

PAVEMENT MARKING MATERIAL – AIRPORT RUNWAY MARKINGS

1 SCOPE

- a) This specification applies to airport runway marking materials that are typically water-borne paints.
- b) This document is prepared in a manner compliant with the requirements of AS/NZS ISO/IEC 17065.
- c) This type of pavement marking material can be applied to the following types of surfaces in order to increase their safe use:
 - i. Spray seal surfaces – generally found in rural general aviation airfields
 - ii. Dense grade asphalt – used in taxiways and aprons
 - iii. Concrete – for larger aircraft
 - iv. Dense grade asphalt (with grooves to improve shedding of water) – commonly used for commercial runways
- d) Safe use of these pavement surfaces is facilitated through:
 - i. Brighter lines
 - ii. Introduced order
 - iii. Delineation
- e) APAS® is a trademark registered with IP Australia, owned by CSIRO, the Scheme Owner, and protected under applicable laws. Use of the trademark or the Certification Scheme is prohibited unless prior approval in writing is obtained from CSIRO via the APAS Secretariat.

2 BACKGROUND

- a) To obtain a broad overview of the Australian Paint Approval Scheme (APAS), refer to APAS document AP-D001.
- b) To obtain an overview of restricted ingredients in APAS certified products, refer to APAS document AP-D123.
- c) To obtain the current list of APAS participating manufacturers (and suppliers) and resellers, refer to APAS document AP-D152.
- d) To obtain an overview of how to participate in the APAS, refer to APAS document AP-D177.
- e) 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) The application of airport runway markings is generally referred to as airside work. It is a significantly different environment to standard pavement marking application in regard to the type of work involved, the level of expertise required in application, the equipment set up and the types of marking patterns implemented.
- b) Airport and aerodrome markings, their line patterns, colours and dimension, are regulated by the Australian Civil Aviation Safety Authority through the Part 139 (Aerodromes) Manual of Standards for Airside works and are used to:

- i. Improve airside road safety for aircraft and vehicles used to transport equipment and passengers
 - ii. Provide delineation, acting as a guide to pilots and ground staff.
- c) Pavement marking materials found in airports are typically applied by spray application, and are used in four areas:
1. **Runway:** The touchdown / take off areas. There are two types of systems used in Australia:
 - i. **System 1 (Ablative water-borne runway pavement markings used without glass beads):** Specific runway materials are used here to maximise slip resistance (glass beads are not used), where remarking can cause overbuild issues and the ablativ nature of the markings resist rubber build up by having a degree of self-cleaning properties. These materials are typically water-borne paints, such as acrylics, and as such, are easy to apply and dry quickly.

NOTE: The paints used in this system are the subject of this specification.

- ii. **System 2 (Alternative paints and glass beads complying to US FAA specifications TTP 1952E and TTB 1325D):** There are three types of paints covered by TTP 1952E: normal weather conditions, adverse weather conditions and normal weather conditions but with higher durability/glass bead adhesion required. There are three types of beads covered by TTB 1325D: Type I Gradation A, soda lime beads similar to type B/BHR beads seen in AS/NZS 2009 (and also seen in APAS specification AP-S0042, sub-class 0042/1) but with a higher requirement for rounds of 80%; Type III, barium titanate glass bead with a refractive index greater >1.9 (represented in APAS specification AP-S0042, sub-class 0042/4); and Type IV Gradation A, equivalent to type D/H-HR beads seen in AS/NZS 2009 (and also seen in APAS specification AP-S0042, sub-class 0042/3).

NOTE: The paints and glass beads used in this system are not the subject of this specification.

2. **Apron:** The parking areas for aircraft and equipment, and the transfer of passengers and loading (can include airside roads). Markings used in this area are typically more durable than that used for runways, providing longer service life with the ability to retain glass beads and aggregates. Glass beads used in this application aid in retroreflectivity for night operations by assisting in preventing stranding of vehicles and runway incursions and improved airfield regulation compliance. Aggregates on pedestrian path markings (also applied to chevrons and arrows) airside aid in improving anti-slip and anti-skid properties for safer pedestrian movement.

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3. **Taxiway:** The area that allows aircraft to move between the runway to the apron which includes an apron taxiway and a rapid exit taxiway.
4. **Landside:** The areas not connected to airside including roads leading to the airport, carparks etc., and are covered under road authority specifications.

