

PAVEMENT MARKING MATERIAL – COLD APPLIED PLASTIC

1 SCOPE

- a) This specification applies to Cold Applied Plastic for use as a pavement marking material.
- 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 is applied to the following types of surfaces and areas, both in on-road and off-road applications, in order to increase their safe use:
 - i. Bituminous – Asphalt or Spray Seal roads
 - ii. Concrete roads
 - iii. Paved paving
 - iv. Car parks
 - v. Bus lanes, cycle lanes and pedestrian crossings
- d) Safe use of these pavement surfaces is facilitated through:
 - i. Brighter lines to separate traffic on both minor and major roads
 - ii. Introduced order in carparks and public spaces
 - iii. Delineation of roads
- 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) Pavement marking materials are used by road authorities to:
 - i. Improve road safety and other surfaces used to carry all types of traffic including cars, trucks, pedestrians, cyclists, busses and aircraft.
 - ii. Provide delineation, acting as a guide to drivers to maintain their respective lane position, deterring accidents and providing direction.
- b) Because of these functions, pavement marking materials must withstand many different types of wear and still perform as required.
- c) When selecting a pavement marking material, several performance factors should be considered including, but not limited to, the roadway surface i.e., smooth or

rough, heat sensitivity, porosity, traffic volume, and environmental conditions.

- d) Pavement marking material durability is dependent on many factors including, but not limited to, traffic volume, location of the lines, application rates, retroreflectivity, performance of the material under various traffic conditions, location of the lines and individual product durability. Depending on the circumstances, centre and lane lines can be painted yearly, and edge lines two-yearly but in high traffic volume areas, such lines can require repainting up to four times a year. More durable materials, such as Cold Applied Plastics and Thermoplastic, have been shown to reduce the frequency in pavement material marking application.
- e) Cold Applied Plastics (CAP) are cold curing two (or more) component resin based systems that are typically 100% volume solids. A typical binder is methyl methacrylate, but other forms of binder technology exists, such as Polyaspartic.
- f) Cold Applied Plastics are very durable, have high chemical resistance and are high performing. They have excellent wear properties and the ability to obtain higher retroreflectivity and skid resistance values when applied as part of a system. CAP products have been widely and successfully used in the USA, parts of Europe and Australia, for the last 30+ years.
- g) Cold Applied Plastics are classified by their modes of application:
 - i. **Roll-on:** Applied with a paint roller; premixed coloured product without intermixed glass beads used in broad area markings; can be applied with or without surface applied glass beads and anti-skid media.
 - ii. **Trowel:** Applied with a cement finishers hand trowel to predefined limits, providing sharp high-build levels as seen in intersection markings, legends and arrows; premixed products combining both glass beads and anti-skid media into the product, providing retroreflectivity and anti-skid properties for the life of the marking. Trowel application is not suited to longitudinal lines.
 - iii. **Screed:** Can either be applied using a hand box screeder (for use in intersection markings) or applied with a machine using auto-catalysation for longitudinal line work in the application of ATLM, generally containing intermixed glass beads.
 - iv. **Spray:** Machine applied with auto-catalysation, used on highway lines; the product sprayed does not necessarily, but may contain intermixed beads and/or anti-skid material.
 - v. **Extruded:** Machine applied with auto-catalysation, used on highway lines and ATLM; the extruded product may contain intermix beads and anti-skid material.
 - vi. **Structured:** Machine applied; as CAP has better adhesion to road surfaces, application patterns can be produced in a number of ways such as agglomerates (typically on open graded asphalt), multi-dots, checker board pattern and a dotted lines can be achieved, producing a solid line effect

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in line marking and may contain intermixed glass beads.

NOTE: Spray and extruded CAP is available in two forms: 1:1 or 98:2 base to catalyst ratios, both of which require different equipment for application.

