



DISRUPTIVE PATTERN CAMOUFLAGE POLYURETHANE FINISHING SYSTEM FOR VEHICLES AND EQUIPMENT

1 SCOPE

A two-pack polyurethane paint system to be used for the finishing and refinishing of vehicles and equipment of the Australian Defence Services. The system is to be a chemical agent resistant coating which, when applied as instructed in this document, provides a disruptive pattern (DP).

2 BACKGROUND

- To obtain a broad overview of the Australian Paint Approval Scheme (APAS), refer to APAS document AP-D001.
- To obtain an overview of restricted ingredients in APAS certified products, refer to APAS document AP-D123.
- To obtain the current list of APAS participating manufacturers (and suppliers) and resellers, refer to APAS document AP-D152.
- To obtain an overview of how to participate in the APAS, refer to APAS document AP-D177.
- APAS approval to this specification may be gained by compliance with the requirements detailed in this specification and those in APAS document AP-D192.

3 DESCRIPTION AND GUIDE FOR USERS

3.1 General Requirements

- A two-pack polyurethane paint system to be used for the finishing and refinishing of vehicles and equipment of the Australian Defence Services. The system is to be a chemical agent resistant coating which, when applied as instructed in this document, provides a disruptive pattern (DP).
- Available in a low gloss (sub-class AP-S0502/1) or flat (sub-class AP-S0502/2) finish and at reflectance levels specified to maximise camouflage whilst maintaining a reduction in solar heat absorption in comparison to the conventional coatings described in APAS specification AP-S0154.
- The paint systems shall be suitable for use over suitably pre-treated ferrous and non-ferrous metal surfaces, suitably treated non-metallic surfaces and also over aged polyurethane or alkyd paintwork.
- The finishing paint, when applied by spray in accordance with the manufacturer's directions to a vertical surface, shall produce a film of dry thickness 25 - 35 μm .
- All paints and pre-treatments shall be prepared and applied according to the manufacturer's instructions. Care should be taken to ensure that the manufacturer's instructions are followed regarding application conditions and recoating times.

3.2 Application

a) Application to Ferrous Metals:

- Metal pre-treatment by phosphating or abrasive blast cleaning as described in AS 1627.4 is followed by the application of an epoxy primer to sub-class AP-S0502/3 or of a suitable commercial

multipurpose primer to sub-class AP-S0502/5. Primer may be applied in one or, if necessary, two coats, to achieve a total primer DFT of 30-50 μm , followed by two coats (each having a DFT of 25-35 μm) of the camouflage green polyurethane finish, sub-class AP-S0502/1 or AP-S0502/2. The disruptive pattern is produced as specified for the vehicle concerned by the application of the DP colours, each to a DFT of 35-50 μm .

- The paint system is to be applied so that at no point should the DFT be less than 80 μm or greater than 190 μm . The priming paint should be applied so that at no point should the primer DFT be less than 30 μm .

b) Application to Non-Ferrous Metals:

- Metal pre-treatment is to be by conversion coating or by abrasive blasting. Where it is not possible for these pre-treatments to be employed, an alternative is the application of an etch primer to APAS specification AP-S0035/2.

NOTE: Etch primers should **not** be used other than in exceptional circumstances. The etch primer should only be used on small surfaces that are difficult to clean and prepare for painting and not for general surface pre-treatment. If an etch primer is used, it should not be over-coated with the epoxy primer for 24 hours.

- Pre-treatment is followed by the application of an epoxy primer to sub-class AP-S0502/4 or of a suitable commercial multipurpose primer to sub-class AP-S0502/5. Primer may be applied in one or, if necessary, two coats, to achieve a total primer DFT of 30-50 μm , followed by the polyurethane finish coats as described in clause 3.2 a) above.
- The paint system is to be applied so that at no point should the DFT be less than 80 μm or greater than 190 μm . The primer should be applied so that at no point should the primer DFT be less than 30 μm .

c) Application to Previously Painted Surfaces:

- Where practical, the preferred procedure is to remove any oil, grease or wax and to strip the existing coating back to bare substrate by abrasive blasting (as per AS 1627.4), followed by full repainting as described in clause 3.2 a) or b) above.
- For cases where the full repainting is not practical, the aged painted surface should be cleaned using a suitable solvent or an alkaline detergent wash (followed by a water wash) to remove any oil, grease or wax, followed by light abrasion of the aged polyurethane or aged alkyd paint using whip blasting, mechanical sanding or hand sanding with a fine grade of paper. Abrasion should continue until a sound, well-adhered, defect-free paint film is reached with a uniformly well-abraded surface.
- Paint application should be similar to the methods described in clause 3.2 a) and b) above, with the application of epoxy primer (DFT 30-40 μm) and one coat of camouflage green polyurethane finish paint (to sub-class AP-S0502/1 or AP-S0502/2, DFT 40-

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50 µm), followed by the application of subsequent paint layers to produce the disruptive pattern as described in clause 3.2 a) above. Areas where abrasion has exposed bare substrate should be painted as described in clause 3.2 a) or b) as appropriate.

