Dispersion (Fineness of Grind) | ASTM D 1210 or AS 1580.204.1. | Degree of dispersion (fineness of grind) of the admixed primer shall be minimum of 5 on the Hegman scale. |
| Storage Stability | The primer shall be stored in a sealed container in an environment where the ambient temperature is maintained at 0 - 45° C for a minimum of 12 months. | After 12 months the primer shall still meet all requirements of this specification). |
| Odour | ASTM D 1296 - 01 | There shall be no residual odour after 48 hours air drying. |
| Volatile Organic Compound (VOC) | ASTM D 3960. | The maximum VOC content at application shall meet the requirement of para 7.1.1.1 of this DEF(AUST). |
| Mixing and Dilution | Thoroughly mix each component of the primer separately. Slowly pour the primer components together while stirring, until the manufacturer's specified mixing ratio is achieved. If necessary, dilute the admixed primer with recommended thinner, ensuring that maximum VOC limit is not exceeded. Stir and allow a dwell time of 30 minutes. | When admixed in the volume mixing ratio specified by the manufacturer, all components of the primer coating, including any required thinner, shall blend homogeneously and shall not separate into distinct layers within one hour of mixing. |
| Viscosity | ASTM D1200 or AS 1580.214.2. | Immediately after mixing the primer components, the maximum viscosity of the primer paint measured with a #4 Ford Cup shall be 30 seconds (for both Class I and Class II primers). |
| Pot Life | ASTM D1200 or AS 1580.214.2. | Viscosity of admixed primer after 4 hours at room temperature shall be a maximum of 40 seconds when measured with a #4 Ford Cup. |
| Application and Surface Appearance | Application of primer shall be by airless, conventional air, air assisted airless, electrostatic or high volume, low pressure (HVLP) spray equipment. | The admixed primer shall be capable of application by all spray equipment and shall produce a smooth, uniform film with no runs or sags at a dry film thickness of 15 to 25 µm. |
| Drying Time | ASTM D1640 or AS 1580.401.1 & 401.6. | <u>Class I:</u> The primer coatings shall be dry to coat in 2 hours and shall remain recoatable for up to 48 hours when tested in accordance with ASTM D1640 or AS 1580.401 and 401.6 <u>Class II:</u> The primer coatings shall be dry to coat in 3 hours and shall remain recoatable for up to 72 hours when tested in accordance with ASTM D1640 or AS 1580.401 and 401.6 |

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 and 10.2 | REQUIREMENTS |
|--------------------------------------|--|---|
| Adhesion | Test panels shall be immersed in distilled water for not less than 24 hours at room temperature. After the test panels are removed from the distilled water and dried with absorbent paper the panels must be tested in accordance with AS 1580.408.4 or ASTM D 3359. This test must be carried out within 3 minutes of the test panels being removed from the distilled water. | The primer coating shall have a classification of no more than 2 when tested in accordance with AS 1580.408.4, or 3B when tested in accordance with ASTM D 3359. |
| Flexibility | Test according to ASTM D 6905 with primer applied to ANODISED 0.5 mm 2024-0 unclad aluminium alloy test panels. Testing is to be conducted after 14 days cure time. | The primer coating shall not exhibit any cracking or flaking when examined under 10x magnification at the 20 % elongation site. |
| Strippability | Age test panel for 4 days at 100° C. Place on rack so that the coated side is 60° to the horizontal. Pour Turco T5351 Methylene Chloride paint remover (MIL-R-81294D) over top edge of panel so that all of the primer coating is covered. After standing for 60 minutes the loosened coating shall be brushed off with a stiff bristle brush while rinsing under a stream of cool water. ¹ | A minimum of 90 % of the primer coating shall be stripped. |
| Infra Red Reflectance (Type II only) | Spectrophotometric Method in accordance with Federal Standard 141.6241.2 | In accordance with paragraph 7.4, Type II primer coatings shall have a maximum total reflectance (specular plus diffuse) of <10 % throughout the range of 700 to 2,600 nanometers (nm). |
| Water Resistance | ASTM D 870 | After immersing in distilled water at 50 ±3° C for 7 days, the primer coating shall not exhibit any softening, wrinkling, blistering or other defect. |
| Solvent Resistance | Test according to ASTM D 5402 using MEK as the solvent and employing 50 double rubs. | The primer coating shall withstand 50 double rubbing passes without rubbing through to the substrate. |
| Fluid Resistance | Two separate panels shall have half their length immersed in the following fluids for 24hrs: a) Lubricating oil conforming to MIL-PRF 23699, maintained at 120 ±3° C b) Hydraulic fluid conforming to MIL-PRF-83282, maintained at 65 ±3° C | The primer coating shall not exhibit any softening, blistering, or loss of adhesion after immersion. Adhesion is measured using the cross hatch method (AS 1580.408.4) and the immersed primer shall have a rating of no more than 2. |
| Filiform Corrosion | ISO 4623-2 | After testing for 1000 hours the primer coating shall not exhibit filiform corrosion filaments extending beyond 6 mm from the scribe mark, and the majority of the filaments shall be less than 3 mm in length. |

¹ MIL-R-81294 has been cancelled, however the ADF currently use Turco T5351 Methylene Chloride paint remover which is manufactured to this specification and is approved in AAP 7021.004-1 and USAF Technical Order (TO) 1-1-8.

