

NZRF ROADMARKING MATERIALS GUIDE

Rev 3
2022



NZRF Roadmarking Materials Guide – Introduction

Introduction

The NZ Roadmarkers Federation developed the roadmarking materials guide in 2004 and undertook the first revision in 2009 with further revision in 2022. It brings together technical information about the range of marking materials, and associated products that are used by the pavement marking industry.

This version of the guide has involved consultation with industry.

All information not contributed by industry has been sourced from the public domain.

The guide should be regarded as a 'work in progress' and we welcome feedback from industry to make the document appropriate to users' needs. We particularly welcome information from users on recorded environmental hazards, and recorded health and safety incidents.

As this is a general guide, please follow all supplier recommendations specific to their products and ensure the regulations mentioned are still current.

Review and Amendment

This document has been revised by the New Zealand Roadmarkers Federation Inc (NZRF).

All information contained in it has been prepared in good faith by the NZRF and is, to the best of our knowledge, correct and complete. While every care has been taken in the preparation of the information provided, no warranty is given by the NZRF as to the correctness of the information herein and no liabilities accepted for any statement or opinion, nor for any error or omission.

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1 Materials covered

Paint

- Waterborne Paint
- Polymer Modified Solvent Based Paint
- Chlorinated Rubber Modified Alkyd
- Alkyd

Cold-Applied Plastic

Thermoplastic

- Powder / granulated/ solid
- Pre-formed (sheet form)

Self Adhesive Tapes

- Permanent Standard Flat
- Permanent High Performance
- Temporary / Removable

Glass Beads / Retroreflective Media

- Standard Refractive Index Glass Beads
- High Index Glass Beads

Angular Material

- Quartz
- Silica
- Corundum

Solvents

- Alkyd Paint Thinners
- Chlorinated Rubber Thinners
- Waterborne Thinners
- Cold Applied Plastic Thinners

Catalysts

- Waterborne Paint Catalysts
- Benzyl Peroxide

NZRF Roadmarking Materials Guide – Materials Covered

Raised Pavement Markers (RPM's)

- Permanent Retroreflective (Type A AS 1906.3)
- Permanent Non Retroreflective (Type B AS 1906.3)
- Snow-Ploughable Retroreflective
- Road Studs
- Illuminated
- Temporary – “Flickies”

RPM Adhesive

- Bituminous
- Two Component Adhesive
- Self-adhesive Pads
- Burn on Pads

Pavement Overlay Binders

- Epoxy
- Polyurethane
- Cold applied Plastic (see above)
- Thermoplastic (see above)

Cement Based Coatings

- Roller Applied
- Spray Applied

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2 Generic Headings

It is envisaged that each of the following headings is used to provide a repository for the material relating specifically to the item being discussed. Where this material exceeds two paragraphs a summary will be provided. If there is no data for a heading it is not included.

1. General Description
2. Composition
3. Physical Properties
4. Performance Properties
5. Durability
6. Compatibility
7. Adhesion
8. Application Parameters
9. Manufacturing Process
10. Testing of Physical Properties
11. Handling, Storage and Packaging
12. Environmental Impacts
13. Occupational Health and Safety Hazards
14. Application Process
15. Process Monitoring Equipment
16. Post-Application Measuring Equipment
17. Test Methods
18. Quick Reference Safety Guide
19. Recorded Environmental Hazards
20. Recorded Health and Safety Incidents
21. Related National / International Standard Specifications
22. Useful References

3 Heading Content and Scope

General Description

Basic description of the product / material. may include definition.

Composition

Description of the typical composition of the component parts of the raw materials used to produce the item.

Physical Properties

List of the physical properties of the product / material, e.g. density, hardness, etc

Performance Properties

List of the performance properties relating to the use of the material in pavement marking, i.e. properties such as skid resistance, retroreflectivity and colour as specified by the relevant Road Controlling Authority, National, or International Specification.

Durability

Description of the typical performance of the product under prescribed pavement surface conditions. Values for resistance to trafficking, UV exposure and weathering are provided where these are available. The source of the material, e.g. NZTA M Series, International Standards (AS 4049, EN 1824, etc), APAS, will be provided.

Compatibility

Description of the known compatibility of the product / material with common pavement surfaces and other pavement marking materials currently in use. Will provide guidance to known primers and or surface preparation adhesives where possible. (Surface preparation adhesive is an American term used due to VOC classification considerations)

Adhesion

Description of the known adhesion properties of the product / material to commonly used pavement surfaces. Will provide guidance to known primers and surface preparation adhesives / adhesion techniques where possible.

Application Parameters

Description of the parameters which need to be complied with for product to perform as intended by the manufacturer / supplier.

NZRF Roadmarking Materials Guide – Heading Content and Scope

Manufacturing Process

Brief description, where available, of the process by which the product / material is manufactured or prepared for supply to the pavement marking contractor.

Testing of Physical Properties

Description of the testing methods relating to the product / materials physical properties.

Handling, Storage and Packaging

Description of the physical handling methods, storage requirements and packaging associated with the product / material. Includes transport Dangerous Goods Information.

Note: Occupational Health and Safety Issues will be dealt with separately

Environmental Impacts

Description, where available, of the possible / likely impact on the natural environment. May include precautions or methods to manage these impacts in accordance with the New Zealand Resource Management Act (RMA) 1991 and Hazardous Substances and New Organisms Act (HSNO) 1996.

Occupational Health and Safety Hazards

Description of the Occupational Health and Safety issues relating the use / application of the material / product. May include precautions for use to manage these risks in accordance with the New Zealand Health and Safety at Work Act (HSWA) Act 2015, subsequent amendments and associated Regulations.

Application Process

Description of the application process intended by the manufacturer / supplier or in common use.

Process Monitoring Equipment

Description of the process monitoring equipment and methods normally associated with the application of the material / product.

Post - Application Measuring Equipment

Description of the measuring equipment commonly associated with the measurement of the performance and / or characteristics of the product / material after application.

Test Methods

Description of the methods used to measure the parameters related to the installed product / resultant markings.

NZRF Roadmarking Materials Guide – Heading Content and Scope

Quick Reference Safety Guide

Brief description of the safety items relating to the material / product. Will summarise the material on Safety Data Sheets.

Recorded Environmental Hazards

Recounted and reported stories of impacts on the environment encountered / observed by users / suppliers.

Recorded Health and Safety Incidents

Recounted and reported occupational health and safety incidents.

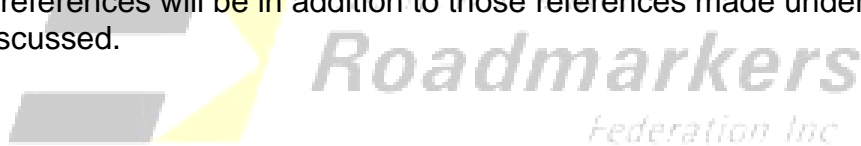
Related Road Controlling Authority / National / International Standard Specifications

A catalogue of the Road Controlling Authority, National and International Standard Specifications relevant to the use / application of the material / product.

Useful References

Identification of classic text / reference material relating to the product / material.

Note: These references will be in addition to those references made under the particular item being discussed.



4 General Descriptions

4.1 Paint

Definition: A liquid containing pigments which converts to an opaque film on drying. Pigments are dispersed in a binder with a solvent that is either hydrocarbon based or water.

Roadmarking paints are specially blended to provide low gloss and low skid and slip values. Both solvent based and waterborne paint types are used. Solvent based paints can be modified by the addition of materials such as chlorinated rubber to enhance glass bead retention. Waterborne paints may be either catalysed or un-catalysed.

Typically applied by spraying in dry film thicknesses varying typically from 200 µm to 500 µm. Application rate dependent on the product type, purpose, required life and type of surface dressing applied to marking.

May include or have surface applied glass beads to provide retroreflectivity and improve skid resistance. May also include surface applied aggregate to provide appropriate skid and slip resistance values.

Roadmarking paint was first applied as a centreline in Michigan, USA in 1911, followed by Europe shortly after.

There has been an ongoing world-wide movement towards waterborne, high volume solids paint in an endeavour to limit the release of excessive quantities of volatile organic compounds (VOC) into the atmosphere.

In Australia, the Australian Paint Approval Scheme (APAS) has set limits for VOC's. In New Zealand, the New Zealand Ecolabelling Trust requires that VOC's are limited (60 to 100 gm/l) for the paint to carry the Environmental Choice label. The level of solvents such as toluene in the solvent based paints, and the levels of ammonia in the current waterborne paints would preclude them from Ecolabelling.

Paint is the most common form of marking applied in New Zealand, although there is a move towards high solids and long life materials.

4.2 Cold-Applied Plastic (CAP)

Definition: A cold hardening 2-part poly methyl methacrylate (PMMA) resin material. The material may include glass beads and angular material.

CAP roadmarking material is tailored for specific application methods such as audio-tactile profiled (ATP) markings, structured/multi dot markings and plain flat markings. All types come in white or lead free yellow. All are catalysed by benzoyl peroxide. Applied at thicknesses from 400 µm up to 15 mm.

NZRF Roadmarking Materials Guide - General Descriptions

Glass beads are typically applied to the surface of the marking to provide retroreflectivity, and skid and slip resistance.

High film build applications of CAP can be refreshed if their retroreflectivity level drops below an acceptable level through the application of a spray applied CAP or paint marking system with surface applied glass beads.

CAP was developed in 1933 and manufactured for particular uses under licence. Roadmarking forms have been used in Europe since 1966. It was first used for pavement marking in New Zealand in 1968.

4.3 Thermoplastic

Definition: A material consisting of aggregate, pigment, binder, glass beads and extenders, capable of being softened by heating and hardened by cooling.

Thermoplastic binders are either alkyd or synthetic. Roadmarking material is tailored for specific application methods such as audio-tactile profile (ATP) markings, multi dot markings and plain flat markings. All types come in white or lead free yellow.

Applied at thicknesses varying from 0.5 mm to 13 mm. The glass beads, normally in the range of 20 to 40percent by mass, and aggregates bound by the other material, progressively become exposed with wear to maintain night visibility and skid and slip resistance.

Glass beads re typically surface applied to provide initial retroreflectivity, and skid and slip resistance.

Developed in UK during World War 2 to aid motorists during “blackout” periods.

4.4 Self-Adhesive Tapes

Definition: A pre-formed adhesive backed product, generally in roll or pre-cut form relying on pressure on the adhesive to create a bond with the pavement surface.