3.3 Sub-Classes

- a) This specification incorporates the following sub-classes:
- i. **AP-S0502/1:** Low gloss DP camouflage finish coat
 - ii. **AP-S0502/2:** Flat DP camouflage finish coat
 - iii. **AP-S0502/3:** Epoxy primer for steel
 - iv. **AP-S0502/4:** Epoxy primer for aluminium
 - v. **AP-S0502/5:** Multi-purpose epoxy primer for steel and aluminium
 - vi. **AP-S0502/6:** Thinner

3.4 Basis of this Specification

- a) Sub-classes AP-S0502/1 and AP-S0502/2 are similar to the coatings described in APAS specification AP-S0154 but also satisfies all of the requirements outlined in clause 10, Table 1.
- b) Sub-class AP-S0502/3 is an epoxy primer for steel similar to MIL DTL 53022 but also satisfies all of the requirements outlined in clause 10, Table 1.
- c) Sub-class AP-S0502/4 is a chromate-free epoxy primer for aluminium similar to BMS 10-79, urethane compatible primer, but also satisfies all of the requirements outlined in clause 10, Table 1.
- d) Sub-class AP-S0502/5 is a multipurpose epoxy primer suitable for use on steel and aluminium that fulfils all of the requirements outlined in clause 10, Table 1 in the sections **For each COMPONENT (Primer and Finishing Paints)** and **For All Cured Priming Paints**, and when used with the finish coats, satisfies all of the requirements outlined in the section **For the Complete Cured Coating System** of clause 10, Table 1.
- e) Sub-class AP-S0502/6 is thinner which is compatible with the finish coatings (sub-classes AP-S0502/1 and AP-S0502/2) described in this specification. Thinned paint must comply with all performance requirements outlined in clause 10, Table 1.
- f) Paints approved under this specification do not comply with any of the paint types referenced in either AS/NZS 2311 or AS/NZS 2312.

4 REFERENCED DOCUMENTS

- a) The following standards are referenced in this document:
- i. **AS/NZS 1580** – Paints and related materials: Methods of test
 - ii. **AS 1627.4** – Metal finishing – Preparation and pre-treatment of surfaces – Abrasive blast cleaning of steel
 - iii. **AS/NZS 2311** – Guide to the painting of buildings
 - iv. **AS/NZS 2312** – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings

- v. **ASTM B117-19** – Standard Practice for Operating Salt Spray (Fog) Apparatus
- vi. **ASTM D610-08** – Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
- vii. **ASTM G155-13** – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
- viii. **MIL DTL 12468 Revision E** – Decontaminating Agent, Stb
- ix. **MIL DTL 53022 Revision E** – Primer, Epoxy Coating, Corrosion Inhibiting Lead and Chromate Free
- x. **MIL DTL 53039 Revision E** – Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
- xi. **MIL DTL 64159** – Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant
- xii. **MIL PRF 85285 Revision E** – Coating: Polyurethane, aircraft and support equipment
- xiii. **SAE AMS STD 595** – Colours used in Government Procurement

These documents may be purchased through the Reference Standards Australia website:

<https://www.standards.org.au/>

- xiv. **BMS 10-79** – Boeing Materials Specification – Urethane compatible, corrosion resistant primer

This document is available from the Boeing Aircraft Limited website: <https://www.boeing.com>

- xv. **DEF(AUST) 8232** – Reflectance data for disruptive pattern camouflage finishing systems for Army vehicles and equipment

This document is available from the Department of Defence, Australia <https://www1.defence.gov.au/>

- xvi. **The Poisons Standard October 2021:** Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) No. 34, Part 2: Control on Medicines and Poisons, Section Seven / Appendix I Paint or Tinters

This document is available from the Australian Government Federal Register of Legislation website at: <https://www.legislation.gov.au/Details/F2021L01345>

- xvii. **Work Health and Safety Act 2011**

This document is available from the Australian Government Federal Register of Legislation website at: <https://www.legislation.gov.au/Details/C2018C00293>

- b) The following APAS documents are referenced in this document:
- i. AP-D001 Rules Governing How APAS® Operates
 - ii. AP-D123 Restrictions on Ingredients in Product Formulations
 - iii. AP-D152 APAS® Participating Manufacturers and Resellers

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- iv. AP-D177 Rules Governing How Product Manufacturers participate in APAS®
- v. AP-D181 Volatile Organic Compounds (VOC) Limits
- vi. AP-D192 Rules Governing APAS® Product Certification Scheme
- vii. AP-S0035/2 Etch Primer for Zinc and Zinc/Aluminium Coated Metals – One pack etch primer, chromate-free
- viii. AP-S0154 Polyurethane Finishing System for Vehicles and Equipment
- ix. AP-S0165 Alkyd Disruptive Pattern Paint for Vehicles and Equipment

All APAS documents and specifications are available for download from the APAS website:

<https://vs.csiro.au/apas/documents/>
<https://vs.csiro.au/apas/specifications/>

5 COMPOSITIONAL REQUIREMENTS

5.1 Binder

- a) The polyurethane finish (sub-classes AP-S0502/1 and AP-S0502/2) shall be supplied in two components.
- b) One component shall consist typically of orthophthalic trimethylol propane polyesters combined with pigments and solvents. The second component shall typically consist of an aliphatic polyisocyanate dissolved in solvents. The two components shall be mixed in a simple volume ratio.

5.2 Volatiles

- a) Although not restricted by this specification, the volatile component can be expected to consist typically of a mixture of hydrocarbon and oxygenated organic solvents.
- b) For VOC content restrictions, refer to APAS document AP-D181.