- h) CAP product use can be especially applicable to high wear road conditions, such as intersections, as the cost associated with the use of higher durability products can be justified under these circumstances.
- i) Due to the higher durability of CAP, and by varying the viscosity of the material, higher film builds are able to be achieved, including use as ATLM. The hardness formed by the cured film also aids in glass beads not emerging to the surface. Caution must be used in ensuring the correct film build is used in the right area. For example, thinner film builds can be used in transverse intersection lines (2mm) and all other areas can go as low as 1mm, whereas wheel path and higher wear areas can achieve 3mm film builds. The thicker the film build, the greater tendency for the anti-skid and retroreflectivity to significantly decrease over time, so is better suited to well-lit areas. Although with the proper formulation, film builds can vary from 250 µm and 10mm, the typical application thickness is under 5mm.
- j) CAP products typically consist of methyl methacrylate, fillers, pigments, Dibenzoyl Peroxide (BPO) which acts as a catalyst (added separately), and glass beads (such as Type B or B-HR and Type C or C-HR, the latter are also known as Intermix beads). The resin is thermosetting, has excellent adhesive properties and forms an extremely hard film when cured.
- k) Surface applied glass beads, such as B-HR (on transverse and other types of road markings) and/or D-HR (on longitudinal line marking), are also used in conjunction with cold applied plastics to provide retroreflectivity under all conditions. The HR glass bead types have been adopted by the majority of road authorities for use in main road production and maintenance due to their superior retroreflectivity for only a small cost increase. Standard glass beads are generally used in car parking applications.

NOTE: Glass beads are certified by APAS under specification AP-S0042.

- l) Due to the hard nature of a cured CAP film, it can have the tendency to polish to a glass-like finish. To counteract this, surface applied anti-skid media and glass beads (with or without adhesion coatings) can be added at the time of application, depending on the specification requirement or applicator preference. Anti-skid media typically consists of crushed quartz, crushed glass, calcined bauxite aggregates or other approved materials, and use with CAP is application dependant. Anti-skid media are angular, polishing-resistant and generally coloured to match the markings.
- m) Coloured CAP products are used in a variety of road, line and pavement marking applications:
 - i. **White:** longitudinal line marking and road marking

- ii. **Yellow:** longitudinal line marking and road marking, such as parking restriction lines and markings above the snow line
 - iii. **Red:** bus lanes
 - iv. **Green:** cycle lanes and high conflict areas
 - v. **Various other colours** (i.e., blue, orange etc.,) chevrons, words, numerals and other miscellaneous road markings
 - vi. **Matt Grey and Matt Black:** typically used for ATLMs when offset to provide audio tactile response on centre lines; as they do not provide visibility or contrast, they do not contain glass beads.
- n) CAP products have good adhesion to most clean dry surfaces, however some suit CAP better than others:
- i. **Asphalt:** New asphalt has a long cure time (30+ days) so is best initially marked with water-borne pavement marking paint (that can be applied in the cure time) then overlaid by CAP as these two types of material are compatible.
 - ii. **Concrete:** Also has a 30+ day cure time but the adhesion of CAP to concrete is less than asphalt so may require surface preparation and the use of a primer to aid the process.
 - iii. **Pavers:** CAP has particularly good adhesion and flexibility around joints but may require surface preparation and the use of primer.
 - iv. **Spray Seal:** CAP adheres well but as the marking material is stronger than the substrate, could cause the substrate to dislodge and act as a projectile, as seen with ATLM.

3.2 Sub-Classes

- a) This specification incorporates the following sub-classes:
- i. **0041/3.1:** Roll-on
 - ii. **0041/3.2:** Trowel
 - iii. **0041/3.3:** Screed
 - iv. **0041/3.4:** Spray
 - v. **0041/3.5:** Extruded
 - vi. **0041/3.6:** Structured

3.3 Basis of this Specification

- a) This specification is based primarily on AS 4049.4, AS 4049.5, industry standards and specifications, and road authority standards and specifications.