A variety of materials may be used. Tapes may be either hot or cold applied. Tapes are classified as permanent or temporary / removable

4.5 Raised Pavement Markers

Definition: A “standard non retro-reflective raised pavement marker” “RPM” is a small ceramic, plastic or metallic object adhered to the pavement surface aimed at providing audible / tactile feedback to motorists.

Note: In common usage the term “RPM” can include both RPM’s and RRPM’s

Definition: A “standard retro-reflective raised pavement marker” “RRPM” is a small plastic or metallic object adhered to the pavement surface aimed at providing both audible / tactile feedback and night-time delineation to motorists. The night-time delineation is provided by reflecting vehicle headlights in a narrow-focused beam back to the motorist.

Definition: A “glass faced” or “ceramic faced” RRPM denotes a marker that has an additional protective layer over the lens to add retroreflective durability.

Definition: A “snow-ploughable” RRPM is one that has been designed in such a manner that the risk of it being damaged or removed by regular snow removal operations is minimised.

Definition: A “road stud” is a RRPM provided with a spigoted base, which is fitted into a hole, drilled into the road surface.

Definition: An “illuminated” RRPM is one which has been designed to project a steady or flashing beam of light towards motorists to replicate the function of standard RRPM’s when illuminated by the motorist’s headlights.

RRPM’s were first developed in the UK in the mid 1930’s. The nickname “cats’ eyes” arose from an incident that prompted the inventor to develop and patent a spherical lens device in 1935.

Illuminated RRPM’s have been developed for a number of applications such as providing delineation in tunnels, providing warning to motorists approaching pedestrian crossings which have been activated by pedestrians wishing to cross, as a lane indicator for contra flow lanes and when having a temperature sensor, a flashing blue light is activated when ice may be present. Illuminated RRPM’s are either solar powered directly, wired directly or inductively powered from a solar or reticulated electric power source.

4.6 RPM Adhesive

Definition: Material used to attach raised pavement markers (RPM’s) to the road surface, where the RPM does not have adhesive attached.

RPM adhesive can be bituminous (hot-applied), self adhesive pads, single or two component material.

4.7 Glass Beads (Retroreflective Beads)

Definition: Small spherical silica glass beads applied to / in pavement markings to improve the night-time visibility by retro-reflecting vehicle headlights.

Roadmarking glass beads are available in a range of size, clarity and refractive index classifications.

The higher index beads are aimed at specific applications such as airport markings and those markings requiring superior performance in conditions of rain.

The size of retroreflective beads applied needs to be matched to marking materials dry film thickness and optimal embedment to work effectively.

Roadmarking beads applied on NZTA funded / managed roading networks are required to comply with Australian and New Zealand Standard AS 2009.

In addition to the RMA and HSNO requirements, NZTA have applied a limit for heavy metals in beads used on New Zealand roads as set out in NZTA T 17.

4.8 Angular Material

Definition: Fine angular shaped aggregate or glass applied to / in pavement markings to improve the skid and slip resistance of the marking over a range of conditions.

Angular material is either incorporated in and / or surface applied to pavement markings to enhance the skid and slip resistance. The addition of angular material with glass beads must be well controlled to ensure that retroreflectivity is not compromised.

4.9 Modified Epoxy Resin

Definition: A cold-hardening 2 part epoxy resin modified to bind fine angular shaped aggregate to pavement surfaces.

Epoxy paving aggregate or glass binding material is tailored for specific application methods. Typically applied at 1 to 2.5 kg/m².

4.10 Modified Polyurethane Resin

Definition: A cold-hardening 2 part polyurethane resin modified to bind fine angular shaped aggregate to pavement surfaces.

Polyurethane paving aggregate binding material is tailored for specific application methods. Typically applied at 1.35 to 2.6 kg/m².

4.11 Cement Based Coatings

Definition: A compound consisting of white cement and aggregates which when mixed with water cures by hydration.

Applied at thicknesses of 2 to 3 mm to vertical and inclined surfaces such as kerbs, New Jersey barriers and roundabout faces. Greater thicknesses can be achieved by layering. Glass beads are injected into the surface under pressure to provide retroreflectivity.

5 Roadmarking Material Classification Schemes

5.1 Waka Kotahi New Zealand Transport Agency

Most of the roadmarking materials used on New Zealand roads are tested and approved against physical and performance requirements specified in NZTA specifications.

Paint, CAP, thermoplastic and tapes

Paint, CAP, thermoplastic and tapes are tested and approved against the requirements of NZTA M07 – Specification for approved roadmarking products. Approved materials are reported in NZTA List of M07 approved products.

There are three classifications. Normal life classification, extended life classification and long life classification. There are two visibility levels; standard and high.

The material results are reported for products for use on chipseal or asphalt surfaces.

Raised Pavement Markers

Raised pavement markers, both reflectorised and non-reflectorised, are tested and approved under NZTA M 12 – Specification for the design, manufacture, installation and maintenance of raised pavement markers.

The performance requirements are principally those required by Australian Standard AS 1906.3 – Retroreflective Materials and Devices for Road Traffic Control Purposes.

Internally illuminated raised pavement markers are tested and approved under NZTA M 29.

5.2 Australian Paint Approval Scheme (APAS)

The Australian Government operates the APAS approval scheme which sets criteria for material performance, environmental health and safety and quality assurance.

Under NZTA M07 5.6.3 as an alternative to a field trial, evidence of performance may be considered based on the following: (a) The road marking material has Class 1 certification of product conformity from the Australian Paint Approval Scheme (APAS) operated by CSIRO. See APAS publication AP-D192, and (b) The road marking material complies with the relevant material and performance requirements of AS 4049, and (c) Written attestation of the performance of the road marking material on asphalt and/or chip seal surfacing is provided by an Australian State Roading Authority or equivalent agency.

6 Waterborne Paint

General Description

- A high-solids quick drying water-based acrylic pavement marking paint
- May be formulated for use with catalysts to accelerate dry-time and / or enhance performance.
- Glass beads are surface applied to provide retroreflectivity where required.

Composition

- Typically 60 to 68 percent volume solids
- Water miscible solvents used in formulation
- Thinned with water-based thinners.

Physical Properties

- Fast drying – “No-pickup” time 7-15 minutes as per AS/NZS 1580 401.8. “Dry-through” times in the range of 40 to 60 minutes. Drying time dependent on film thickness, relative humidity, temperature and airflow
- Specially formulated waterborne paints used with catalysts have “no-wash-out” times of 1 minute
- Low Gloss
- Self cleaning
- Colours: Full range including White, Yellow, and Black
- Holds beads, (particularly Type D), better than standard alkyd paints
- pH of approximately 10
- High miscibility in water.

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9mm when tested in accordance with 8.2 of NZTA M7
- Without the aid of surface applied particles skid resistance can be as low as 30 BPN
- Retroreflectivity: No values available for un-beaded paint
- When tested in accordance with 8.3 of NZTA M07, the retroreflectivity and luminance of a beaded test paint film after the required number of vehicle passes shall not be less than the values set out in 8.3 of NZTA M 07 for “high” or “standard” visibility classification
- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For yellow material the colour shall be equal to AS2700 Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.

NZRF Roadmarking Materials Guide – Water Borne Paint

Durability

- The durability of a waterborne paint system is dependent on its formulation, film thickness and the beads / aggregate applied to it. Waterborne paint systems (with appropriate formation and application) are capable of achieving the requirements of NZTA M07 "high" visibility classification.
- Thickness of application necessitates repeated application compared to "long-life" materials such as cold applied plastics or thermoplastic, however, this depends on traffic volumes, pavement surface and applied thickness
- Material remains "plastic" throughout ageing process
- NZTA M07 approvals classification provides guidance on durability and performance.

Compatibility

- Can be used on most types of surfaces and for longitudinal, transverse and other markings
- No compatibility problems observed. Water based paint appears to adhere well to CAP, thermoplastic, solvent based paint and itself
- Should not be applied on metal substrates without the use of an appropriate anticorrosive primer.

Adhesion

- Does not perform well on mechanically trowelled / polished concrete. All paints are sensitive to the alkalinity of fresh concrete. Concrete curing agents may have adverse effect on paint adhesion. New concrete should be aged for a minimum of 30 days prior to painting (The USA, with history in concrete road formation, recommends 90 days open to traffic for new concrete to wear off curing compound). Sealers and primers may be used.

Application Parameters

- Markings must be protected from traffic until thoroughly dry.
- Road and air temperatures should be 10°C and rising
- Relative humidity should be below 85 percent Rh and decreasing.
- Paint should not be applied if dew is expected in 2 hours
- Paint should not be applied if precipitation is expected in 24 hours
- Spray application recommended, thinning normally not recommended.
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Application by brush / roller not recommended
- Public roads and thoroughfares
- Recommended film thickness varies, dependent on proposed life and size of glass beads being applied:

NZRF Roadmarking Materials Guide – Water Borne Paint

- 360 µm wet – approximately 220 µm dry – approximately 3.0 square metres / litre for Type B beads
- 500 µm wet – approximately 350 µm dry – approximately 2.0 square metres / litre for Type D beads
- With asphalt designed for low traffic density e.g. car parks and tennis courts, higher application rates with waterborne paints can lead to problems with a tendency to curl and tear the asphalt around the marking

Manufacturing Process

- The coloured and extender pigments are intimately mixed into the binder, using a High Speed Disperser or similar machine and then “let down” with solvents and various chemical additives to form the finished paint
- After laboratory QC testing the paint is filtered and packaged, labelled, and issued with a Standard QC Certificate confirming its conformity to NZTA M07 requirements.

Testing of Physical Properties

- Paint may be tested to NZTA specification M07

Handling, storage and packaging

- 20L plastic or lacquer lined steel pails, 200L plastic or lacquer lined steel drums and 500L and 1000L transport containers
- May be or not be classified Non-Hazardous according to NZ Dangerous Goods and Toxic Substances Regulations
- Empty Drums not usually considered hazardous
- Storage temperatures 1°C to 40°C
- Avoid freezing, excessive heat and changes in temperature. If the product becomes frozen it may become lumpy and some of the water may separate out. There may also be a colour change. It may be possible to restore the paint through agitation but the paint may have to be discarded.
- Incompatible substances are strong oxidisers and acids
- Paint transfer pumps must be of low shear type, e.g. diaphragm or piston pumps
- Typical Classification – refer to product specific data sheets
 - Shipping Name: None
 - Transport Hazard Class: None
 - UN/NA Number: None
 - ADR Number: None
 - Packing Group: None

NZRF Roadmarking Materials Guide – Water Borne Paint

Environmental Impacts

- VOC in the range of up to 150 gm/l
- Waterborne paints are extremely miscible in water, care must be taken to ensure that any spills or cleaning materials do not enter or contaminate soil or waterways
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Occupational Health and Safety Hazards

- Fluid injection via spray equipment
- Fumes, gases, vapours
- Potential to poison
- Potential to lead to infection
- Lack of oxygen (also Fumes vapours and gases). Confined spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficit.