5.3 Pigmentation

- a) The pigmentation shall be chosen to provide the properties detailed in clause 10, Table 1 below.
- b) No paint defined by this specification shall contain lead or chromates.

5.4 Colour

- a) Products approved under this specification are normally available in a range of colours, including camouflage colours and colours suitable for producing a disruptive pattern (DP) finish: Camouflage Green (Olive Drab), Camouflage Brown, Black, Pilbara Brown and White.

6 PRODUCT APPROVAL REQUIREMENTS

6.1 General Requirements

- a) The product and its application for approval shall comply with the relevant requirements of APAS document AP-D192 during the life of the approval.

6.2 Technical Requirements

- a) The product shall comply with **all** the requirements of clause 10, Table 1 below, where applicable.
- b) Tests are to be carried out under the routine conditions of AS/NZS 1580.101.5 unless otherwise specified.
- c) Test panels should be painted as described in clause 3.2 a), b) and c), where applicable, unless otherwise specified. Panels are to be cured for 7 days using the routine conditions outlined in AS 1580.101.5 and specifically 23 ± 3 °C and 60 ± 15 % RH, before testing, unless otherwise specified. Care should be taken to ensure that the manufacturer's instructions are followed regarding application conditions and recoating times.
- d) For all **finishing products**, testing shall be performed in accordance with all three sections of clause 10, Table 1 below.
- e) For all **priming products**, initial testing shall be performed in accordance with the tests detailed in clause 10, Table 1 under the heading **For Each Component of the System** and **For All Cured Priming Paints**. The primer shall subsequently be included in tests involving the coating system (see **For the Complete, Cured Coating System** section in clause 10, Table 1) and satisfactory test results as part of the coating system tested will allow granting of approval to the particular primer used.
- f) Due to the extremely hazardous nature of the chemicals used in the tests in Clause 8 and Clause 9, the test procedure detailed in these clauses shall be performed by the Land Division of DSTG. The following contact information is current until 30th June 2022 after which time the details will be updated to reflect impending divisional changes:

Ms Sue Pantelidis
Land Division, DSTG
Email: sue.pantelidis@defence.gov.au

6.3 Health and Safety Requirements

- a) The manufacturer's Safety Data Sheet (SDS) must be studied closely prior to using the product and complied with during use of the product.
- b) Products (finish and priming paints) intended for sale in Australia shall comply with all the requirements of the SUSMP and shall not be classified as either Schedule 1, 2, or 3 paints.
- c) The product and the practical application of the product shall comply with the requirements stipulated in the appropriate section(s) of the Work Health & Safety (WHS) Act 2011 and regulations.
- d) Products intended for sale in other countries shall comply with all local WHS and environmental requirements.
- e) Appropriate precautions should be taken during mixing, application and cure of paints that utilise isocyanate-curing agents. Spray-painting operations should be conducted in a spray booth away from other personnel, and a positive pressure air-fed full-face respirator should

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- be worn whilst spraying. In all circumstances of use, care should be taken to avoid contact of isocyanate-containing paint with the skin.
- f) Paints containing hydrocarbon and/or oxygenated organic solvents are flammable and should be stored away from all sources of heat or ignition. Vapours from these solvents are usually heavier than air and may build up in low-lying areas if ventilation is inadequate. Containers should be resealed immediately after use and good ventilation provided during use to minimise the risk of fire or explosion and the long-term toxic effects of absorption of the vapour into the lungs.
 - g) Care should be taken to avoid contact of all paint types with the skin using protective clothing and gloves, and if necessary, a barrier cream. All pumping equipment should be adequately earthed.
 - h) The product shall comply with all requirements of clause 6.3 and 6.4 of APAS document AP-D192.

7 APPENDIX A

General Test Procedures

7.1 Corrosion Resistance – Salt Spray:

7.1.1 Paint System Applied to Aluminium Substrate:
 Test using primer sub-class AP-S0502/4 and AP-S0502/5. Diagonal cross scribed (through to substrate), 75 x 150 mm panels (coated with full paint system with final cure of 7 days at 23°C and 50% RH) exposed to 5% salt spray for 2000 hours in accordance with ASTM B117 shall not exhibit blistering, lifting, nor substrate pitting.

7.1.2 Paint System Applied to Mild Steel Substrate:
 Test using primer sub-class AP-S0502/3 and AP-S0502/5. Diagonal cross scribed (through to substrate), 75 x 150 mm panels (full paint system both sides, scribed one side) shall be exposed to 5% salt spray for 1000 hours in accordance with ASTM B117 and gently washed with warm running water until free from any visible salt deposits. Areas well away from the scribed cross shall show no more than a trace of rusting (ASTM D610, No. 9) and no more than five scattered blisters, none larger than 1 mm in diameter. On removal of the paint system, there shall be no more than a trace of rusting, pitting or corrosion of the substrate. There shall be no corrosion creep reaching greater than 5 mm from the scribe mark.

7.2 Dry Hiding Power – Contrast Ratio:

- a) Similar to the method described in MIL PRF 85285. Apply the admixed coating, at a dry film thickness of no greater than 30 µm, to a black and white chart (Leneta Form 3B, or equivalent). The contrast ratio of the cured paint shall be determined by measuring the L* lightness value with a spectrophotometer (Specular Component Included - SCI) of the coating over the black (L*B) and white (L*W) side of the chart, respectively. The contrast ratio is calculated as follows: $C = L^*B / L^*W$. The contrast ratio shall

be reported along with the dry film thickness of the coating.