NOTE:

- Landside, Apron and Taxiway areas **are not** the subject of this specification. Refer to APAS specifications AP-S0041/2, AP-S0041/3, AP-S0041/4 and AP-S0041/5 for further information.
- Aggregate used can be crushed glass, calcined bauxite, quartz or similar hard, angular material of similar size to B-HR glass beads.

3.2 Sub-Classes

- a) This specification does not incorporate any sub-classes.

3.3 Basis of this Specification

- a) This specification is based on AS 4049.3, the RIAA Industry Guide 1.2 Aerodrome Marking Guide, and industry standards and specifications.

4 DEFINITIONS AND ACRONYMS

4.1 Definitions

The definition of terms used in this document and in the Certification Scheme can be found in APAS document AP-D001. In addition, the following definitions within this document shall apply:

- a) **Agency for Conformity Assessment:** An organisation or testing authority, recognised by APAS, that is either part of the Clients Recognised Manufacturing Unit (RMU) and perform all of the required tests, or a specialist laboratory contracted either by the APAS Secretariat or by the Client, to carry out specific tests that are beyond the capability of the Client RMU.
- b) **Aerodrome:** A defined area that includes any buildings, installations and equipment used for the arrival, departure and surface movement of aircraft.
- c) **Airport:** Aerodrome equipped with terminals and infrastructure for handling of passengers and cargo.
- d) **Airside:** An aerodrome, adjacent terrain and buildings and the movement area between.
- e) **Certification Scheme:** The Certification system related to specified products (Paint, Surface Coating Materials and Non-Paint Products) to which the same specified requirements, specific rules and procedures apply. APAS is the applicable Certification Scheme.
- f) **Longitudinal Line Markings:** All lines that are generally parallel to the traffic flow, such as dividing, barrier, lane, edge, turn, continuity and transition lines and outline markings.

- g) **Pavement Markings:** All longitudinal, transverse and airside pavement markings for the purpose of guiding aircraft and ground vehicles.
- h) **Retroreflectivity:** The value of reflected light measured in millicandela / square metre / incident lux ($\text{mcd}/\text{m}^2/\text{lx}$) using a retroreflectometer.
- i) **Scheme Owner:** The organisation responsible for developing and maintaining the certification scheme. CSIRO is the APAS Scheme Owner.
- j) **Secretariat:** The organisation that provides administrative support and other resources necessary to keep the Certification Scheme functioning. The Secretariat is vested in CSIRO.
- k) **Transverse Line Markings:** All lines and markings that are marked at right angles to the traffic flow such pedestrian crossway lines.

4.2 Acronyms

ACE	Agency for Conformity Assessment
APAS	Australian Paint Approval Scheme
CRCL	CSIRO Recognised Competent Laboratory
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EO	Executive Officer, APAS
PDS	Product Data Sheet
RMU	Recognised Manufacturing Unit
SDS	Safety Data Sheet
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
TDS	Technical Data Sheet
VOC	Volatile organic compounds

5 REFERENCED DOCUMENTS

- a) The following standards are referenced in this document:
 - i. **AS 1152** – Specification for test sieves (withdrawn)
 - ii. **AS/NZS 1580** – Paints and related materials: Methods of test.
 - iii. **AS/NZS 2009** – Glass beads for pavement-marking materials
 - iv. **AS 2700** – Colour standards for general purpose
 - v. **AS 4049.3** – Paints and related materials - Pavement marking materials – Part 3: Waterborne paint - For use with surface applied glass beads
 - vi. **AS 4049.4** – Paints and related materials – Pavement marking materials – Part 4: High performance pavement marking systems
 - vii. **AS 4049.5** – Paints and related materials – Pavement marking materials – Part 5: Performance assessment of pavement markings
 - viii. **AS 4663** – Slip resistance measurement of existing pedestrian surfaces
 - ix. **AS ISO/IEC 17025** – General requirements for the competence of testing and calibration laboratories
 - x. **AS/NZS ISO/IEC 17065** – Conformity assessment: Requirements for bodies certifying products, processes and services

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

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

- xi. **The Poisons Standard June 2022:** Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) No. 36, 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 web site at:

<https://www.legislation.gov.au/Details/F2022L00730>

- xii. **Test Method TP343 – Determination of Skid Resistance with the Micro Griptester** DPTI (Department of Planning, Transport & Infrastructure), Technical Services Group Procedures