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 and 10.2 | REQUIREMENTS |
|----------------------|---|---|
| Corrosion Resistance | ASTM B117 | The primer coating shall not exhibit any corrosion, blistering or lifting of the coating from the substrate or substrate corrosion after exposure to salt spray for 2000 hours. |
| Thickness | AS 1580.108.1 or ISO 2808 | The primer coating shall be able to produce a dry film thickness of $20 \pm 5 \mu\text{m}$ in a single application. |

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TEST METHODS AND REQUIREMENTS OF PHYSICAL AND FUNCTIONAL PROPERTIES FOR
POLYURETHANE FINISHING PAINT SYSTEM

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 - 10.3 | REQUIREMENTS |
|--|---|---|
| Condition in Containers | The components, after standing without agitation for a minimum of 14 days at ambient temperature shall be mixed by hand by vigorous stirring. | Within 5 minutes of stirring, the base component shall be smooth, homogeneous and pourable. The material shall be free of grit, seeds, lumps, abnormal thickening or livering and shall not exhibit pigment floatation or excessive settling. Other components shall be homogenous, clear, and free from gelation or particulate matter. In addition, the containers shall exhibit no deformation due to internal pressure. |
| Degree of Dispersion (Fineness of Grind) | ASTM D 1210 or AS 1580.204.1. | Degree of dispersion of the admixed paint shall be a minimum of 7 for gloss colours and 5 for matt and camouflage colours on the Hegman scale. |
| Coarse Particles | ASTM D 185 | Coarse particles shall be no more than 0.5 % by weight when retained by a No. 325 sieve. |
| Storage Stability | The finishing paint components shall be stored in a sealed container in an environment where the ambient temperature is maintained at 0 - 45° C for a minimum of 12 months. | After 12 months the finishing paint shall still meet all requirements of this specification. |
| Accelerated Storage | The curing component shall be stored in a sealed container at 57° C ± 3° C for 24 hours and then cooled to room temperature. | The can shall not exhibit excessive pressure build-up or distortion. The material shall exhibit no trace of gelation or particulate matter either suspended or settled. |
| Odour | ASTM D 1296 - 01 | There shall be no residual odour after 48 hours air drying. |
| Moisture Content | ASTM D 1364 or AS 1580.503.1. | The Base component shall contain a moisture content of no more than 1% by weight. |
| Free Isocyanate | ASTM D 3432 (1996) | The maximum free isocyanate content shall be no more than 1% by weight. |
| Volatile Organic Compound (VOC) | ASTM D 3960. | The maximum VOC content at application shall meet the requirement of para 7.2.1.1 |
| Viscosity | ASTM D 1200 or AS 1580.214.2. | The viscosity of the admixed paint, after thinning to the specified maximum VOC content, measured with a # 4 Ford Cup shall be no more than 30 seconds for both Class I and Class II paints. |
| Pot Life | ASTM D 1200 or AS 1580.214.2. | After keeping the admixed paint at the prescribed conditions for 4 hours, the viscosity of the paint, measured with a # 4 Ford Cup, shall not be greater than 60 seconds. The admixed paint shall not gel within 8 hours after mixing. |