- b) The finishing paint shall have a contrast ratio of not less than 0.98 for all colours except white, which will have a contrast ratio of not less than 0.96, at a dry film thickness of 30 µm.

7.3 Resistance to Fluids:

7.3.1 Water Resistance: When a film of the finish paint (sub-class AP-S0502/1 or AP-S0502/2), applied over epoxy primer (sub-class AP-S0502/3, AP-S0502/4 or AP-S0502/5), is allowed to cure for 7 days, and is then immersed in distilled water at room temperature (23 ± 3°C) for 7 days, then removed and allowed to dry for 18 hours, is then examined, the film shall show no defects and shall appear identical with a panel similarly prepared but not immersed in water.

7.3.2 Mineral Oil Resistance: When a film of the finish paint (sub-class AP-S0502/1 or AP-S0502/2), applied over epoxy primer (sub-class AP-S0502/3, AP-S0502/4 or AP-S0502/5), is allowed to cure for 7 days, and is then immersed in mineral oil at 50 ± 2°C for 7 days, and is then removed, dried and examined, the film shall show no defects and shall appear identical with a panel similarly prepared but not immersed in mineral oil.

7.3.3 Petroleum Spirit Resistance: When a film of the finish paint (sub-class AP-S0502/1 or AP-S0502/2), applied over epoxy primer (sub-class AP-S0502/3, AP-S0502/4 or AP-S0502/5), is allowed to cure for 7 days, and is then immersed in petroleum spirit at room temperature 23 ± 3°C for 7 days, and is then removed, dried and examined, the film shall show no defects and shall appear identical with a panel similarly prepared but not immersed in petroleum spirit.

7.3.4 Acid Resistance: When a film of the finish paint (sub-class AP-S0502/1 or AP-S0502/2), applied over epoxy primer (sub-class AP-S0502/3, AP-S0502/4 or AP-S0502/5) and allowed to cure for 7 days, is spotted with a 30 - 50 mm diameter spot of 10 % acetic acid (by volume), which shall then be covered with a watch-glass and allowed to stand for 1 hour, is rinsed with water and dried, the spotted area shall show no defects and shall appear identical with the unspotted surroundings.

7.4 Resistance to Chemical Agent Decontamination Fluid (Stb):

- a) Panels coated with the full paint system should be dried at 25°C and 50% RH for 14 days prior to testing. Place two spots (approximately 0.5 mL each) of Stb agent (MIL DTL 12468) on the panel surface. Do not cover; allow to stand for 30 minutes, and then thoroughly wash with water. The exposed film shall exhibit no blistering, wrinkling, or film softening immediately after washing. After drying, use a spectrophotometer to measure the colour of the exposed area and compare to a portion of

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untested panel. The difference in colour (calculated as CIE 1976 CIELAB, ΔE^*) should be no greater than 2.5.

absorbent paper and re-weigh the panels between 10 and 15 minutes after removal from the simulants.

c) Calculate the mass gain in milligrams.

7.5 Wet Adhesion to Aged Coatings:

7.5.1 **Preparation of Aged Panels:** Test panels with aged paint are to be prepared as follows:

- i. **CAR polyurethane:** Panels coated with 30-50 μm of priming paint (sub-class AP-S0502/3, AP-S0502/4 or AP-S0502/5) and 50-70 μm of finishing paint (sub-class AP-S0502/1 or AP-S0502/2), as described in this specification, should be dried at $23 \pm 3^\circ\text{C}$ for 24 hours and then at 60°C for 500 hours.
- ii. **Alkyd:** Panels coated in the alkyd primer and alkyd finish coat system described in APAS specification AP-S0165 should be dried at $23 \pm 3^\circ\text{C}$ for 24 hours and then at 60°C for 500 hours.

7.5.2 **Wet Adhesion Test:** The aged panels shall then be coated with 30-50 μm of priming paint (sub-class AP-S0502/3, AP-S0502/4 or AP-S0502/5) and 50-70 μm of finishing paint (sub-class AP-S0502/1 or AP-S0502/2), as described in this specification, and dried at 23°C and 50% RH for 14 days. The fully painted panels shall then be immersed in water for 24 hours at 23°C , gently wiped dry and allowed to air dry for several minutes. The final paint system shall have an adhesion rating of no more than 2 (AS 1580.408.4: cross hatch). Note that the crosshatch should be scored through to the metal substrate.

8 APPENDIX B

Chemical Agent Simulant Resistance

NOTE: Due to the extremely hazardous nature of the chemicals used in this test, the test procedure detailed in this appendix shall be performed by the Land Division of DSTG - refer to contact information in clause 6.2 f).

The below procedure is similar to that of MIL-C-46168A (Coating Aliphatic Polyurethane, Chemical Agent Resistant, Clause 4.3.26, 23 August 1978) that has now been superseded by MIL DTL 53039 and MIL DTL 64159.

8.1 Panel Preparation: Coat by spraying both sides of four steel panels, 100 x 20 x 1.2 mm, with the **coating system** to a dry film thickness of between 80 and 120 μm (30-50 μm of primer and two coats of the finish paint being tested, each 25-35 μm). Age the films at room temperature $23 \pm 3^\circ\text{C}$ for 7 days before testing.