This document is available from the DPTI website:

https://www.dpti.sa.gov.au/materials_technology_documents/test_procedures2

- xiii. **Part 139 (Aerodromes) Manual of Standards 2019**, Australian Civil Aviation Authority

This document is available from the Australian Government Federal Register of Legislation website at: <https://www.legislation.gov.au/Details/F2020C00797>

b) The following documents were utilised in the creation of this document:

- i. Austroads Technical Specification ATS 4110: Longitudinal Pavement Marking
- ii. NZTA P30: Specification for High Performance Roadmarking
- iii. QA Specification R145 Pavement Marking (Performance Based), Transport for NSW (TfNSW)
- iv. QA Specification 3351 Road Marking Paint, Transport for NSW (TfNSW)
- v. QA Specification 3356 Waterborne Road Marking Paint, Transport for NSW (TfNSW)
- vi. RIAA Industry Guide: Series 1 – Facilities Pavement Marking, 1.2 Aerodrome Marking Guide
- vii. RIAA Industry Guide: Series 2 – Materials; 2.3 Waterborne Paints
- viii. Section 721 – Pavement Markings, VicRoads
- ix. Section 971 – Traffic Marking Materials, Florida Department of Transport
- x. Specification 604: Pavement Marking, Main Roads QA
- xi. SWA-0-QA-SPE-0610 Pavement Marking (All Lane Running Section), SmartWays Alliance
- xii. Transport and Main Roads Specifications MRTS45 Road Surface Delineation
- xiii. TT-P-1952E Federal Specification Paint, Traffic and Airfield Marking, Waterborne
- xiv. TT-B-1325D Federal Specification Beads (Glass Spheres) Retro-reflective

c) The following APAS documents are referenced in this document:

- i. AP-D001 Rules Governing How APAS® Operates

- ii. AP-D114 Rules Governing APAS® Recognition as a Testing Authority
- iii. AP-D123 Restrictions on Ingredients in Product Formulations
- iv. AP-D152 APAS® Participating Manufacturers and Resellers
- v. AP-D177 Rules Governing How Product Manufacturers participate in APAS®
- vi. AP-D181 Volatile Organic Compounds (VOC) Limits
- vii. AP-D192 Rules Governing APAS® Product Certification Scheme
- viii. AP-S0041/2 Pavement Marking Material – Solvent-borne Paint
- ix. AP-S0041/3 Pavement Marking Material – Cold Applied Plastic
- x. AP-S0041/4 Pavement Marking Material – Thermoplastic
- xi. AP-S0041/5 Pavement Marking Material – Water-borne Paint
- xii. AP-S0042 Glass Beads – For use in and with Pavement Marking Materials

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/>

6 COMPOSITIONAL AND GENERAL REQUIREMENTS

6.1 Binder

- a) There are no restrictions placed on the type of binder used in airport runway marking materials.
- b) Primary importance is placed on the ability of the binder to be compliant with the technical requirements clause 8, Table 1 below.

6.2 Volatiles

- a) The volatile portion shall principally be comprised of non-volatile aqueous solvents, such as water.
- b) For VOC content restrictions, refer to APAS document AP-D181.

6.3 Pigmentation

- a) Pigments used shall be non-toxic, non-corrosive and lead-free, complying with the requirements of the SUSMP.
- b) White products shall have a pigment volume concentration (PVC) not less than 70%.
- c) Primary importance is placed on the ability of the pigmentation to be compliant with the technical requirements clause 8, Table 1 below.

6.4 Colour

- a) Airport Runway Markings are typically white in colour and are used in touchdown / take off areas of an airport and/or aerodrome. Refer to the manufacturer's Technical Data Sheet (TDS) or Product Data Sheet (PDS) for further information.



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7 PRODUCT APPROVAL REQUIREMENTS

7.1 General Requirements

- a) The product and its application for approval shall comply with the relevant requirements of this specification and of APAS document AP-D192 during the life of the approval.
- b) Upon successful assessment of the laboratory component of this specification, CLASS II (interim) certification may be awarded in order to undertake the field testing component. One (1) year from date of certificate issue is the timeframe given in order to undertake this work.
- c) After successful assessment of the field testing component of this specification, CLASS I (full) certification may be awarded for the balance of the standard seven (7) year certification period i.e., 6 years.