Application Process

- Painted pavement markings are applied by an applicator which sprays paint from a fixed nozzle, connected to paint supply system (typically a high pressure paint pump), while the applicator is driven at a uniform speed following the existing markings (or set-out spots in the case of new work). The applicator must have UV capability to cure the system.
- The applicator driver normally controls the entire process
- Tip size, fluid pressure, atomising air pressure, paint viscosity and paint temperature are all critical to the appearance, consistency and performance of the product
- Paint application plant requires verification / calibration to ensure application requirements are known. Refer to NZTA/NZRF T 8
- Paint dispensing equipment must be made with 304 or higher grade stainless steel or other material that will not react with the paint and cause application or storage problems
- Paint may be heated to give optimum drying times. Paint temperatures used typically lie between 35°C and 45°C. If heat exchangers are used, care needs to be taken to ensure that paint temperature does not go above 50°C
- For high pressure airless spray equipment, water based paint may need lower paint pump pressures than solvent based paint
- With conventional spray equipment, water based paints may need higher paint and atomisation pressures than solvent based paints
- Commonly used nylon lined hoses may degrade with waterborne paint and should be replaced with Teflon lined hoses
- Single spray guns angled backwards by 5 to 10 degrees may assist with even line spread
- Double gun operation recommended for heavier film builds

NZRF Roadmarking Materials Guide – Water Borne Paint

- Equipment cleaned / flushed with water or mixture of water and methylated spirits (3/1 ratio) or ammonia and / or detergent. Window cleaning solutions work well on tips and hose connections.

Process Monitoring Equipment (As per requirements of NZTA T8 /T12)

- Portable environmental measuring devices for temperature and humidity
- Paint application rate computers
- Electronic scales / bead bucket and stop watch for glass bead application rate
- Applicator speedometers, calibrated over range of applicator speeds
- Paint pressure and / or hydraulic/air pressure gauges
- Wet film gauges
- Bead application comparison plates.

Post-Application Measuring Equipment

- Non-destructive eddy current device such as the Elcometer and steel test plates for dry film thickness
- Retroreflectometers
- Skid resistance testers.

Test Methods

- Colour, Dry Film thickness, Skid Resistance and Retroreflectivity tested to NZTA M07, Dry film thickness measurements in accordance with Appendix A of NZTA P 22
- Alternative dry film thickness measurements method provided in NZTA/NZRF T 8
- Retroreflectivity refer also to Glass Beads
- Skid Resistance refer also to Glass Beads and Angular Material.

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist (may cause respiratory irritation).
- Inhalation: Half face-piece class P1 Organic vapour respirator conforming to AS 1716
- Eye Protection: If spray mist is encountered, goggles conforming to AS 1337
- Skin Protection: Wear overalls and gloves. Gloves of neoprene, nitrile rubber or PVC industrial-weight lined gauntlet as per NZS 5812:1982 4.5.2(b). Use of silicone free barrier cream.
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic

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compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible. All paint crew members should carry the NZRF paint injection safety card.

- If inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If swallowed, DO NOT induce vomiting; give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.
- If skin contact, wash affected area thoroughly with soap and water. Wash contaminated clothing.

Related National / International Standard Specifications

- APAS 0041 – Australian Paint Approval Scheme Specification 0041, Pavement Marking Paint
- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS 4049.3 - Paints and related materials – Roadmarking materials, Part 3: Waterborne paint for use with drop-on beads
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 – Specification for approved roadmarking products
- NZTA T8 / T12
- NZTA P22

Useful References

- Manufacturers safety data sheets and technical data sheets

7 Polymer Modified Solvent Based Paint

General Description

- A solvent thinned quick drying pavement marking paint modified by the addition of polymers to enhance particular performance characteristics
- Glass beads are surface applied to provide retroreflectivity where required.

Note: As the selection of particular resins and the application of particular polymers may be aimed at enhancing particular performance characteristics and or particular application environments, the manufacturer's technical data should be referred to for specific details.

Composition

- Various formulations provided by individual paint manufacturers
- May be covered by licence agreements and trade names/marks
- Typically 50 to 65 percent volume solids
- Petroleum based solvents used in formulation.
- Solvent based formulation may include modified alkyd extenders.

Physical Properties

- Rapid drying – No pickup time 1-15 minutes as per AS/NZS 1580 401.8
- Low Gloss
- Self cleaning
- Colours: Range may include White, Yellow and Black
- Formulations aimed at bead retention, durability and range of available application conditions.
- Solubility in water less than 50gm/l at 20°C
- Formulations may include those aimed at providing high bead retention strength.

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9mm when tested in accordance with 8.2 of NZTA M07
- Without the aid of surface applied particles skid resistance can be as low as 30 BPN
- Retroreflectivity: No values available for un-beaded paint
- When tested in accordance with 8.3 of NZTA M07, the retroreflectivity and luminance of a beaded test paint film after the required number of vehicle passes shall not be less than the values set out in 8.3 of NZTA M07 for “high” or “standard” visibility classification
- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.

NZRF Roadmarking Materials Guide - Polymer Modified Solvent Based Paint

Durability

- Greater life than the traditional chlorinated rubber modified paints, performance may match or better that of waterborne paints
- The polymers used are selected on the basis of their durability and UV resistance
- Thickness of application necessitates repeated application compared to “long life” materials; however, this depends on traffic volumes, pavement surface and applied thickness
- In general the durability may range between 1 and 2 million vehicle passes. The durability achieved is dependent on the polymers used, application thickness and the substrate to which the material is applied. Reference should be made to individual supplier data sheets.
- NZTA M07 approvals classification provides guidance on durability and performance.

Compatibility

- Can be used on most types of surfaces for longitudinal, transverse and other markings.

Adhesion

- Generally does not perform well on mechanically trowelled / polished concrete. All paints are sensitive to the alkalinity of fresh concrete. Concrete curing agents may have adverse effect on paint adhesion. New concrete should be aged for a minimum of 30 days prior to painting. Sealers and primers may be used
- Specific formulations may be available, aimed at providing good adhesion to particular substrates.

Application Parameters

- Markings must be protected from traffic until thoroughly dry. Refer to Manufacturer's Technical Data Sheets
- Road and air temperatures should be 5°C and rising
- Relative humidity should be below 85 percent Rh and decreasing.
- Paint should not be applied if dew is expected in 2 hours
- Precipitation in the 4hrs following application may adversely affect paint performance
- Spray application recommended, thinning normally not recommended
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Application by brush / roller not recommended
- Public roads and thoroughfares
- Recommended film thickness varies dependent on proposed life and size of glass beads being applied.
- 380 µm wet – approximately 220 µm dry – approximately 3 square metres / litre for Type B beads

NZRF Roadmarking Materials Guide - Polymer Modified Solvent Based Paint

- 540 µm wet – approximately 300 µm dry – approximately 2 square metres / litre for Type D beads
- With asphalt designed for low traffic density e.g. car parks and tennis courts, higher application rates with paints can lead to problems with a tendency to curl and tear the asphalt around the marking

Manufacturing Process

- The coloured and extender pigments are intimately mixed into the binder, using a High Speed Dispenser or similar machine and then “let down” with solvents and various chemical additives to form the finished paint
- After laboratory QC testing the paint is filtered and packaged, labelled, and issued with a Standard QC Certificate confirming its conformity to NZTA M07 requirements or APAS Specification.

Testing of Physical Properties

- Paint may be tested to NZTA specification M07.

Handling, storage and packaging

- Approved 20L steel and plastic pails, 200L steel drums, 500l and 1000L transport containers
- Storage temperatures 1°C to 40°C, store at a constant temperature
- High flammability. Dangerous goods stores generally needed. Hazardous Goods Licence generally required for transport
- Take precautions against static electricity
- Incompatible substances are strong oxidizers, acids and alkalis
- Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical
- Typical Classification – refer to product specific data sheets
 - Dangerous Goods Class 3.1b
 - Haz Chem Code 3[Y]E
 - UN Number 1263
 - Packaging Group II
 - Flash Point Less than 23°C
 - Third on Toxic Substances Schedule.

Environmental Impacts

- VOC in the range of 400 to 500 gm/l
- High flammability, fumes heavier than air, can create explosion potential in enclosed spaces
- Heavier than water with low solubility in water
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

NZRF Roadmarking Materials Guide - Polymer Modified Solvent Based Paint

Occupational Health and Safety Hazards

- Fluid injection
- Fire and explosion
- Hazardous decomposition products on burning
- Fumes, gases, vapours
- Potential to poison
- Potential to lead to infection
- Lack of oxygen (also fumes vapours and gases). Confined spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Repeated and prolonged occupational overexposure to solvents can damage liver, brain and central nervous system.

Application Process

- Painted pavement markings are applied by an applicator which sprays paint from a fixed nozzle, connected to paint supply system (typically a high pressure paint pump), while the applicator is driven at a uniform speed following the existing markings (or set-out spots in the case of new work)
- The applicator driver normally controls the entire process.
- Tip size, fluid pressure, atomising air pressure, paint viscosity and paint temperature are all critical to the appearance, consistency and performance of the product
- Paint application plant requires verification / calibration to ensure application requirements are known. Refer to NZTA/NZRF T 8
- Single spray guns angled backwards by 5 to 10 degrees may assist with even line spread
- The compatibility of each particular product with other roadmarking paints may vary significantly from product to product. Manufacturer's flushing and thinning procedures need to be strictly adhered to.

Process Monitoring Equipment

- Paint application rate computers
- Electronic scales for glass bead application rate
- Speedometers
- Paint pressure and or hydraulic/air pressure gauges
- Wet film gauges
- Bead application comparison plates.

Post-Application Measuring Equipment

- Dry Film Thickness measured using non-destructive eddy current device such as the Elcometer
- Steel test plates
- Retroreflectometers
- Skid resistance testers

NZRF Roadmarking Materials Guide - Polymer Modified Solvent Based Paint

Test Methods

- Dry Film thickness, Skid Resistance and Retroreflectivity tested to NZTA M07
- Dry film thickness measurement in accordance with Appendix A of NZTA P 22
- Alternative dry film thickness measurement in accordance with NZTA/NZRF T 8
- Retroreflectivity refer to Glass Beads
- Skid Resistance refer also to Glass Beads and Angular Material.