8.2 Procedure:

- a) Weigh the coated panels to the nearest 0.1 mg and immerse duplicate panels to a depth of 75 mm in each chemical agent simulant (triethyl phosphate for GD agent and tetrachloroethylene for HD Agent).
- b) After 60 minutes, remove the panels from the simulants, rinse thoroughly with a stream of isopropyl alcohol from a wash bottle, blot dry with

9 APPENDIX C

Chemical Agent Resistance

NOTE: Due to the extremely hazardous nature of the chemicals used in this test, the test procedure detailed in this appendix shall be performed by the Land Division of DSTG - refer to contact information in clause 6.2 f).

9.1 Panel Preparation:

- a) Spray two 75 x 75 x 1.2 mm steel panels, with epoxy primer conforming to sub-class AP-S0502/3 or AP-S0502/5 to a dry film thickness of 30 - 50 μm .
- b) Air dry for 2 hours and spray on the finish paint (sub-class AP-S0502/1 or AP-S0502/2) to be tested to a dry film thickness of 50 - 70 μm .
- c) Age the films for 7 days before testing.

9.2 Test Conditions:

- a) The desorption rate of agents from paint is temperature dependent and hence all agent tests will be conducted at 25°C .
- b) Toxic materials are used in this testing; therefore, all work will be performed in an **approved** fume hood and with appropriate support procedures.

9.3 Test Apparatus:

- a) In the fume hood, use a short length of tubing, not exceeding 50 mm, to attach an apparatus similar to that shown in Figure 1 (page 10) to two sampling bubblers, similar to those shown in Figure 2 (page 10), filled with 5 mL diethyl phthalate and arranged in series.
- b) The inlet of the apparatus should be supplied with dry air. Connect the outlet of the bubbler to a vacuum line in the hood with a 100 mL per minute critical orifice between the bubbler and the vacuum line.

9.4 Test Procedure:

- a) Using separate panels for each of the agents HD and GD and using a soft lead pencil so that the coating is not damaged, outline a circle 30 cm^2 in area near the centre of the panel.
- b) Using a micro-syringe, place 30 mg of the chemical agent in 1 μL drops within the 30 cm^2 area so that the entire area is evenly covered. Note that this uses 23 drops of HD and 30 drops of GD and represents a **challenge concentration** of 10 g/m^2 .
- c) After an exposure time of 30 minutes, remove the excess agent from the surface by directing a stream of isopropanol (reagent grade) onto the panel (100 mL aliquot used for each panel, panel inclined at 45° during washing). Allowed the panels to air dry before being placed in the test cell.
- d) Place the panel in the test apparatus and start sampling. Draw dry air into the inlet of the test apparatus, over the contaminated film and through



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the bubbler and critical orifice (controlled at 100 mL / min).

- e) Any agent vapours emitted are picked up by the air stream and absorbed in the diethyl phthalate in the bubblers.
- f) After sampling continuously for 24 hours, analyse the diethyl phthalate for the presence of agent using the methods detailed in the Appendix of MIL DTL 53039.
- g) Determine the amount of agent recovered in micrograms.



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10 TABLE 1: PERFORMANCE PROPERTIES

TEST	AS/NZS 1580 METHOD	REQUIREMENTS
For each COMPONENT of the System (Primer and Finishing Paints only, <u>not</u> applicable to sub-class AP-S0502/6)		
Preliminary Examination	103.1	To be readily reincorporated. Shall be free of coarse particles, gel and foreign matter.
Density	202.1	To be recorded.
Non-Volatile Content	301.1	To be recorded.
Fineness of Grind	204.1	AP-S0502/1 and AP-S0502/2: Maximum 40 µm. AP-S0502/3, AP-S0502/4 and AP-S0502/5: Maximum 40 µm.
Reincorporation after Storage	203.1 Method B	After storage for 18 months at ambient temperature, there shall be no curdling, gelling or seeding and the settling rating shall not be less than 6. Manual stirring shall produce a uniform product.
VOC Content	APAS AP-D181	Refer to APAS document AP-D181 for method and limits. If the APAS specification is not listed on AP-D181, a declaration of VOC content is still required .
For All Cured Priming Paints		
Infra-red Reflectance		Shall comply with the requirements set out in DEF(AUST) 8232. Values shall be reported.
For the Mixed (Finishing) Paint		
Application Properties - Spraying	205.2	Shall show satisfactory application properties and the dry film shall be free of defects.
Consistency	214.X	To be recorded.
Thinner Compatibility	208.1	No defects when thinned to the maximum amount allowed in the manufacturer's written instructions.
Surface Dry Condition	401.1	Maximum 1 hour.
Hard Dry Condition (Mechanical Thumb Test)	401.6	Maximum 8 hours.
Recoating Properties	404.1	The paint shall be suitable for recoating for 8 – 72 hours after application.
Pot life		The paint shall have satisfactory application properties for a minimum of 4 hours after combining the components.
Dry Hiding Power Contrast Ratio	Clause 7.2, Appendix A	The dried finishing paint, at a dry film thickness of less than 30 µm, shall have a contrast ratio of not less than 0.98 for all colours except white, which will have a contrast ratio of not less than 0.96 at a dry film thickness of 30 µm.