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 - 10.3 | REQUIREMENTS |
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| Drying Time | The following test methods are to be used to assess the drying time parameters: (i) Dry to recoat: ASTM D 1640, paragraph 7.8.1. (ii) Dry to touch: ASTM D1640 paragraph 7.5.2. (iii) Surface dry condition: AS 1580.401.1 (vi) Hard dry or Dry to handle: ASTM D1640 paragraph 7.7.1. | (i) The paint coating shall be dry-to-recoat in 1 hour. (ii) The paint coating shall be dry to touch in 4 hours. When the paint is dry to touch no marks shall be left in the film by a finger lightly touching the film. (iii) The paint shall be surface dry in 5 hours. Surface dry is defined as when the beads are easily and completely removed from the paint film (AS 1580.401.1). (vi) The paint shall be hard dry in 12 hours. The paint shall be considered to be hard dry when there is no tackiness evident and the film shall resist loosening, detachment, wrinkling and any other evidence of distortion (rotating thumb test). |
| Application and Surface Appearance | Application of paint shall be by airless, conventional air, air assisted airless, electrostatic or high volume, low pressure (HVLP) spray equipment | The paint coating shall dry to a uniform smooth surface, which is free from runs, sags, bubbling, streaking, hazing, seeding, orange peel, floating or other defects for all application systems. |
| Colour | ASTM D 2244 or AS 1580.601.1 and 601.4 | The finishing paint shall be a good visual match to the specified colour standard. The colour difference (ΔE) of the coating shall not be greater than 1.0 to be considered a good visual match. |
| Gloss | ASTM D 523 or AS 1580.602.2 | The polyurethane finishing paint gloss levels, measured at a 60° angle of incidence, shall be as follows: a. Full Gloss 90 to 100 b. Semi-gloss 15 to 45 c. Matt < 5 In addition, the Matt coatings shall have a maximum gloss of 9 at an 85° angle of incidence. |
| Infra-Red Reflectance (IRR) | Federal Standard 14, method 6241.2 | In accordance with paragraph 7.2.1.2, polyurethane finishing paint shall have an infra-red reflectance (IRR) as follows: a. TYPE I Standard: No IRR requirement b. TYPE II Low IRR: 0 – 10 % (measured at 450 - 2700 nm wavelength) c. TYPE III High NIRR: 65 - 100 % (measured at 800 nm wavelength) |
| Opacity (hiding power) | Apply the finishing paint, at a dry film thickness no greater than 40 μm , to a black and white chart (Leneta form 3B or equivalent). The contrast ratio shall be determined by measuring the reflectance value “L” (specular component included) of the coating over the black (L_B) and white (L_W) side of the chart, respectively (according to ASTM D 2244). The contrast ratio is calculated as follows: $C = L_B \div L_W$. The contrast ratio shall be recorded along with the dry film thickness of the coating. | The finishing paint shall have a contrast ratio of not less than 0.95 for all colours except yellow and orange, which will have a contrast ratio of not less than 0.90 at the minimum specified thickness (40 μm). |

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 - 10.3 | REQUIREMENTS |
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| Tape Resistance | The coating applied to the test panel shall be air dried for only 8 hours. A strip of 25 mm wide masking tape having an adhesive strength of 5.5 N/25 mm shall be applied to the surface and pressed down with a roller weighing 2 kg. After 1 hour the tape shall be carefully removed. | There shall be no evidence of permanent marking in the form of imprinting of the tape texture or other visible defects caused by masking tape applied to the coating. |
| Adhesion | The adhesion of the coating system to the test panel shall be determined using the cross hatch adhesion method according to AS 1580.408.4 or ASTM D 3359. | The paint system shall have an adhesion rating of no more than 1 when tested in accordance with AS 1580.408.4, or 4B when tested in accordance with ASTM D 3359. |
| Water Resistance and Wet Adhesion | Test panels shall be immersed in distilled water for not less than 7 days at $50 \pm 3^\circ\text{C}$. After removal, the panel shall be dried with absorbent paper and within 3 minutes after removal from the water, shall be tested for adhesion in accordance with AS 1580.408.4. Paint colour will be measured both before and after immersion according to ASTM D 2244 or AS 1580.601.1 and 601.4. | The paint system shall have an adhesion rating of no more than 2 when tested in accordance with AS 1580.408.4. In addition, the coating shall not exhibit any softening, wrinkling, blistering or other defect after the immersion. Any colour change due to the immersion shall not exceed a ΔE of 1.0. |
| Impact Flexibility (Ambient Temperature) | The coating is tested with an impact flexibility apparatus according to ASTM D 6905. Coatings are to be applied to ANODISED 0.5 mm 2024-0 unclad aluminium alloy test panels. Testing shall be carried out on (i) finishing paint applied directly to the substrate and (ii) finishing paint applied over primer applied to the substrate (i.e., the full paint system). | The finishing paint shall not exhibit any cracking or flaking at 20% elongation when examined under 10x magnification for both (i) the finishing paint only and for (ii) the full paint system. |
| Aged Impact Flexibility (Ambient Temperature) | The cured coatings are aged by 500 hours exposure in an artificial xenon arc light weathering unit in accordance with ASTM G 155 using the light only cycle. Coatings are to be applied to ANODISED 0.5 mm 2024-0 unclad aluminium alloy test panels. Testing shall be carried out on (i) finishing paint applied directly to the substrate and (ii) finishing paint applied over primer applied to the substrate (i.e., the full paint system) using an impact flexibility apparatus according to ASTM D 6905. | The finishing paint shall not exhibit any cracking or flaking when examined under 10x magnification; (i) at 20% elongation for the finishing paint only and (ii) at 10% elongation for the full paint system. |
| Flexibility (Cold Temperature) | ASTM D 522 Method B or AS 1580.402.1, gloss and semi gloss paints are to be tested over a 25 mm mandrel at $-51 \pm 3^\circ\text{C}$. Matt paints are to be tested over a 50 mm mandrel at $-51 \pm 3^\circ\text{C}$ | The flexibility of the test panel, coated with the finishing paint (no primer), shall be examined at $-51 \pm 3^\circ\text{C}$. The coating shall not exhibit cracking or flaking when bent coated side out, over the specified mandrels. |
| Humidity Resistance | ASTM D 2247 or AS 1580.452.1. | The coating shall withstand exposure for no less than 30 days in a humidity cabinet maintained at $50 \pm 2^\circ\text{C}$ and 100% relative humidity without blistering, softening, exhibiting any loss of adhesion, nor other film defects. |
| Thickness | AS 1580.108.1 or ISO 2808 | The finishing paint shall be able to produce a dry film thickness (DFT) of $50 \pm 10\mu\text{m}$ in 1-2 applications. |