7.2 Technical Requirements

- a) **Current Requirements:** All laboratory testing must be completed as per the requirements of clause 8, Table 1 by an ACE. All performance based field testing must be carried out by a CRCL (refer to Note B) within the CLASS II certification period.
- b) **Future Requirements:** All laboratory testing and field testing requirements stated in clause 8, Table 1 must be undertaken by an AS ISO/IEC 17025 accredited laboratory with all applicable test methods included in their Scope of Accreditation. A grace period will exist in order for all testing facilities to achieve AS ISO/IEC 17025 accreditation. This Grace period will end on **31st July 2023**.
- c) AS ISO/IEC 17025 accreditation shall be provided by an organisation accredited by an ILAC Mutual Recognition Arrangement signatory and having a Scope of Accreditation covering AS ISO/IEC 17025 requirements. In Australia, NATA provides AS ISO/IEC 17025 accreditation. A list of international ILAC accreditation bodies can be found on the ISO website.

7.3 Health and Safety Requirements

- a) The product shall comply with all requirements of clause 6.3 and 6.4 of APAS document AP-D192.
- b) The manufacturer's Safety Data Sheet (SDS) must be studied closely prior to using the product and complied with during use of the product.
- c) Products intended for sale in Australia shall comply with all the requirements of the SUSMP. Products intended for sale in other countries shall comply with all local WHS and environmental requirements.



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8 TABLE 1: PERFORMANCE PROPERTIES

TEST:	APPLICABLE STANDARD / TEST REFERENCE:	REQUIREMENTS:
Laboratory Testing Requirements ^A Note: There shall be no use of glass beads in laboratory tests		
Theoretical PVC		White: ≥ 70% - report results.
Condition in the Container	AS 4049.3 (clause 6.1.1) AS/NZS 1580.103.1 AS/NZS 1580.211.1	Tested at 4 weeks from the date of product manufacture, the Settling Rate is to be not less than 8 and material to be free from skin, lumps, gel and coarse particles - report results.
Fineness of Paint	AS 4049.3 (clause 6.1.2 and Appendix E) AS 1152	Not more than 0.1% paint remaining - report results.
Consistency	AS 4049.3 (clause 6.1.3) AS/NZS 1580.214.1	Within ± 5% of manufacturers specification - report results.
Application Properties – Spray Application	AS 4049.3 (clause 6.1.4) AS/NZS 1580.205.2 AS/NZS 1580.205.4	Smooth and uniform film, with even edges. As product is applied by spray, there should be no objectionable splatter and the gun does not clog under normal requirements - report results.
No-Pick-Up Time	AS 4049.3 (clause 6.1.5) AS/NZS 1580.401.8	≤ 5 minutes - report results.
Early Washout Resistance	AS 4049.3 (clause 6.1.6 and Appendix F)	≤ 120 minutes - report results.
Colour	AS 4049.3 (clause 6.1.7 and Appendix G) AS/NZS 1580.601.1 AS 2700	White: Approximate match to N14 White - report results.
Specular Gloss	AS 4049.3 (clause 6.1.8 and Appendix G) AS/NZS 1580.602.2	≤ 20 gloss units - report results. NOTE: Alternative gloss levels will be considered on a case by case basis by the APAS EO as any new product innovations develop.
Luminance Factor	AS 4049.3 (clause 6.1.9, Appendix H, Method 1)	White: ≥ 80% - report results.
Storage Properties	AS 4049.3 (clauses 6.1.10, 6.1.4 and Appendix C and D) AS/NZS 1580.214.1 AS/NZS 1580.103.1 AS/NZS 1580.211.1 AS/NZS 1580.211.2	<ul style="list-style-type: none"> Change does not exceed ± 5 Krebs Units from initial value. Report Initial and storage values. No skinning. Settling rate > 4. Readily reincorporated. Report all results.
Volatile Organic Content (VOC)	APAS AP-D181	≤ 60 g/L Report results.