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist
- Wash hands in soap and water prior to eating or smoking
- Inhalation: Organic vapour respirator conforming to AS 1716
- Eye Protection: If spray mist is encountered, goggles conforming to AS 1337
- Skin Protection: Wear overalls and gloves. Use of silicone free barrier cream.
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible. All paint crew members should carry the NZRF paint injection safety card.
- If inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If swallowed, DO NOT induce vomiting, give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.

Related National / International Standard Specifications

- APAS 0041 – Australian Paint Approval Scheme Specification 0041, Pavement Marking Paint
- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 Specification for approved roadmarking products

NZRF Roadmarking Materials Guide - Polymer Modified Solvent Based Paint

Useful References

- Manufacturers safety data sheets and technical data sheets
- Worksafe “Reducing harm when working with organic solvents”



8 Chlorinated Rubber Modified Alkyd Paint

General Description

- A high-solids alkyd, solvent thinned quick drying pavement marking paint modified by the addition of chlorinated rubber
- Glass beads and / or reflective elements are surface applied to provide retroreflectivity where required.

Composition

- Typically 45 to 65 percent volume solids.
- Petroleum based solvents used in formulation.
- Solvent based formulation includes modified alkyd extenders
- Normally thinned with aromatic hydrocarbons.

Physical Properties

- Fast drying – No pickup time 7-15minutes as per AS/NZS 1580 401.8
- Low Gloss
- Self cleaning
- Colours: Full range including White, Yellow and Black
- Appears to hold beads well, although typical application rates will not hold large beads
- Solubility in water less than 50gm/l at 20°C.

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9mm when tested in accordance with 8.2 of NZTA M07
- Without the aid of surface applied particles skid resistance can be as low as 30 BPN
- Retroreflectivity: No values available for un-beaded paint
- When tested in accordance with 8.3 of NZTA M07, the retroreflectivity and luminance of a beaded test paint film after the required number of vehicle passes shall not be less than the values set out in 8.3 of NZTA M07 for “high” or “standard” visibility classification
- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.

Durability

- Greater life than the unmodified alkyd paints
- The addition of the chlorinated rubber modifiers reduces the rate at which the alkyd paint becomes harder and more brittle as it ages

NZRF Roadmarking Materials Guide - Chlorinated Rubber Modified Alkyd Paint

- Thickness of application necessitates repeated application compared to “long life” materials, however, this depends on traffic volumes, pavement surface and applied thickness
- NZTA M07 approvals classification provides guidance on durability and performance.

Compatibility

- Can be used on most types of surfaces for longitudinal, transverse and other markings.

Adhesion

- Does not perform well on mechanically trowelled / polished concrete. All paints are sensitive to the alkalinity of fresh concrete. Concrete curing agents may have adverse effect on paint adhesion. New concrete and asphalt should be aged for a minimum of 30 days prior to painting. Sealers and primers may be used.

Application Parameters

- Spray application recommended, thinning normally not required / desirable
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Application by brush / roller not recommended
- Public roads and thoroughfares
- 360 µm wet – approximately 220 µm dry – approximately 3 square metres / litre for Type B beads
- With asphalt designed for low traffic density e.g. car parks and tennis courts, higher application rates with paints can lead to problems with a tendency to curl and tear the asphalt around the marking

Manufacturing Process

- The coloured and extender pigments are intimately mixed into the binder, using a High Speed Disperser or similar machine and then “let down” with solvents and various chemical additives to form the finished paint
- After laboratory QC testing the paint is filtered, packaged, labelled and issued with a Standard QC Certificate confirming its conformity to NZTA requirements

Testing of Physical Properties

- Paint may be tested to NZTA specification M07

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Handling, storage and packaging

- Approved 20L steel and plastic pails, 200L steel drums, 500l and 1000L transport containers
- Storage temperatures 1°C to 40°C, store at a constant temperature
- High flammability. Dangerous goods stores generally needed. Hazardous Goods Licence generally required for transport.
- Take precautions against static electricity.
- Typical Classification – refer to product specific data sheets
 - Dangerous Goods Class 3.2
 - Haz Chem Code 3[Y]E
 - UN Number 1263
 - Packaging Group II
 - Incompatible substances are strong oxidisers, acids and alkalis
 - Flash Point Less than 23°C
 - Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical
 - Third on Toxic Substances Schedule.

Environmental Impacts

- VOC in the range of 400 to 500gm/l
- High flammability, fumes heavier than air, can create explosion potential in enclosed spaces
- Heavier than water with low solubility in water.
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Occupational Health and Safety Hazards

- Fluid injection
- Fire and explosion
- Hazardous decomposition products on burning
- Fumes, gases, vapours
- Potential to poison
- Potential to lead to infection
- Lack of oxygen (also fumes vapours and gases). Confined spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Repeated and prolonged occupational overexposure to solvents can damage liver, brain and central nervous system.

Application Process

- Painted pavement markings are applied by an applicator which sprays paint from a fixed nozzle, connected to paint supply system (typically a high pressure paint pump), while the applicator is driven at a uniform

NZRF Roadmarking Materials Guide - Chlorinated Rubber Modified Alkyd Paint

speed following the existing markings (or set-out spots in the case of new work)

- The applicator driver normally controls the entire process
- Tip size, fluid pressure, atomising air pressure, paint viscosity and paint temperature are all critical to the appearance, consistency and performance of the product
- Paint application plant requires verification / calibration to ensure application requirements are known. Refer to NZTA/NZRF T 8
- Single spray guns angled backwards by 5 to 10 degrees may assist with even line spread.
- Equipment cleaned / flushed with thinners such as Toluene.

Process Monitoring Equipment

- Paint application rate computers
- Electronic scales for glass bead application rate
- Speedometers
- Paint pressure and or hydraulic/air pressure gauges
- Wet film gauges
- Bead application comparison plates.

Post-Application Measuring Equipment

- Dry Film Thickness measured using non-destructive eddy current device such as the Elcometer
- Steel test plates
- Retroreflectometers
- Skid resistance testers.

Test Methods

- Dry Film thickness, Skid Resistance and Retroreflectivity tested to NZTA M07
- Dry film thickness measurement in accordance with Appendix A of NZTA P 22
- Alternative dry film thickness measurement in accordance with NZTA/NZRF T 8
- Retroreflectivity refer to Glass Beads
- Skid Resistance refer also to Glass Beads and Angular Material.

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist
- Wash hands in soap and water prior to eating or smoking.
- Inhalation: Organic vapour respirator conforming to AS 1716:1994

NZRF Roadmarking Materials Guide - Chlorinated Rubber Modified Alkyd Paint

- Eye Protection: If spray mist is encountered, goggles conforming to AS 1337:1992
- Skin Protection: Wear overalls and gloves. Use of silicone free barrier cream.
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible.
- If inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre. All paint crew members should carry the NZRF paint injection safety card.
- If swallowed, DO NOT induce vomiting; give several glasses of water. Contact a Doctor or Poisons Information Centre
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.

Related National / International Standard Specifications

- APAS 0041 – Australian Paint Approval Scheme Specification 0041, Pavement Marking Paint
- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 Specification for approved roadmarking products

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Worksafe “Reducing harm when working with organic solvents”

9 Alkyd Paint

General Description

- An alkyd, solvent thinned quick drying pavement marking paint
- Glass beads are surface applied to provide retroreflectivity where required.

Composition

- Typically 55 to 60 percent volume solids for high solids alkyds
- Typically 45 to 55 percent volume solids for low solids alkyds
- Petroleum based solvents used in formulation
- Thinned with organic solvents such as Toluene.

Physical Properties

- Fast drying – No pickup time 7-15minutes as per AS/NZS 1580 401.8
- Low Gloss
- Self cleaning
- Colours: Full range including White, Yellow and Black
- Does not hold beads well, although high solids alkyd holds beads better than low solids alkyd. Typical application rates will not hold large beads
- Solubility in water less than 50gm/l at 20°C.

Performance Properties

- Skid Resistance: not less than 45 BPN when tested in accordance with 8.2 of NZTA M07
- Retroreflectivity: No values available for un-beaded paint
- Standard alkyd paint markings are unlikely to meet the performance requirements for NZTA M07 approvals, so would likely only be used for car park or off road marking.
- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.

Durability

- Lowest life of all marking materials - highest life cycle cost
- Material becomes harder and more brittle as it ages
- Thickness of application necessitates repeated application compared to “long life” materials, however, this depends on traffic volumes, pavement surface and applied thickness
- When applied at 220 µm dry film thickness, performance is generally less than 1 million vehicle passes
- May be used as temporary marking prior to application of “long life” materials.

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Compatibility

- Can be used on most types of surfaces for longitudinal, transverse and other markings.

Adhesion

- Does not perform well on mechanically trowelled / polished concrete. All paints are sensitive to the alkalinity of fresh concrete. Concrete curing agents may have adverse effect on paint adhesion. New concrete should be aged for a minimum of 30 days prior to painting. Sealers and primers may be used.

Application Parameters

- Spray application recommended, thinning normally not required / desirable
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Application by brush / roller not recommended
- Car parks and other off road facilities
- Recommended film thickness 370 µm wet. 220 µm dry – approximately 3 square metres / litre
- With asphalt designed for low traffic density e.g. car parks and tennis courts, higher application rates with paints can lead to problems with a tendency to curl and tear the asphalt around the marking

Manufacturing Process

- The coloured and extender pigments are intimately mixed into the binder, using a High Speed Disperser or similar machine and then “let down” with solvents and various chemical additives to form the finished paint
- After laboratory QC testing the paint is filtered, packaged, labelled and issued with a Standard QC Certificate

Testing of Physical Properties

- Paint may be tested to NZTA specification M7.

Handling, storage and packaging

- Approved 20L steel and plastic pails, 200L steel drums, 500l and 1000l bulk containers
- Storage temperatures 1°C to 40°C, store at a constant temperature
- High flammability. Dangerous goods stores generally needed. Hazardous Goods Licence generally required for transport.
- Take precautions against static electricity.
- Typical Classification – refer to product specific data sheets

NZRF Roadmarking Materials Guide - Alkyd Paint

- Dangerous Goods Class 3.2
- Haz Chem Code 3[Y]E
- UN Number 1263
- Packaging Group II
- Incompatible substances are strong oxidisers, acids and alkalis
- Flash Point Less than 23°C
- Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical
- Third on Toxic Substances Schedule.