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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) **Audio Tactile Line Marking:** Raised ribs applied to the road surface to provide a tactile, audio and visual response, also referred to as a type of profile pavement marking; can be in any colour, but are typically white, grey or black; generally produced with CAP or thermoplastic materials but are not limited to this technology; white ATLMs contain intermix beads. There are historically two types:
 - i. **Continuous:** Raised ribs applied at regular intervals over a base strip layer of the same material; this type is generally not used anymore.
 - ii. **Discontinuous:** Raised ribs placed directly on road surface.
- c) **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.
- d) **Cold Applied Plastic:** Two (or more) component thermosetting resin, typically methyl methacrylate, suitably pigmented to obtain the depth of colour required for the end application, provide adhesion to aggregate, glass beads and substrate. Must be resistant to fuel and oils found in traffic situations, be non-flammable after placement and curing on roads, be free from lead and heavy metals, UV stable, able to withstand mechanical and manual street cleaning and not emit offensive odours.
- e) **Coloured Surface Markings:** Provide a trafficable coloured surface for enhanced delineation for a specific road use i.e., bus lanes, cycleways, school crossings; consist of a coloured cold applied plastic used in conjunction with coloured aggregate.
- 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 line markings, transverse line markings and pavement messages for the purpose of guiding traffic.
- h) **Retroreflectivity:** The value of reflected light measured in millicandela / square metre / incident lux (mcd/m²/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 as stop and give way lines, turn lines, markings at stop and give way signs, pedestrian crossway lines, diagonal and chevron markings, arrows, shapes, symbols, numerals, parking areas and kerb markings.

4.2 Acronyms

ACE	Agency for Conformity Assessment
APAS	Australian Paint Approval Scheme
ATLM	Audio Tactile Line Marking
CAP	Cold Applied Plastic
CRCL	CSIRO Recognised Competent Laboratory
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EO	Executive Officer, APAS
PDS	Product Data Sheet
SDS	Safety Data Sheet
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
TDS	Technical Data Sheet
VOC	Volatile organic compounds
WHS	Workplace Health and Safety

5 REFERENCED DOCUMENTS

- a) The following standards are referenced in this document:
 - i. **AS/NZS 1580** – Paints and related materials: Methods of test.
 - ii. **AS/NZS 2009** – Glass beads for pavement-marking materials
 - iii. **AS 2700** – Colour standards for general purpose
 - iv. **AS 4049.1** – Paints and related materials – Pavement marking materials – Part 1: Solvent-borne paint - For use with surface applied glass beads
 - v. **AS 4049.2** – Paints and related materials – Pavement marking materials – Part 2: Thermoplastic pavement marking materials – For use with surface applied 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 2021:** Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) No. 33, 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/F2021L00650>

- 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

- 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, New Zealand Transport Agency
 - iii. QA Specification 3360 Two Part Cold Applied Road Marking Material, Transport for NSW (TfNSW)
 - iv. QA Specification R110 Coloured Surface Coatings for Bus Lanes and Cycleways, Transport for NSW (TfNSW)
 - v. QA Specification R145 Pavement Marking (Performance Based), Transport for NSW (TfNSW)
 - vi. RIAA Industry Guide: Series 1 – Facilities Pavement Marking, 1.1 Off Street Parking Facilities Marking Guide
 - vii. RIAA Industry Guide: Series 2 – Materials, 2.1 Cold Applied Plastic
 - viii. Section 721 – Pavement Markings, VicRoads
 - ix. Section 971 – Pavement Marking Materials, Florida Department of Transport
 - x. Specification 604: Pavement Marking, Main Roads QA
 - xi. Specification M16 Application of Pavement Marking, DPTI
 - xii. SWA-0-QA-SPE-0610 Pavement Marking (All Lane Running Section), SmartWays Alliance
 - xiii. Transport and Main Roads Specifications MRTS45 Road Surface Delineation, Department of Transport and Main Roads QLD
 - xiv. Traffic and Road Use Management Volume 3 – Signing and Pavement Making, Part 4: Materials and Equipment, Department of Transport and Main Roads QLD
 - xv. TNZ M/20 Specification for Long-life Roadmarking Materials, Transit New Zealand