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TEST:	APPLICABLE STANDARD / TEST REFERENCE:	REQUIREMENTS:
Performance Based Testing Requirements (Field Testing) ^{A, B}		
<p>Setting up Performance Based Testing:</p> <ul style="list-style-type: none"> Products must be applied as per manufacturer's specifications, typically by spray application to 150-200 µm wet film thickness. Glass beads are not to be applied to field-testing area. Due to the abrasive nature of this type of material, field testing must be performed within 3-6 months post-application. <p>NOTE:</p> <ul style="list-style-type: none"> Initial CLASS II (interim) certification will be granted on products based on satisfactory laboratory testing results. After initial 3-6 month CLASS II certification, product must undergo performance-based testing and all values reported. CLASS I status will only be granted on materials having undergone complete performance-based testing and satisfactory results obtained from such testing. 		
Degree of Wear	AS 4049.3 (Appendix K)	≥ 75 % after 3-6 months - report results.
Luminance	AS 4049.3 (clause 6.2.4, Appendix H Method 2)	White: Lighter than Natural Colour System (NCS) swatch S 2500-N - report results.
Skid Resistance	AS 4049.4 (clause 6.3.5 and Appendix J) and/or TP343	≥ 50 BPN or ≥ 0.55 Grip Number after 3-6 months - report results.
Slip Resistance	AS 4049.4 (clause 6.3.6) AS 4663 Appendix A and Table A1	≥ 35 BPN after 3-6 months - report results.

NOTE:

A: Laboratory Testing must be conducted by an ACE and field testing by a CRCL. From **31st July 2023**, all laboratory and field testing must be carried out by an AS ISO/IEC 17025 accredited facility with all applicable testing under its Scope of Accreditation. The NATA website can assist in identifying an appropriate testing facility <https://www.nata.com.au/>.

B: Performance Based Testing (Field Testing) can be conducted by the following CRCLs:

Australian Road Research Board (ARRB)
David Milling
Team Leader, Transport Safety
21 McLachlan Street, Fortitude Valley, QLD, 4006
Phone: +61 438 859 779
Email: david.milling@arrb.com.au

Department for Infrastructure & Transport – South Australia
George Spartalis
Technical Officer
Photometrics Laboratory, Road Asset Management Services
Phone: +61 8 8260 0578
Email: george.spartalis@sa.gov.au



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APPENDIX A

Document History

Status: Current
 Version: 1
 Date Published: 06-09-2022

Document Version No.:	Date Published:	Summary of Changes:
1 AP-S0041/6	06-09-2022	<ul style="list-style-type: none"> Updated SUSMP information.
0 AP-S0041/6	29-07-2021	<ul style="list-style-type: none"> Full Technical document review of APAS specification 0041 Separation of original specification (AP-S0041 V11) into pavement marking material types (Solvent-borne, CAP, Thermoplastics, Water-borne and Airport Pavement Markings); this document is now referenced as AP-S0041/6 Pavement Marking Material – Airport Runway Markings Document brought in line with requirements of AS/NZS ISO/IEC 17065 General formatting update Inclusion of clause 4 Definitions and Acronyms Inclusion of clause 5 b) Reference material Inclusion of clause 7.1 b) & c) regarding CLASS I & II requirements Inclusion of 7.2 a), b) & c) regarding testing requirements Revision of laboratory based testing parameters for Colour, Specular Gloss, Luminance Factor and VOC Expansion of performance based testing parameters (field testing) relating to colour change and slip resistance Inclusion of alternative CRCL for Field Testing - ARRB
11 AP-S0041	10-11-2020	<ul style="list-style-type: none"> Addition of Appendix A Document History and removal of the Editorial Note previously used in specification versions Updated document to the current format Updated internal and external document references Inclusion of VOC Content requirement to Table 1 Performance Properties Updated Note C contact information Addition of "People + Product = Protection" to Footer
10	16-10-2015	<ul style="list-style-type: none"> Clarified requirements for runway, apron and taxiway markings for sub-class 0041/6
9	23-03-2015	<ul style="list-style-type: none"> Underwent a major revision with the inclusion of requirements for sub-class 0041/3 cold applied products and 0041/6 airport marking
8	10-01-2013	<ul style="list-style-type: none"> Added sub-class 6, underwent a general update and the field-testing details in Table 1 were updated
7	03-05-2007	<ul style="list-style-type: none"> Aligned the specification with the revised AS 4049 – 2005
6	13-02-2001	<ul style="list-style-type: none"> Initiated the second stage of the move to new specification numbering with prominence given to the new number (previously GPC-P-41)