Environmental Impacts

- VOC in the range of 400 to 500gm/l
- High flammability, fumes heavier than air, can create explosion potential in enclosed spaces
- Heavier than water with low solubility in water
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Occupational Health and Safety Hazards

- Fluid injection
- Fire and explosion
- Hazardous decomposition products on burning
- Fumes, gases, vapours
- Potential to poison
- Potential to lead to infection
- Lack of oxygen (also fumes vapours and gases). Confined spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Repeated and prolonged occupational overexposure to solvents can damage liver, brain and central nervous system.

Application Process

- Painted pavement markings are applied by an applicator which sprays paint from a fixed nozzle, connected to paint supply system (typically a high pressure paint pump), while the applicator is driven at a uniform speed following the existing markings (or set-out spots in the case of new work)
- The applicator driver normally controls the entire process
- Tip size, fluid pressure, atomising air pressure, paint viscosity and paint temperature are all critical to the appearance, consistency and performance of the product
- Paint application plant requires verification / calibration to ensure application requirements are known. Refer to NZTA/NZRF T 8
- Single spray guns angled backwards by 5 to 10 degrees may assist with even line spread
- Equipment cleaned / flushed with thinners such as Toluene

NZRF Roadmarking Materials Guide - Alkyd Paint

Process Monitoring Equipment

- Paint application rate computers
- Electronic scales for glass bead application rate
- Speedometers
- Paint pressure and or hydraulic/air pressure gauges
- Wet film gauges
- Bead application comparison plates.

Post-Application Measuring Equipment

- Dry Film Thickness measured using non-destructive eddy current device such as the Elcometer
- Steel test plates
- Retroreflectometers
- Skid resistance testers.

Test Methods

- Dry Film thickness, Skid Resistance and Retroreflectivity tested to NZTA M07
- Dry film thickness measurement in accordance with Appendix A of NZTA P 22
- Alternative dry film thickness measurement in accordance with NZTA/NZRF T 8
- Retroreflectivity refer to Glass Beads
- Skid Resistance refer also to Glass Beads and Angular Material.

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist
- Wash hands in soap and water prior to eating or smoking.
- Inhalation: Organic vapour respirator conforming to AS 1716:1994
- Eye Protection: If spray mist is encountered, goggles conforming to AS 1337:1992
- Skin Protection: Wear overalls and gloves. Use of silicone free barrier cream
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible. All paint crew members should carry the NZRF paint injection safety card.
- If inhaled, Provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.

NZRF Roadmarking Materials Guide - Alkyd Paint

- If swallowed, DO NOT induce vomiting; give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.

Related National / International Standard Specifications

- APAS 0041 – Australian Paint Approval Scheme Specification 0041, Pavement Marking Paint
- AS 4049.1 - Paints and related materials – Roadmarking materials, Part 1: Solvent borne paint for use with drop-on beads
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 Specification for approved roadmarking products

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Worksafe “Reducing harm when working with organic solvents”



10 Cold-Applied Plastic (CAP)

General Description

- A cold hardening poly methyl methacrylate (PMMA) resin combined with aggregates and fillers to produce a pourable solution which is virtually 100percent solids
- Also known as acrylic glass
- Material is catalysed by the application of benzoyl peroxide in ether liquid or powder form
- Glass beads are applied as a subsequent operation to provide retroreflectivity
- Aggregate may be applied as a subsequent operation to produce an overlay surface with appropriate colour and skid resistance.

Composition

- CAP roadmarking material is tailored for specific application methods such as audio-tactile profiled (ATP) markings, structured / multidot markings and plain flat markings. For example, the material is specially formulated to enable raised portions to be formed cleanly and accurately.
- Products are covered by patents and licencing agreements
- Poly methyl methacrylate (PMMA) resin
- Typically virtually 100 percent volume solids.
- Contains titanium dioxide, inorganic and organic colour pigments and may contain glass beads

Physical Properties

- High elasticity
- Fast drying – “No-pickup” time 7-15 minutes as per AS/NZS 1580 401.8. “Dry-through” times in the range of 15 to 20 minutes. Drying time dependent on relative humidity, temperature and airflow, i.e. 15 minutes at 20°C
- Low Gloss
- Colours: White Yellow, Green, Red Blue and Black with other colours available on request.

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9mm when tested in accordance with 8.2 of NZTA M7
- When tested in accordance with 8.3 of NZTA M7, the retroreflectivity and luminance of a beaded test CAP film after the required number of vehicle passes shall not be less than the values set out in 8.3 of NZTA M7 for “high” or “standard” visibility classification

NZRF Roadmarking Materials Guide - Cold-Applied Plastic

- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to AS2700 Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.
- Material can only be tested in flat or structured / multidot format as ATP dimensions are less than the sweep of, and their shape reduces accuracy, of British Pendulum Tester results.
- Retroreflectivity / skid should not be measured immediately after application. Trafficking is advised prior to testing.

Durability

- Regarded as “long life” as far as “wear” is concerned
- Retroreflective performance durability will be relative to the durability of the glass beads or reflective elements used but will likely be less than the durability of the material.
- As CAP is a Long Life system so the use of coated highly reflective beads is recommended.
- NZTA requires all ATP markings to be high performance markings in accordance with NZTA P 30
- Very useful in high wear areas, but soiling of the marking may occur in certain environments.

Compatibility

- Can be used on many types of surfaces and for longitudinal, transverse and other markings.
- Not recommended for application on paving stones or bricks.
- Application to thermoplastic requires pre-application tests.

Adhesion

- Can be applied to most surfaces and textures. Concrete needs priming. New concrete should be aged for a minimum of 30 days prior to application. Sealers and primers may be used.

Application Parameters

- Both components need to be thoroughly stirred. It is recommended that the component containing the hardener is machine stirred
- Road and air temperatures should be in the range of 5 to 30°C and rising
- Recommended application rates of between 0.85 to 1 kg/m²
- Application by specially built / modified airless spray applicators recommended
- Application of hardener must be rigorously monitored to ensure application to entire marking.

NZRF Roadmarking Materials Guide - Cold-Applied Plastic

Manufacturing Process

- The coloured and extender pigments are intimately mixed into the binder, using a High Speed Disperser or similar machine and then “let down” and various chemical additives to form the finished paint
- After laboratory QC testing the paint is filtered, packaged, labelled and issued with a Standard QC Certificate confirming its conformity to NZTA requirements

Testing of Physical Properties

- CAP may be tested to NZTA M07

Handling, storage and packaging

- Available in a variety of containers from 25 kg to 1500 kg
- Flammable - attention needed to storage and transport requirements. Dangerous goods store and licences may be required
- Store in cool dry place protected from rain, sun and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Typical Classification – refer to product specific data sheets
 - Shipping Name: PAINT
 - Transport Hazard Class: 3
 - UN/NA Number: 1263
 - Packing Group: II

Environmental Impacts

- Reported as zero solvent (VOC) emission.
- Although both resin and hardener are not usually considered hazardous once cured, some requirements may be stipulated for the disposal of waste
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Occupational Health and Safety Hazards

- Fluid Injection
- Fumes, Gases, Vapours
- Potential to Poison
- Allergic dermatitis (Sensitisation)
- Severe Irritation and Chemical Burns
- Respiratory Irritation.

Application Process – Audio-Tactile Profiled (ATP)

NZRF Roadmarking Materials Guide - Cold-Applied Plastic

- Material commonly applied using a mechanism to produce raised portions (blocks) at regular intervals in a line which provides motorists with audio-tactile feedback
- Products and their application are covered by patents and licencing agreements
- The CAP and benzoyl peroxide are combined using a mechanism which has an agitator to ensure consistent mixing
- A mechanism used to produce raised portions (blocks) at regular intervals controlled by a computer. The block height and length is controlled by the equipment. The spacing of the resultant blocks is determined by the computer timing
- The applicator driver may or may not control the entire process
- The CAP viscosity (affected by ambient temperature), applicator travel speed and cleanliness of application mechanism are all critical to the appearance, consistency and performance of the product
- Glass beads are applied to provide retroreflectivity
- At regular intervals, and immediately after the completion of marking the application mechanism and associated equipment must be thoroughly cleaned.

Application Process – Structured / Multidot

- Products and their application are covered by patents and licencing agreements
- Structured Material may be applied using a rotating roller having spikes or lumps used to randomly distribute the CAP along the marking
- Multidot materials may be applied using a matrix of nozzles
- Structured markings may be applied in combination with audio-tactile profile markings
- Glass beads are applied to provide retroreflectivity
- At regular intervals, and immediately after the completion of marking the application mechanism and associated equipment must be thoroughly cleaned

Application Process – Spray

- Products and their application are covered by patents and licencing agreements
- The two components are typically through a static mixer spray gun combined with a flushing system
- The pavement markings are applied by an applicator which sprays material from a fixed nozzle connected to supply system (typically a high pressure paint pump), while the applicator is driven at a uniform speed following the existing markings (or set-out spots in the case of new work)
- The applicator driver normally controls the entire process
- Tip size, fluid pressure, atomising air pressure, paint viscosity and material temperature are all critical to the appearance, consistency and performance of the product.

NZRF Roadmarking Materials Guide - Cold-Applied Plastic

- Glass beads are applied to provide retroreflectivity

Application Process – Hand Applied

- Products and their application are covered by patents and licencing agreements
- The two components are commonly combined in a clean steel container and mixed with a slow speed drill attached to an appropriate paddle
- Appropriate filler may be added to produce a mortar for filling or for vertical surfaces
- The pot life is typically 5-10 minutes, depending on hardener and ambient temperature
- Material is applied by roller / trowel / screed and / or a combination of these, to the desired thickness and finish. Multiple coats may be used to build desired profiles / shapes.
- Equipment is cleaned with speciality solvents – refer CAP solvents

Process Monitoring Equipment

- Application rate computers
- Applicator speedometers, calibrated over range of applicator speeds
- ATP block dimension measuring equipment – depth gauges, wedges, ruler, tape measure
- Electronic scales and paper for structured / multidot application rate determination and setting
- Electronic scales / bead buckets for glass bead application rate determination and setting
- Bead application comparison plates.

Post-Application Measuring Equipment

- Block dimension measuring equipment – depth gauges, wedges, ruler, tape measure
- Steel test plates
- Retroreflectometers
- Skid resistance testers

Test Methods

- Block dimensions, block spacing, film thickness, skid resistance and retroreflectivity tested to NZTA P 30.
- Retroreflectivity, refer also to Glass Beads
- Skid Resistance, refer also to Glass Beads and Angular Material.