| PROPERTY | TEST METHOD | REQUIREMENTS |
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| Weather Resistance (Accelerated weathering) | Test panels shall be prepared in accordance with paragraphs 10.1 - 10.3 ASTM G 155 Cycle 1. | The test requirements refer to the paints listed in the Table in Section 9.2. After testing for 1000 hours, the coating shall not exhibit: (i) a colour change (ΔE) of > 1.0 when tested in accordance with ASTM D2244 or AS 1580.601.1 & 601.4 and (ii) the degree of chalking shall not exceed Rating 1 (AS 1580.481.11, method A). After testing for 500 hours, the gloss change shall be as follows (when gloss is measured in accordance with ASTM D 523 or AS 1580.602.2): (i) for matt coatings there shall be no increase in gloss and any decrease in gloss shall be no greater than one gloss unit; (ii) for semi-gloss coatings the change in 60° gloss shall be no greater than 50% of the initial gloss level. |
| Solvent Resistance | Test according to ASTM D 5402 using MEK as the solvent and employing 50 double rubs. | The finishing coating shall withstand 50 double rubbing passes without rubbing through to the primer coating. |
| Fluid Resistance | Test panels shall be coated with the paint system and cured for 14 days, after which three separate test panels shall be immersed for half their length, one in each of the following liquids: a) Lubricating oil conforming to MIL-PRF-23699, for 24 hours maintained at $120 \pm 3^\circ C$ b) Hydraulic fluid conforming to MIL-PRF-83282, for 24 hours maintained at $65 \pm 3^\circ C$, and c) Avtur FSII Fuel F34 conforming to DEF(AUST) 5240, for 7 days at room temperature. | The coating system shall not exhibit any softening, blistering, or loss of adhesion after immersion. Adhesion shall be measured using the cross hatch method (described in AS 1580.408.4) and after exposure the paint system shall have an adhesion rating of no more than 2. Slight staining of the coating is acceptable. |
| Heat Resistance | ASTM D 2244 or AS 1580.601.1 & 601.4. | The coated panel shall be exposed to a temperature of $120 \pm 3^\circ C$. After testing for 1 hour, the test panel shall have a ΔE of less than or equal to 1.0 and a gloss change of no more than 10% for matt coatings and 5% for semi-gloss and gloss coatings compared to an unexposed sample of the same batch and tested in accordance with ASTM D2244 or AS 1580.601.1 & 601.4. |
| Corrosion Resistance | ASTM B117. | The coating system shall not exhibit any blistering, lifting of the coating system or substrate corrosion after exposure to salt spray for 2000 hours. |
| Filiform Corrosion | ISO 4623-2 | After testing for 1000 hours the coating system shall not exhibit filiform corrosion filaments extending beyond 6 mm from the scribe mark, and the majority of the filaments shall be less than 3 mm in length. |

| PROPERTY | TEST METHOD Test panels shall be prepared in accordance with paragraphs 10.1 - 10.3 | REQUIREMENTS |
|---------------|--|---|
| Strippability | Age test panel coated in the paint system for 4 days at 100° C. Place coated test panels on a rack so that the coated side is 60° to the horizontal. Pour Turco T5351 Methylene Chloride paint remover (MIL-R-81294D) over top edge of panel so that all the paint coating is covered. After standing for 60 minutes the loosened coating shall be brushed off with a stiff bristle brush while rinsing under a stream of cool water | Minimum of 90% of the coating system shall be stripped. |

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