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TEST	AS/NZS 1580 METHOD	REQUIREMENTS
For the Complete Cured Coating System		
Finish	603.1	Shall be smooth, free of coarse particles, wrinkling or orange peel and have a uniform gloss, colour and appearance.
Colour: Spectrophotometric Analysis	See Note 1 for test method Also refer to: 601.3 and 601.4 601.1	<p>The finishing paint shall be a close colour match to the specified colour standard (see list below). For colours other than Black, the colour difference, ΔE^* of the coating shall not be greater than 1.0 to be considered a close visual match.</p> <p>Camouflage Green (Olive Drab): SAE AMS STD 595, colour No. 34088. Camouflage Brown: SAE AMS STD 595, colour No. 30219. Pilbara Brown: SAE AMS STD 595, colour No. 30109. White: SAE AMS STD 595, colour No. 37875. Black: SAE AMS STD 595, colour No. 37038</p> <p>Black colour panels are to be assessed as follows:</p> <p>Visually: When observed under the daylight simulator and positioned such that the effect of gloss is removed, the colour match shall be considered Close according to AS/NZS 1580.601.1, and</p> <p>Instrumentally: When measured by spectrophotometer (see Note 1) colour shall be characterised by the following L^*, a^*, b^* data: $22 \leq L^* \leq 27$, $-0.5 \leq a^* \leq 0.5$ and $-0.7 \leq b^* \leq 0.1$.</p>
Specular Gloss	Note 2	<p>AP-S0502/1: 7 - 10 units using the 60° head. AP-S0502/2: < 5 gloss units using the 85° head.</p> <p>Note that gloss requirements apply to coatings at full paint system film build levels achieved by spray application of paint as specified in this document.</p>
Metamerism	Note 1	<p>When the colour is measured using Illuminant D65/10° and Illuminant A/10° (all measurements SCI), the colour difference (between L^*, a^*, b^* values generated for each illuminant), ΔE^* shall be as follows:</p> <p>Camouflage Green: $\Delta E^* \leq 3.5$. Camouflage Brown: $\Delta E^* \leq 5.5$. Black: $\Delta E^* \leq 1.0$. Pilbara Brown: $\Delta E^* \leq 7.0$.</p>
Infra-red Reflectance		Shall comply with the requirements set out in DEF (AUST) 8232. Values shall be reported.
Resistance to artificial Weathering – Xenon Arc Light Exposure – Colour, Chalking and Infra-red Reflectance	ASTM G155 and Note 3 Note 1, 601.3 and 601.4 481.1.11	<p>After 1000 hours of continuous exposure to the xenon arc light, there shall be no integrity failure in the coating and the following ratings shall apply:</p> <p>Colour: The colour change (ΔE^*) shall not exceed 3.0. Chalking: The degree of chalking shall not exceed 1. IR Reflectance: The reflectance at 800nm shall change by no more than +5 % Reflectance units from the initial reflectance at 800 nm.</p>



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TEST	AS/NZS 1580 METHOD	REQUIREMENTS
For the Complete Cured Coating System (Cont.,)		
Resistance to Artificial Weathering - Xenon Arc Light Exposure - Gloss	ASTM G155 and Note 3	After 1000 hours of continuous exposure to the xenon arc light, the 60° gloss value of sub-class AP-S0502/1 coatings shall not be less than 60% of the original gloss level.
Resistance to Artificial Weathering – Fluorescent UV Condensation Type Instrument (Q-UV).	483.2 Note 4	<p>After 2000 hours exposure to a UVA 340 lamp/condensation cycle (note 4), there shall be no integrity failure of the film and the following ratings shall apply:</p> <p>Colour: The colour change (ΔE^*) shall not exceed 1.0 for Camouflage Green and Pilbara Brown and shall not exceed 1.5 for Camouflage Brown, Black and White.</p> <p>Gloss: The 60° gloss value of sub-class AP-S0502/1 coatings shall not have changed by more than 30% of the original gloss level.</p> <p>Chalking: The degree of chalking shall not exceed 1.</p>
	601.3 Note 1	
	602.2	
	481.1.11 Method A	
Resistance to Natural Weathering – Colour, Chalking and Infra-red Reflectance	457.1 Note 1, 601.3 and 601.4 481.1.11 Method A	<p>After 24 months exposure at 45°N at a tropical site there shall be no coating integrity failure and the following ratings shall not be exceeded:</p> <p>Colour: The colour change (ΔE^*) shall not exceed 3.0.</p> <p>Chalking: The degree of chalking shall not exceed 1.</p> <p>IR Reflectance: The reflectance at 800nm shall change by no more than +5 % Reflectance units from the initial reflectance at 800 nm.</p>
Resistance to Natural Weathering – Gloss	457.1 481.1.5	After 12 months exposure at 45°N at a tropical site the 60° gloss value of sub-class AP-S0502/1 coatings shall not be less than 50% of the original gloss level.
Bend Test	402.1	After air drying for seven days, the film shall show no sign of cracking or loss of adhesion after bending around a 6 mm mandrel.
Corrosion Resistance: Salt Spray Testing	Clause 7.1, Appendix A ASTM B117 ASTM D610	<p>Applied to Aluminium Substrate: Diagonally scribed, painted (full system) panels exposed to 5% salt spray for 2000 hours shall not exhibit blistering, lifting, nor substrate pitting.</p> <p>Applied to Mild Steel Substrate: Diagonally scribed, painted (full system) panels exposed to 5% salt spray for 1000 hours shall show no more than a trace of rusting (ASTM D610, No. 9) and no more than five scattered blisters, none larger than 1 mm in diameter in areas away from the scribed area. On removal of the paint system, there shall be no more than a trace of rusting, pitting or corrosion of the substrate. There shall be no corrosion creep reaching greater than 5 mm from the scribe mark.</p>
Adhesion - Crosshatch Method	408.4	Adhesion rating (crosshatch test) shall not be greater than 1.
Wet Adhesion Testing - Crosshatch Method	408.4	After immersion in water (24 hours, 23°C), the panel shall be gently wiped dry and allowed to air dry for several minutes. The paint system shall have an adhesion rating of no more than 2 (crosshatch test).