Note: the skid resistance of ATP material cannot be determined in current NZ ATP format with a British Pendulum Tester because the block pitch is smaller than the sweep area of the tester.

NZRF Roadmarking Materials Guide - Cold-Applied Plastic

Quick Reference Safety Guide

- Methyl methacrylate resin may cause skin sensitisation or other allergic responses. Avoid inhalation of vapour. Prevent contact with skin and eyes
- Benzoyl peroxide, avoid contact
- Associated cleaning solvents (may be a mixture of toluene and methyl ethyl ketone MEK), avoid contact.
- Skin Protection: Wear overalls and gloves. Use face-shield where splashing may occur. Use barrier creams
- Eye Protection: Use full face-shield / goggles while mixing.
- Inhalation: Should be handled and used in well ventilated areas. Refer to CAP solvents.
- If skin contact - wash immediately with soap and water – Do not use cleaning solvents or thinners.
- If eye contact - flush with water keeping eyelids apart for at least 20 minutes. Seek medical help.
- Remove contaminated clothing and shoes immediately. Wash clothes before reuse, discard contaminated footwear.

Recorded Health and Safety Incidents

- Reports of dermatitis and allergic dermatitis (sensitisation) are common.
- Specialist sector groups interested in the safe use of methacrylates established overseas

Related National / International Standard Specifications

- Products and their application are covered by patents and licencing agreements
- APAS 0041 – Australian Paint Approval Scheme Specification 0041, Pavement Marking Paint
- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- ASTM E1710 - Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
- ASTM E2176 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance of Pavement Markings in a Standard Condition of Continuous Wetting (RL-Rain)
- ASTM E2177 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness
- EN 1871 – Roadmarking Materials – Physical properties

NZRF Roadmarking Materials Guide - Cold-Applied Plastic

- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 – Specification for approved roadmarking products
- NZTA P 33 Specification for coloured pavement surfacings

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Worksafe “Reducing harm when working with organic solvents”



11 Thermoplastic

General Description

- A material consisting of aggregate, pigment, binder, glass beads and extenders which becomes liquid when heated and is applied in a molten form

Composition

- Thermoplastic roadmarking material is tailored for specific application methods such as audio-tactile profiled (ATP) markings structured / multidot markings and plain flat markings. For example, the material is specially formulated to enable raised portions to be formed cleanly and accurately. The formulation may contain fibres and /or other bonding agents.
- Virtually 100 percent volume solids
- Aggregates, (silica sand, calcite, quartz or calcined flint) approximately 40 percent, combined with pigment and extenders make up 80 percent of formulation
- Glass beads in the range 20 percent – 40 percent
- Pigments may be titanium dioxide, carbon black approximately 10 percent
- Binder (either natural or synthetic resins in an oil mixture) approximately 20 percent
- Extender (chalk or similar to extend pigment) approximately 10 percent.

Note: Many formulations can be softened / dissolved in aromatic solvents (i.e. Toluene or Xylene) or chlorinated hydrocarbon solvents (i.e. Chloroform or Dichloromethane)

Physical Properties

- Rapid setting
- Top surface at a uniform height from road surface
- Edge definition affected by surface texture
- Low Gloss
- Colours: Full range including White, Yellow, Red, Green, Blue and Black
- Beads can form significant percentage of structure
- Softening point not less than 100°C
- Relative density approximately 1.98kg/l.

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9mm when tested in accordance with 8.2 of NZTA M07

NZRF Roadmarking Materials Guide - Thermoplastic

- When tested in accordance with 8.3 of NZTA M07, the retroreflectivity and luminance of a beaded test thermoplastic film after the required number of vehicle passes shall not be less than the values set out in 8.3 of NZTA M07 for “high” or “standard” visibility classification
- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.
- Material can only be tested in flat or structured / multi dot format as ATP pitch is less than sweep of, and their shape reduces accuracy, of British Pendulum Tester results.
- Retroreflectivity / skid should not be measured immediately after application due to the presence of process components on the material. Trafficking is advised prior to testing.

Note: The skid resistance and retroreflectivity of thermoplastic marking material is not a fixed property for any given formulation. It may vary considerably according to the temperature at which it is laid and will also vary throughout its life according to conditions such as traffic and weather.

Durability

- Regarded as a “long life” material as far as “wear” is concerned
- Recent overseas developments using high performance rosins have seen significant improvements in service life
- The life of the material is largely dependent on the formulation, thickness applied, the pattern of the line and the degree of trafficking.

Note: The pattern of line is selected by Road Controlling Authority for each particular purpose, many of which are unlikely to be trafficked to any degree, e.g. audio tactile edge-line on straight sections of highway.

Compatibility

- Can be used on most types of surfaces for longitudinal, transverse and other markings.
- Thermoplastic placed over cold-applied plastic and waterborne paints may fail
- May cause a break down in the resin of waterborne paint. A solution is to apply at 190 - 200°C to ensure thermoplastic melts through paint to bond with bitumen in road surfacing.
- Thermoplastic applied over alkyds of significant thickness, i.e. over 150 µm may fail.

Adhesion

- Can be applied over most surfaces. Concrete requires priming.
- Can be applied immediately to fresh asphalt (with better adhesion on asphalt that has had 3 month settling period). NZTA P 22 Notes

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recommend marking new surfaces with paint and allowing a few months settling prior to thermoplastic application.

Application Parameters

- Correctly formulated material must be used for profile to form cleanly and accurately
- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding vessels must have continuous agitation
- Although alkyd (wood rosin) and hydrocarbon materials will fuse to one another on the road, they are incompatible in melting vessels. Pre-melters and applicator tanks must be cleaned thoroughly between different types of thermoplastic.

Molten thermoplastic should not be:

- Held above 200°C for more than six hours
- Heated above 230°C
- Reheated more than three times
- Markings must be protected from traffic until set. Markings being trafficked prior to setting will be deformed. Un-beaded markings coming into contact with tyres while still warm will draw carbon black and road grime from tyres.
- Road and air temperatures should be greater than 10°C and rising. Poor bond will develop if road temperature falls below 5°C
- Road surface needs to be clean and dry. Moisture tests need to be conducted prior to application as any moisture on the surface or in aggregate voids may lead to delamination
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Road surface needs to be smooth and free of objects / shape changes that may affect the travel of the screed box.

Manufacturing Process

- For powder products the components are mixed using a ribbon or similar blender to form the finished product.
- Following QC testing the powder is bagged and labelled.

Testing of Physical Properties

- Thermoplastic may be tested to NZTA M77.

Handling, storage and packaging

- Generally supplied as a powder or powder/oil suspension

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- 25 kg plastic and paper bags. Plastic bags can be formulated such they can be added to the mix
- Store powder mix protected from rain and moisture. Presence of moisture can cause foaming, spitting and expansion on heating
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous unless heated
- Flash Point exceeds 230°C
- Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical
- When Heated Typical Classification – refer to product specific data sheets
 - Proper Shipping Name: Elevated Temperature Liquid
 - Class: 9
 - Packing Group: III
 - HazChem Code: 2W

Environmental Impacts

- Thermoplastic is largely inert. Powder and waste material can usually be disposed of in accordance with local disposal regulations for non-hazardous materials.

Note: Heat transfer oils used in pre-melters and applicators is classified as 3Z. Heat transfer oils may present particular hazards, refer to related Safety Data Sheets before disposal.

Occupational Health and Safety Hazards

Powder Form

- Dusts
- Eye irritation.

Molten Form

- Burns.

Application Process – Audio-tactile profiled (ATP)

- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding vessels must have continuous agitation
- Machine screeded thermoplastic pavement markings are applied by an applicator which drags a frame (screed box) having a fixed aperture on the lower trailing edge, connected to the molten thermoplastic supply system (typically a feed-screw in a cylinder), following the existing markings (or set-out spots in the case of new work)
- At predetermined intervals a secondary gate mechanism is opened increasing aperture height to form a portion of line with an increased height. The frequency and duration of the gate opening and shutting controls the pattern of the line

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- The width of the aperture controls the line width. The material is normally presented to the screed box aperture through the use of a feed-screw or similar device
- The applicator driver normally has an assistant to monitor conditions and control the process
- The material temperature and the road surface conditions (both texture depth and general condition) are the critical factors to the appearance, consistency and performance of the product
- Machine screed thermoplastic application plant and pre-melters require verification / calibration to ensure application requirements are known. Refer to NZTA T 12 and NZTA T 18
- Glass beads are simultaneously applied to the surface of the molten line if immediate retroreflectivity is specified
- Angular material may be applied in conjunction with beads if required to achieve particular skid resistance values. The addition of angular material with glass beads must be well controlled to ensure that retroreflectivity is not compromised
- This process is typically slower than extrusion methods.

Application Process – Extrusion

- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding vessels must have continuous agitation
- Extruded thermoplastic pavement markings are applied by an applicator which extrudes a ribbon of molten thermoplastic from a fixed width slot, connected to the molten thermoplastic supply system (typically a feed-screw in a cylinder), while the applicator is driven at a uniform speed following the existing markings (or set-out spots in the case of new work)
- The aperture height and the road speed control the thickness achieved on the road. The width of the line is similarly controlled / affected by aperture width and road speed
- The applicator driver normally has an assistant who monitors conditions and controls the process
- Applicator speed, feed rate (feed-screw rpm), height of slot from road surface and material temperature are all critical to the appearance, consistency and performance of the product
- Extruded thermoplastic application plant and pre-melters require verification / calibration to ensure application requirements are known. Refer to NZTA T12 and NZTA T18
- Glass beads are simultaneously applied to the surface of the molten line if immediate retroreflectivity is specified
- Angular material may be applied in conjunction with beads if required to achieve particular skid resistance values
- This process is typically faster than screed methods.

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Application Process – Multidot

- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding vessels must have continuous agitation
- Products and their application are covered by patents and licencing agreements
- Material may be applied as multidot using glass beads are applied to provide initial retroreflectivity

Application Process – Machine Screed

- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding vessels must have continuous agitation
- Machine screeded thermoplastic pavement markings are applied by an applicator which drags a frame (screed box) having a fixed aperture on the lower trailing edge, connected to the molten thermoplastic supply system (typically a feed-screw in a cylinder), following the existing markings (or set-out spots in the case of new work)
- The applicator driver normally drives the applicator while an assistant monitors conditions and controls the process
- The material temperature and the road surface conditions (both texture depth and general condition) are the critical factors to the appearance, consistency and performance of the product
- Machine screed thermoplastic application plant and pre-melters require verification / calibration to ensure application requirements are known. Refer to NZTA T 12 and T18
- Glass beads are simultaneously applied to the surface of the molten line if immediate retroreflectivity is specified. Consistency of beading of machine screeded lines is more difficult to achieve than extrusion
- Angular material may be applied in conjunction with beads if required to achieve particular skid resistance values
- This process is typically slower than extrusion methods
- The quantity of material used and speed of application is highly dependent on the texture depth and condition of the pavement.