- 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-S0042 Glass beads for Use in Pavement Marking Paints

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) The binder types used in cold applied plastic products are typically a cold peroxide cured acrylate-based material, such as methyl methacrylate, but are not limited to this technology. Other technology types, such as Polyaspartic, can also be employed.
- 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 volatile, non-aqueous solvents (solvent-based products), **or** non-volatile aqueous solvents (water-based products).
- b) For VOC content restrictions, refer to APAS document AP-D181.

6.3 Pigmentation

- a) Pigments used shall be non-toxic, non-corrosive, lead-free and either organic or inorganic in nature (for coloured products), complying with the requirements of the SUSMP
- b) Primary importance is placed on the ability of the pigmentation to be compliant with the technical requirements clause 8, Table 1 below.

6.4 Glass Beads

- a) All glass beads used in the production of any cold applied plastic product, such as (but not limited to) Type C or C-HR (intermix) beads, **must be APAS approved prior** to application of the cold applied

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plastic product for certification. For further information, refer to APAS specification AP-S0042.

- b) Evidence of the approval of glass beads used in the production of the cold applied plastic, such as valid, non-expired APAS Certificate of Product Conformity, must be provided at the time of product submission / re-submission.

6.5 Colour

- a) Longitudinal and transverse pavement markings are typically white and yellow.
- b) Transverse (and other pavement markings) can also be a variety of colours, typically but not limited to white, yellow, red (bus lanes), green (cycle lanes), blue, grey and black. Refer to the manufacturer's Technical Data Sheet (TDS) or Product Data Sheet (PDS) for further information.

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. Three (3) years 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., 4 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.
- d) Performance based testing is typically to be undertaken on the **white** product only due to coloured

materials representing lower market volumes, making them exempt from field testing. This exemption only exists **provided that** coloured materials are based on the same formulation (specifically the binder system) as the white product. Yellow products of the same formulation can be substituted in the absence of white.

- e) If a coloured material is the only product seeking certification, then it must also undertake the performance-based testing requirements of clause 8, Table 1.

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) If the product is solvent-borne, it is considered flammable and should be stored away from all sources of heat or ignition.
- d) Solvent-borne product 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.
- e) Care should be taken to avoid contact with the skin using protective clothing and barrier cream where necessary.
- f) 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

COMPOSITIONAL REQUIREMENTS		
<p>Compositional Requirements</p> <ul style="list-style-type: none"> Theoretical calculations are to be conducted on the liquid component as supplied without including the Part B peroxide component or any surface applied materials. NOTE: For CAP products seeking certification that do not meet the Compositional Requirements below, submissions will be considered on a case by case basis by the APAS EO. 		
Minimum Resin Content	Theoretical Calculation	<p>Product Formulations containing Intermix (Type C or C-HR) Glass beads: 18% minimum*; report results.</p> <p>Product formulations that do not contain Intermix (Type C or C-HR) Glass beads: 38% minimum*; report results.</p> <p>NOTE: * For CAP product submissions that do not use the typical methyl methacrylate binder, minimum binder levels / glass bead combinations will be considered on a case by case basis by the APAS EO.</p>
Glass Bead Content	Theoretical Calculation	<p>Product Formulations containing Intermix (Type C or C-HR) Glass beads: 24% minimum[^]; report results.</p> <p>Product formulations that do not contain Intermix (Type C or C-HR) Glass beads: 0% minimum[^]; report results.</p> <p>NOTE: [^] As advancements in Intermix glass beads occur, lower performance criteria for the same formulation may occur. This will be considered on a case by case basis by the EO</p>
Pigment Type (White Only)	Theoretical Calculation	Typically, but not limited to, Rutile TiO ₂ .
Pigment Type (Other Colours)	Theoretical Calculation	Inorganic or Organic pigments.