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TEST	AS/NZS 1580 METHOD	REQUIREMENTS
For the Complete Cured Coating System (Cont.,)		
Adhesion to Aged Coatings – Wet Adhesion, Crosshatch Method	Clause 7.5, Appendix A 408.4	When a paint system is applied over aged polyurethane and aged alkyd coatings (as described in clause 7.5, Appendix A) and tested for wet adhesion, the full paint system shall have an adhesion rating of no more than 2 (crosshatch test).
Resistance to Impact - Falling Weight Test	406.1	Minimum 4.5 Joules.
Scratch Resistance	403.1	Minimum 1000 g.
Resistance to Fluids: - Water - Mineral Oil - Petroleum Spirit - Acetic Acid	Clause 7.3, Appendix A Clause 7.3.1 Clause 7.3.2 Clause 7.3.3 Clause 7.3.4	No change upon exposure. No change upon exposure. No change upon exposure. No change upon exposure.
Stb Resistance (Chemical Agent Decontaminant Resistance)	Clause 7.4, Appendix A	The exposed film shall exhibit no blistering, wrinkling, or film softening immediately after washing. After drying, the colour of the exposed area (see Note 1), in comparison to a portion of the untested panel, shall produce a ΔE^* no greater than 2.5.
Chemical Agent Simulant Resistance	Clause 8, Appendix B	Each simulant immersion (as described) shall not produce a mass gain of greater than 5.0 mg.
Chemical Agent Resistance	Clause 9, Appendix C	A maximum of 40 μg of GD and a maximum of 180 μg of HD to be desorbed.

NOTE:

- Colour is to be measured with a spectrophotometer (having an integrated sphere detector) in CIE 1976 CIELAB colour space using the SCI D65/10° setup to generate L^* , a^* , b^* data. Colour difference is calculated using ΔE^* , where $\Delta E^* = ((L^* - L^*_{ref})^2 + (a^* - a^*_{ref})^2 + (b^* - b^*_{ref})^2)^{1/2}$. The **ref** values refer to the L^* , a^* and b^* for the standard colour card (SAE AMS STD 595) colours listed in clause 10, Table 1, except for the artificial and natural weathering tests where the **ref** values are the initial colour co-ordinates of the test coating before exposure.
- Gloss requirements apply to coatings at the specified final full paint system build levels described in this specification for application to bare steel or aluminium [refer to clause 3.2 a) and b)]. For example, gloss of the black, camouflage brown or Pilbara brown finish coatings is measured when applied at 25-35 μm over 50-70 μm of the camouflage green finish coating, which in turn is applied over 30-50 μm of the appropriate priming paint on the relevant substrate (aluminium or steel). Gloss measurements should be determined with an instrument as defined in AS 1580.602.2 (but not using the method for paint film preparation described in AS 1580.602.2).
- Continuous light exposure using a xenon-arc apparatus conforming to ASTM G155 shall employ a continuous dry cycle set at 63°C black panel temperature and using a Daylight filter with an irradiance of 0.68 W/m² at 340 nm.
- Continuous alternating cycles of 4 hours UV @ 60°C and 4 hours condensation @ 50°C.

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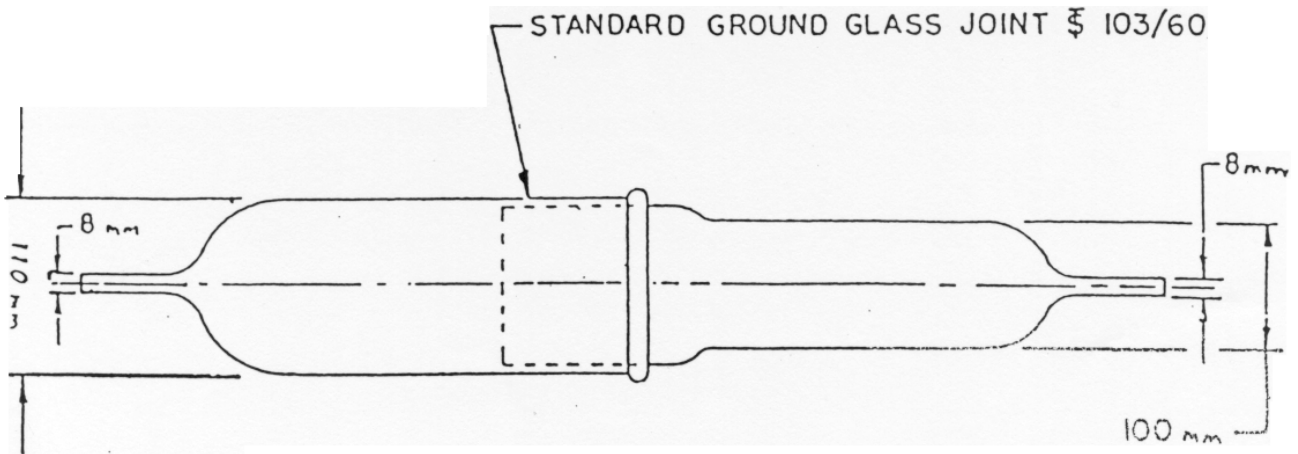