Application Process – Machine Spray

- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding tanks must have continuous agitation
- Sprayed thermoplastic pavement markings are applied by an applicator which sprays molten thermoplastic through a nozzle, connected to the molten thermoplastic supply system (typically pressurised), while the

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applicator is driven at a uniform speed following the existing markings (or set-out spots in the case of new work)

- The applicator driver normally drives the applicator while an assistant monitors conditions and controls the process
- Applicator speed, nozzle pressure, supply pressure, height of nozzle from road surface and material temperature are all critical to the appearance, consistency and performance of the product
- Sprayed thermoplastic application plant and pre-melters require verification / calibration to ensure application requirements are known. Refer to TNZ T 12 and T 18
- Glass beads are simultaneously applied to the surface of the molten line if immediate retroreflectivity is specified
- Angular material may be applied in conjunction with beads if required to achieve particular skid resistance values
- This process is typically faster than screed methods

Note: As the heating vessel is a pressure vessel it is subject to the certification requirements of the Pressure Equipment, Cranes and Passenger Ropeways Regulations 1999.

Application Process – Handscreed

- The thermoplastic material is pre-heated to a molten state in a separate oil jacketed heating vessel
- Pre-melters and applicator holding tanks must have continuous agitation.
- Molten thermoplastic is poured by ladle into a frame (screed box) having a fixed aperture on the lower trailing edge, which is dragged along the existing markings (or set-out spots in the case of new work). Sufficient additional molten material is added to the box to complete the markings
- The material temperature and the road surface conditions (both texture depth and general condition) are the critical factors to the appearance, consistency and performance of the product
- Due to the manual nature of the process the action of simultaneously applying beads and angular material to the surface of the molten line is difficult. The more sophisticated methods using wheeled carts can provide a degree of consistency of bead application
- This process is typically slower than machine extrusion methods, however less equipment is required.

Process Monitoring Equipment

- Portable environmental measuring devices for temperature
- Device for determining the surface including aggregate voids have no moisture
- Thermoplastic application rate computers
- Electronic scales for glass bead application rate
- Speedometers
- Thermoplastic and heating temperature gauges

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- Film thickness gauges
- Fixed form height gauges
- Bead application comparison plates
- Surface texture measuring kit (sand circle equipment).

Post-Application Measuring Equipment

- Dry Film Thickness measured using non-destructive eddy current device such as the Elcometer. Device must be able to measure the full depth of the profile
- Mechanical thickness measuring devices such as external micrometers and snap gauges
- Steel test plates
- Retroreflectometers
- Skid resistance testers

Test Methods

- Block dimensions, block spacing, film thickness, skid resistance and retroreflectivity tested to NZTA P 30
- Retroreflectivity refer to Glass Beads.

Quick Reference Safety Guide

- Understand and carry instructions regarding treatment of burns
- Carry water specifically for the immediate treatment of burns and / or a gel based treatment system
- Wear safety boots or shoes at all times and full length overalls worn outside boots
- Wear gloves and safety glasses / face shield when handling molten thermoplastic
- Ensure that heating vessels are free of excess water before commencing heating process
- Never operate heating systems while vehicle is moving
- Provide adequate ventilation during loading of pre-melters.
- Skin Protection: Wear overalls and gloves. Use face-shield where splashing may occur. Overalls must be safe at high temperature (e.g. cotton) safety boots must be covered to prevent entry of hot thermoplastic, gloves or gauntlets similarly need to be worn inside sleeves to prevent entry of hot thermoplastic.
- Eye Protection: Use full face-shield while transferring molten material and checking holding vessels.
- Inhalation: Should be handled and used in well ventilated areas
- If burnt, Do not attempt to remove any thermoplastic, cool the affected area with water, keep on cooling until medical aid is available, handle carefully, avoid disturbing the burn, remove belts and other constrictions, don't remove clothing, don't attempt to clean area, don't apply lotions or ointments, cover burns free from thermoplastic with clean lint free material, keep patient warm without touching burns with

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blanket. Seek medical help, ensure that they read Burns Card and understand treatment. All thermoplastic crew members should carry a CCNZ burns card. Stay with patient. Treat patient for shock. Only give small amounts of liquids at frequent intervals

Note: There are gel-based products that provide safe and reliable burn cooling effects. Many formulations can be softened / dissolved in aromatic solvents (i.e. Toluene or Xylene), Methyl Ethyl Ketone (MEK) or chlorinated hydrocarbon solvents (i.e. Chloroform or Dichloromethane)

- If eye burn, flush with water for at least 20 minutes. Don't remove thermoplastic, seek medical help, ensure that they read Burns Card and understand treatment. Stay with patient. Treat patient for shock. Only give small amounts of liquids at frequent intervals.
- If dust or fumes inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If eye contact with powder, wash with running water for at least 15 minutes. Seek medical attention.

Related National / International Standard Specifications

- APAS 0041 – Australian Paint Approval Scheme Specification 0041, Pavement Marking Paint
- AS 4049.2 - Paints and related materials - Pavement marking materials - Thermoplastic pavement marking materials - For use with surface applied glass beads
- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- ASTM E1710 - Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
- ASTM E2176 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance of Pavement Markings in a Standard Condition of Continuous Wetting (RL-Rain)
- ASTM E2177 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 Specification for approved roadmarking products
- NZTA P 33 Specification for coloured pavement surfacings

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Civil Contractors New Zealand The bitumen safety book

12 Pre-Formed Thermoplastic

General Description

- A material consisting of aggregate, pigment, binder, glass beads and extenders, supplied pre-formed. The material can be supplied in a variety of line widths and shapes
- The pre-formed material is laid on the road surface and heated until it bonds to the road surface
- Pre-form allows the installation of small quantities of thermoplastic and letters and shapes without overlaps.

Composition

- Virtually 100 percent volume solids
- Aggregates, (silica sand, calcite, quartz or calcined flint) approximately 40 percent, combined with pigment, beads and extenders make up 80 percent of formulation
- Glass beads in the range of 20 to 40 percent
- Pigments may be titanium dioxide, carbon black , approximately 5 to 10 percent
- Binder (either natural or synthetic resins in an oil mixture) approximately 20 percent
- Extender (chalk or similar to extend pigment) approximately 10 percent.

Note: Many formulations can be softened / dissolved in aromatic solvents (i.e. Toluene or Xylene) or chlorinated hydrocarbon solvents (i.e. Chloroform or Dichloromethane)

Physical Properties

- Rapid setting
- Low Gloss
- Colours: Full range including White, Yellow, Green, Blue and Black
- Beads can form significant percentage of structure
- Softening point not less than 75°C
- Relative density approximately 1.98 kg/l

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9mm when tested in accordance with 8.2 of NZTA M07
- When tested in accordance with 8.3 of NZTA M07, the retroreflectivity and luminance of a beaded test thermoplastic film after the required number of vehicle passes shall not be less than the values -set out in 8.3 of NZTA M07 for “high” or “standard” visibility classification

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- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.

Note: The skid resistance and retroreflectivity of thermoplastic marking material is not a fixed property for any given formulation. It may vary considerably according to the temperature at which it is laid and will also vary throughout its life according to conditions such as traffic and weather.

Durability

- Regarded as a “long life” material as far as “wear” is concerned
- The life of the material is largely dependent on the thickness applied
- NZTA P 22 specifies a thickness of 2.0 to 2.5mm on asphalt and 2.0 to 3.0mm on chip-seal

Note: thickness' above 4 to 4.5 mm may cause difficulties for particular road users.

Compatibility

- Can be used on most types of surfaces and for longitudinal, transverse and other markings
- May cause a break down in the resin of waterborne paint
- Thermoplastic placed over cold-applied plastic may fail.
- Thermoplastic applied over paint of significant thickness may fail.

Adhesion

- Can be applied over most surfaces. Concrete requires priming
- Can be applied immediately to fresh asphalt (with better adhesion on asphalt that has had 3 month settling period. aggregate surfaces are best initially marked with paint allowing a few months settling prior to thermoplastic application.

Application Parameters

- Markings must be protected from traffic until set. Markings coming into contact with tyres while still warm will draw carbon black and road grime from tyres if un-beaded.
- Road and air temperatures should be greater than 10°C and rising. Poor bond will develop if road temperature falls below 5°C
- Road surface needs to be clean and dry. Moisture tests need to be conducted prior to application
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt.

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Manufacturing Process

- The pre-formed product is produced by either extrusion or screed processes using standard thermoplastic marking materials. Additives may be used to improve sheet strength. Shapes are commonly cut from sheet product. The material is either rolled up or supplied in sheet form.

Testing of Physical Properties

- Thermoplastic may be tested to NZTA M07, AS 4049.2, AS 4049.4 or EN 1871.

Handling, storage and packaging

- Generally supplied in roll or sheet form. Protect from shock or impact damage
- Store protected from rain and moisture. Presence of moisture can cause spitting and deformation on heating
- Protect from excessive heat or contamination from fuels, oils or greases
- Do not stack other material directly on sheets as they deform under pressure / time
- Classified as Non Hazardous
- Flash Point exceeds 230°C
- Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical.

Environmental Impacts

- Thermoplastic is largely inert, waste material can usually be disposed of in accordance with local disposal regulations for non-hazardous materials

Occupational Health and Safety Hazards

Molten Form

- Burns.

Application Process

- The pre-formed thermoplastic material is laid on the road surface in the desired location
- The material is heated (typically using gas wand) until it softens sufficiently to adhere to the road surface. Care needs to be taken to ensure that material is heated sufficiently to bond without overheating or charring of the surface.
- Pre-formed thermoplastic is ideal for small works where urgent long life marking is required or where there is no other work required. Eliminating the requirement for large thermoplastic equipment on site.

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- Due to manual style of application, it is difficult to consistently apply glass beads / angular material to the top surface. Some manufacturers supply pre-form material with surface treatments.

Process Monitoring Equipment

- Portable environmental measuring devices for temperature

Post-Application Measuring Equipment

- Dry Film Thickness measured using non-destructive eddy current device such as the Elcometer
- Retroreflectometers
- Skid resistance testers.