TEST:	APPLICABLE STANDARD / TEST REFERENCE:	REQUIREMENTS:
Laboratory Testing Requirements ^A – Applicable to all Sub-classes		
Application Properties	AS 4049.1 (clause 7.1.4) AS/NZS 1580.205.1 AS/NZS 1580.205.3 AS/NZS 1580.205.2 AS/NZS 1580.205.4	Smooth and uniform film, with even edges. If applied by spray or machine application, there should be no objectionable splatter and the gun does not clog under normal requirements - report results.
No-Pick-Up Time	AS 4049.1 (clause 7.1.5) AS/NZS 1580.401.8	<p>0041/3.1, 0041/3.2, 0041/3.3 & 0041/3.4: ≤ 20 minutes - report results.</p> <p>0041/3.5 & 0041/3.6: > 20 to < 45 minutes - report results.</p>



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TEST:	APPLICABLE STANDARD / TEST REFERENCE:	REQUIREMENTS:
Laboratory Testing Requirements ^A – Applicable to all Sub-classes (Cont.,)		
Colour	AS 4049.4 (clause 6.2.2 and Appendix F) AS/NZS 1580.601.1 AS 2700	White: Approximate match to N14 White. Alternative colour is whiter than Y35 Off white. Yellow: Approximate match to Y14 Golden Yellow. Alternative colours are Y12 Wattle, Y13 Vivid Yellow or Y15 Sunflower. Red: Approximate match to R13 Signal Red. Alternative colours are R53 Redgum, R54 Raspberry or R62 Venetian Red. Blue: Blue: Approximate match to B21 Ultramarine. Alternative colours are B12 Royal Blue, B23 Bright Blue, B24 Harbour Blue or B41 Bluebell. Green: Approximate match to G13 Emerald Green. Alternative colours are G16 Traffic Green, G23 Shamrock or G35 Lime Green. Black: Approximate match to B64 Charcoal. Alternative colour is N61 Black. NOTE: <ul style="list-style-type: none">• Alternative colours (i.e., grey) may also be tested as per requirements of road authorities.• Colours must be compared to and equivalent to a known AS 2700 colour. State colour designation and results.• No glass beads (intermix or surface applied) are typically used with grey and black coloured materials.
Abrasion Resistance	AS 4049.2 (clause 6.5) AS/NZS 1580.403.2	Test run using CS17 abrasion wheels, 1000g applied weight ≤ 50mg weight loss after 500 cycles - report results.
Luminance Factor	AS 4049.4 (clause 6.2.1, Appendix F and Appendix H)	White: ≥ 80 % - report results. Yellow: ≥ 50 % - report results. Black: ≤ 5 % - report results. Grey: > 5 % - < 15 % - report results. Other Colours: ≥ 15 % - report results.
Volatile Organic Content (VOC)	APAS AP-D181	< 5 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: Applicable Standard / Test Reference and Requirements</p> <ul style="list-style-type: none"> Refer to AS 4049.2 (clause 8.1 and Appendix K) for high performance road marking materials. As this standard relates directly to Thermoplastic material application, adjustments need to be made accordingly for cold applied product equipment and application. Products applied with the following parameters depending on application type: <ol style="list-style-type: none"> 1. For Longitudinal Line Marking (Sprayed, Extruded or Structured): <ol style="list-style-type: none"> a) Sprayed*: 0.75 - 1 mm ± 100µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR beads applied at > 400 g/m² ± 25 g/m² bead rate with 1-2 mm anti-skid media applied at 200g/m² b) Extruded: 1-2 mm ± 100µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR beads applied at > 400 g/m² ± 25 g/m² bead rate with 1-2 mm anti-skid media applied at 200g/m² c) Structured: 1-12mm ± 100µm WFT (depending on the pattern used i.e., agglomerate, dot, ATLM, or manufacturer's specified wet/dry film thickness) using Type B-HR beads applied at > 400 g/m² ± 25 g/m² bead rate with 1-2 mm anti-skid media applied at 200g/m² 2. For Transverse or other line marking types (Rolled, Trowelled, Screeded, Sprayed or Extruded): <ol style="list-style-type: none"> a) Rolled: 2-3 mm ± 100µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR applied at > 300g/m² ± 25 g/m² bead rate with 0.4 - 0.7 mm anti-skid media applied at 200g/m² b) Trowelled: 2-3 mm ± 100µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR applied at > 300g/m² ± 25 g/m² bead rate with 0.4 - 0.7 mm anti-skid media applied at 200g/m² c) Screeded: 2-3 mm ± 100µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR applied at > 300g/m² ± 25 g/m² bead rate with 0.4 - 0.7 mm anti-skid media applied at 200g/m² d) Sprayed: 1-2 mm ± 100µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR applied at > 300g/m² ± 25 g/m² bead rate with 0.4 - 0.7 mm anti-skid media applied at 200g/m² e) Extruded: 1-3 mm ± 100 µm WFT (or manufacturer's specified wet/dry film thickness) using Type B-HR applied at > 300g/m² ± 25 g/m² bead rate with 0.4 - 0.7 mm anti-skid media applied at 200g/m² <p>NOTE: * For Longitudinal markings with surface applied glass beads and anti-skid materials, apply the glass beads first followed by anti-skid</p> <p>Measurements are to be taken at three intervals as specified below and all values reported:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">Substrate Type:</th> <th style="width: 25%;">Initial Measurement Point (IMP):</th> <th style="width: 25%;">Interim Measurement Point (INMP):</th> <th style="width: 25%;">Final Measurement Point (FMP):</th> </tr> </thead> <tbody> <tr> <td>Asphalt (or other substrate types)</td> <td>After application / cure</td> <td>2,000,000 vehicle passes</td> <td>4,000,000 vehicle passes[^]</td> </tr> <tr> <td>Spray Seal</td> <td>After application / cure</td> <td>500,000 vehicle passes</td> <td>1,000,000 vehicle passes[^]</td> </tr> </tbody> </table> <p>NOTE: [^] Substrates must be subjected to specified number of vehicle passes in a 3 to 18 month period post application.</p>			Substrate Type:	Initial Measurement Point (IMP):	Interim Measurement Point (INMP):	Final Measurement Point (FMP):	Asphalt (or other substrate types)	After application / cure	2,000,000 vehicle passes	4,000,000 vehicle passes [^]	Spray Seal	After application / cure	500,000 vehicle passes	1,000,000 vehicle passes [^]					
Substrate Type:	Initial Measurement Point (IMP):	Interim Measurement Point (INMP):	Final Measurement Point (FMP):																
Asphalt (or other substrate types)	After application / cure	2,000,000 vehicle passes	4,000,000 vehicle passes [^]																
Spray Seal	After application / cure	500,000 vehicle passes	1,000,000 vehicle passes [^]																
Degree of Wear	AS 4049.4 (clause 6.3.4 and Appendix L)	≥ 95 % remaining intact at FMP in the wheel path																	
Dry Retroreflectivity	AS 4049.4 (clause 6.3.3 and Appendix K Method 1)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Colour:</th> <th style="width: 25%;">IMP mcd/m²/lx</th> <th style="width: 25%;">INMP mcd/m²/lx</th> <th style="width: 25%;">FMP mcd/m²/lx</th> </tr> </thead> <tbody> <tr> <td>White</td> <td>≥ 350</td> <td>≥ 300</td> <td>≥ 150</td> </tr> <tr> <td>Yellow</td> <td>≥ 300</td> <td>≥ 250</td> <td>≥ 150</td> </tr> <tr> <td>Other colours</td> <td>≥ 250</td> <td>≥ 200</td> <td>≥ 150</td> </tr> </tbody> </table> <p>For ATLM (White only): ≥ 150 mcd/m²/lx</p> <p>Report all results.</p>		Colour:	IMP mcd/m ² /lx	INMP mcd/m ² /lx	FMP mcd/m ² /lx	White	≥ 350	≥ 300	≥ 150	Yellow	≥ 300	≥ 250	≥ 150	Other colours	≥ 250	≥ 200	≥ 150
Colour:	IMP mcd/m ² /lx	INMP mcd/m ² /lx	FMP mcd/m ² /lx																
White	≥ 350	≥ 300	≥ 150																
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SPECIFICATION AP-S0041/3