Figure 1: Test Apparatus

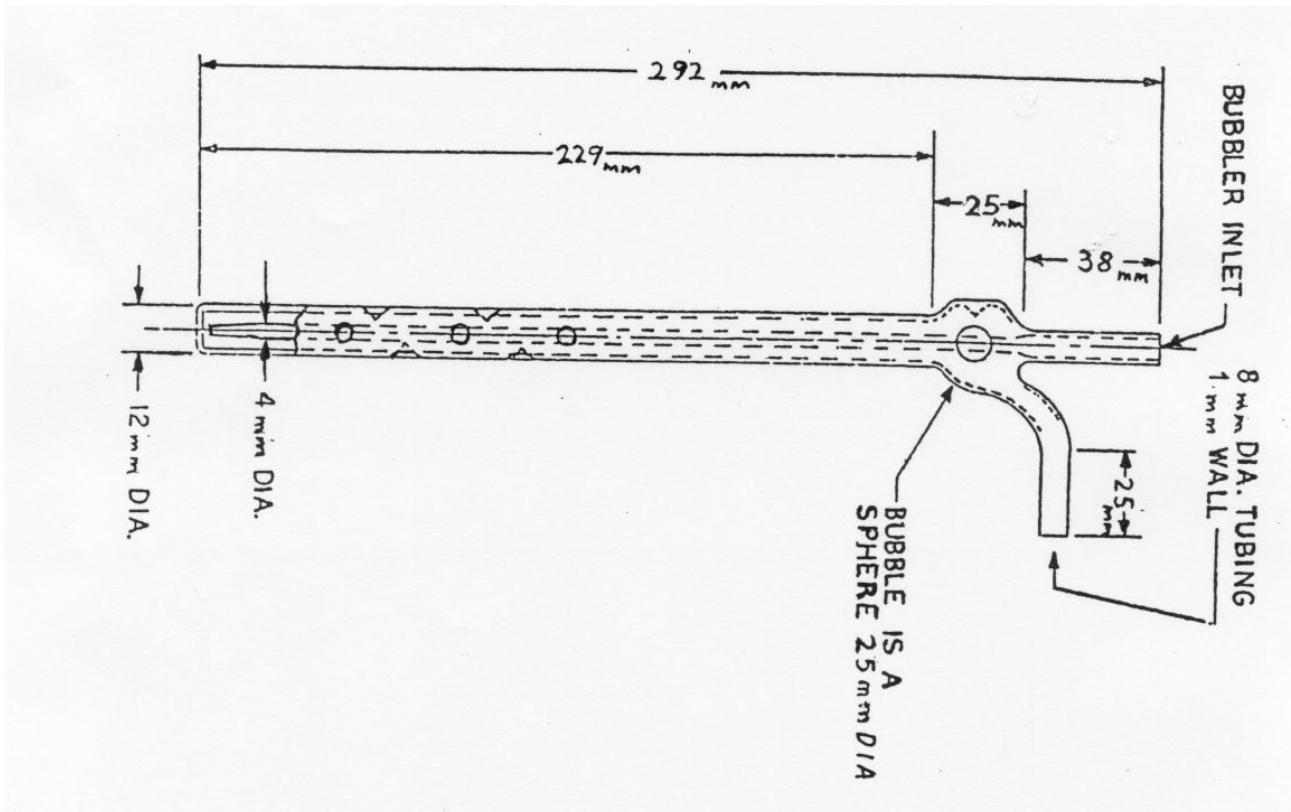


Figure 2: Sampling Bubbler



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11 APPENDIX D

Document History

Status: Current
Version: 5
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Document Version No.:	Date Published:	Summary of Changes:
5	14-01-2022	<ul style="list-style-type: none">General formatting changesUpdated SUSMP informationUpdated contact information for testing relevant to Appendix 9 from the Aeronautical and Maritime Research Laboratory to Land Division, DSTG in clauses in clauses 6.2 f), 8 and 9
4	10-09-2021	<ul style="list-style-type: none">General format changesUpdated background information in clause 2Updated SUSMP informationUpdated APAS website information
3	08-12-2020	<ul style="list-style-type: none">Addition of Appendix D Document History and removal of the Editorial Note previously used in specification versionsUpdated document to the current formatUpdated internal and external document references (including MIL-C-46168A superseded by MIL DTL 53039 and MIL DTL 64159; MIL-D-50030H superseded by MIL DTL 12468 Revision E, and MIL-STD 595b superseded by SAE AMS STD 595)Inclusion of VOC Content requirement to Table 1 Performance PropertiesAddition of "People + Product = Protection" to Footer
2	15-06-2007	<ul style="list-style-type: none">Eased the corrosion creep requirements in A1.2, changed lamp type for QUV accelerated weathering testing and clarified requirements in Table 1
1	13-12-2006	<ul style="list-style-type: none">Eased the metamerism requirements and changed the resistance to artificial weathering (gloss) requirements in Table 1
0	23-11-2005	<ul style="list-style-type: none">Original document