PAVEMENT MARKING MATERIAL – COLD APPLIED PLASTIC

TEST:	APPLICABLE STANDARD / TEST REFERENCE:	REQUIREMENTS:
Performance Based Testing Requirements (Field Testing) ^{A, B} (Cont.,)		
Wet Retroreflectivity	AS 4049.4 (clause 6.3.3, Table 4, Appendix K Method 2)	Applicable to all substrate types and all colours (except grey and black): ≥ 80 mcd/m ² /lx at all times NOTE: Measurements to be taken at IMP, INMP, FMP and results reported.
Luminance	AS 4049.4 (clause 7.3.7, Appendix H Method 2)	White: Lighter than Natural Colour System (NCS) swatch S 2500-N - report results. Yellow: Approximate match to Natural Colour System (NCS) swatch S 1070-Y20R - report results. NOTE: This is applicable to white and yellow materials only, refer to Colour Change for all other colours.
Colour Change	AS 4049.4 (clause 6.3.8 and Appendix G)	All colours assessed at IMP, INMP, FMP testing points must have results ≥ 3 on grey scale. NOTE: Only colours are assessed in this method, refer to Luminance for white and yellow material testing.
Skid Resistance	AS 4049.4 (clause 6.3.5 and Appendix J) and/or TP343	≥ 45 BPN or ≥ 0.55 Grip Number NOTE: Must be tested at two pre-determined locations within the field testing area and locations reported.
Slip Resistance	AS 4049.4 (clause 6.3.6) AS 4663 Appendix A and Table A1	≥ 35 BPN
Visibility	AS 4049.5 (clause 8.3.1 and Appendix C)	Markings must be easily recognisable and clearly visible and must meet the minimum visual performance levels for Transverse (and other) markings (Table C1) or Longitudinal markings (Table C2), whichever is applicable. A minimum of 5 testing locations over the length of a road must be assessed; record and report all measurements, the weather, on-road and lighting conditions.

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
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SPECIFICATION AP-S0041/3



PAVEMENT MARKING MATERIAL – COLD APPLIED PLASTIC

9 APPENDIX A

Document History

Status: Current
 Version: 1
 Date Published: 26-08-2021

Document Version No.:	Date Published:	Summary of Changes:
1	26-08-2021	<ul style="list-style-type: none"> Updated No Pick Up test requirements to be more applicable to current technology products
0 AP-S0041/3	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-S0041/3 Pavement Marking Material – Cold Applied Plastic Document brought in line with requirements of AS/NZS ISO/IEC 17065 General formatting update Update to include clause 3.2, six sub-classes – 0041/3.1, 0041/3.2, 0041/3.3, 0041/3.4, 0041/3.5 & 0041/3.6 Inclusion of clause 4 Definitions and Acronyms Inclusion of clause 5 b) Reference material Inclusion of clause 6.4 regarding certification requirements of glass beads use in the production of CAP products 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 Luminance and inclusion of additional testing for application properties and no pick up time Expansion and revision of performance based testing parameters (field testing) relating to increased number of minimum vehicle passes, dry and wet retroreflectivity, luminance, colour change, slip and skid resistance and visibility 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)