Test Methods

- Dry Film thickness, Skid Resistance and Retroreflectivity tested to NZTA P 22
- Retroreflectivity refer to Glass Beads

Quick Reference Safety Guide

- Understand and carry instructions regarding treatment of burns
- Carry water specifically for the immediate treatment of burns
- Wear full length overalls and safety boots or shoes at all times
- Skin Protection: Wear overalls and gloves. Overalls must be safe at high temperature (i.e. cotton)
- If burnt, Do not attempt to remove any thermoplastic, cool the affected area with water, keep on cooling until medical aid is available, handle carefully, avoid disturbing the burn, remove belts and other constrictions, don't remove clothing, don't attempt to clean area, don't apply lotions or ointments, cover burns free from thermoplastic with clean lint free material, keep patient warm without touching burns with blanket. Seek medical help, ensure that they read Burns Card and understand treatment. All crew members should carry a CCNZ burns card. Stay with patient. Treat patient for shock. Only give small amounts of liquids at frequent intervals

Notes: There are gel-based products that provide safe and reliable burn cooling effects. Many formulations can be softened / dissolved in aromatic solvents (i.e. Toluene or Xylene), Methyl Ethyl Ketone (MEK) or chlorinated hydrocarbon solvents (i.e. Chloroform or Dichloromethane)

- If eye burn, flush with water for at least 20 minutes. Don't remove thermoplastic, seek medical help, ensure that they read Burns Card and understand treatment. Stay with patient. Treat patient for shock. Only give small amounts of liquids at frequent intervals.

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- If dust or fumes inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If eye contact with powder, wash with running water for at least 15 minutes. Seek medical attention.

Related National / International Standard Specifications

- AS 4049.2 - Paints and related materials - Pavement marking materials - Thermoplastic pavement marking materials - For use with surface applied glass beads
- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- ASTM E1710 - Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
- ASTM E2176 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance of Pavement Markings in a Standard Condition of Continuous Wetting (RL-Rain)
- ASTM E2177 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness
- EN 1790 Roadmarking Materials – Preformed roadmarkings
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 – Specification for approved roadmarking products

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Civil Contractors New Zealand The bitumen safety book
- Gel-based Burn Treatment Systems
 - Jackson Allison Medical and Surgical Ltd

13 Permanent Tapes

General Description

- A pre-formed adhesive backed product, generally in roll or pre-cut form relying on pressure on the adhesive to create a bond with the pavement surface.

Composition

- Covered by Licence Agreements
- Virtually 100 percent volume solids
- A variety of materials, which may include but be not limited to polymeric materials, pliant polymers, thermoplastic resins, pigments and beads
- Glass beads are applied as coating to top surface to provide immediate retroreflectivity
- Pigments may be titanium dioxide or carbon black

Physical Properties

- Low Gloss
- Colours: White, Yellow, (may be bordered with black to raise contrast)
- Plain black versions exist designed for the permanent masking of redundant pavement markings.

Performance Properties

- Skid Resistance: not less than 45 BPN for products with a film thickness < 0.9mm and not less than 50 BPN for products with a film thickness ≥ 0.9 mm when tested in accordance with 8.2 of NZTA M07
- When tested in accordance with 8.3 of NZTA M07, the retroreflectivity and luminance of a beaded test thermoplastic film after the required number of vehicle passes shall not be less than the values set out in 8.3 of NZTA M07 for “high” or “standard” visibility classification
- Colour: As per AS 4049.1 clause 7.1.6 for a white material. For a yellow material, the colour shall be equal to Y13 (Vivid Yellow) or Y14 (Golden Yellow) or any colour that lies between Y13 and Y14 of AS 2700.

Note: Tapes are available in a wide variety of styles and patterns and should be selected on the basis of the requirements.

Durability

- Regarded as a “long life” material.

NZRF Roadmarking Materials Guide - Permanent Tapes

Compatibility

- Can be used on most types of surfaces and for longitudinal, transverse and other markings
- Caution is needed when applying thermoplastic over permanent tape as the heat could cause the tape to curl up at the edges
- Caution is required when applying over old markings in poor condition.

Adhesion

- Can be applied over most surfaces. Traditional tapes require priming when applying to concrete
- Can be applied immediately to fresh asphalt, often rolled directly into the warm asphalt
- Damage will be caused by heavy trucks, excessive encroachment on high ADT roadways, narrow lane width, unpaved shoulders, snow removal and ice control techniques.

Application Parameters

- Road surface needs to be clean and dry. Moisture tests need to be conducted prior to application
- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Roller pressure needs to be sufficient to ensure bonding over entire width of tape.

Testing of Physical Properties

- NZTA M07 – Specification for approved roadmarking products
- ASTM D4505 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life.

Handling, storage and packaging

- Generally supplied in roll form. Protect from shock or impact damage
- Use within 12 months of purchase
- Store protected from rain and moisture. Presence of moisture can cause poor bonding on application
- Protect from excessive heat or contamination from fuels, oils or greases
- Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical
- Typically classified as non-hazardous.

Environmental Impacts

- Permanent tapes are largely inert, waste material can usually be disposed of in accordance with local disposal regulations for non-hazardous materials.

NZRF Roadmarking Materials Guide - Permanent Tapes

Occupational Health and Safety Hazards

- May give off fumes on application of heat during removal.

Application Process

- Substrate prepared by hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Road surface needs to be clean and dry. Moisture tests should be conducted prior to application
- The pre-formed thermoplastic material is laid on the road surface in the desired location
- Tape is rolled directly onto surface using a roller appropriate to the substrate.

Post-Application Measuring Equipment

- Tape adhesion / pull-off test kit.

Test Methods

- Retroreflectivity refer to Glass Beads
- Skid Resistance refer also to Glass Beads and Angular Material

Quick Reference Safety Guide

- Permanent grades are difficult to remove often-requiring heat, which may give off noxious fumes. Use organic vapour respirator conforming to AS 1716

Related National / International Standard Specifications

- AS 4049.4 – Paints and related materials – Pavement marking materials Part 4: High performance pavement marking systems
- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
- ASTM E1710 - Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
- ASTM E2176 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance of Pavement Markings in a Standard Condition of Continuous Wetting (RL-Rain)
- ASTM E2177 - Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness
- EN 1790 Roadmarking Materials – Preformed roadmarkings
- EN 1871 – Roadmarking Materials – Physical properties

NZRF Roadmarking Materials Guide - Permanent Tapes

- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials
- NZTA M07 Specification for roadmarking products

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets



14 Temporary Tapes

General Description

- A pre-formed adhesive backed product, generally in roll or pre-cut form relying on pressure on the adhesive to create a bond with the pavement surface, where the adhesive is specifically designed to enable removal after a specified amount of time or traffic passes.

Composition

- Covered by Licence Agreements
- Virtually 100 percent volume solids
- A variety of materials, which may include but be not limited to polymeric materials, pliant polymers, pigments and beads
- Reflective beads.
- Pigments may be titanium dioxide, carbon black or lead chromate, approximately 10 percent, but a number are lead chromate free
- A non reflective black version is available to enable lines to be temporarily covered.

Physical Properties

- Low Gloss
- Typically have an embossed or raised pattern
- Colours: White, Yellow and Black
- Plain black for temporarily covering lines.

Performance Properties

- Retroreflectivity ranges from 150 to 500 mcd plus.
- Have the capability to provide reflectivity under conditions of wetness or rain with the use of high refractive index beads
- Commonly formulated to have initial skid resistance of 50 BPN
- Applied tape is immediately open for vehicle use
- The blackout version has no reflectivity

Note: These tapes are specifically designed to be removed but use beyond their specified limits can increase difficulty of removal.

Durability

- Strictly for short periods determined by time or traffic counts.

Compatibility

- Can be used on most types of surfaces for longitudinal and some transverse markings
- Caution is required when applying over old markings in poor condition

NZRF Roadmarking Materials Guide – Temporary Tapes

Adhesion

- Caution where placement has heavy vehicles negotiating tight bends.
- Can be applied over most surfaces
- Caution should be taken in using the tape for transverse lines
- Can be applied immediately to fresh asphalt
- Damage will be caused by heavy trucks, excessive encroachment on high ADT roadways, narrow lane width, unpaved shoulders, snow removal and ice control techniques.

Application Parameters

- Road surface needs to be clean and dry. Moisture tests need to be conducted prior to application
- Substrate prepared by brooming to remove loose paint, dust and dirt
- Roller pressure needs to be sufficient to ensure bonding over entire width of tape.

Testing of Physical Properties

- No New Zealand or AS/NZS specification
- ASTM D4592 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Limited Service Life.

Handling, storage and packaging

- Generally supplied in roll form. Protect from shock or impact damage
- Use within 12 months of purchase
- Store protected from rain and moisture. Presence of moisture can cause poor bonding on application
- Protect from excessive heat or contamination from fuels, oils or greases
- Extinguishing Media include Foam, Carbon Dioxide, Dry Chemical.

Environmental Impacts

- Permanent tapes are largely inert, waste material can usually be disposed of in accordance with local disposal regulations for non-hazardous materials.

Application Process

- Substrate prepared by brooming to remove loose paint, dust and dirt
- Road surface needs to be clean and dry. Moisture tests should be conducted prior to application
- Tape is rolled directly onto surface using a roller appropriate to the substrate.

NZRF Roadmarking Materials Guide – Temporary Tapes

Process Monitoring Equipment

- Adhesion to the road surface.

Post-Application Measuring Equipment

- Tape adhesion / pull-off test kit.

Test Methods

- Retroreflectivity, refer to Reflective Beads and Retroreflectometer
- Skid Resistance, refer also to Reflective Beads and Angular Material.

Related National / International Standard Specifications

- AS/NZS 1580 401.8 - Methods of test for paints and related materials
- ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
- ASTM E1710 - Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
- ASTM D4592 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Limited Service Life.
- EN 1790 Roadmarking Materials – Preformed roadmarkings
- EN 1871 – Roadmarking Materials – Physical properties
- EN 1436 - Roadmarking Material – Road marking performance for road users
- EN 1824 - Road marking materials. Road trials

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

15 Permanent Non Retroreflective Raised Pavement Markers – Category D, NZTA M 12

General Description

- A small object adhered to the pavement surface aimed at providing audio-tactile feedback to motorists.

Composition

- High impact plastic.

Physical Properties

- Self-cleaning
- High impact strength
- Heat and UV resistant
- White

Performance Properties

- Retroreflectivity: None

Durability

- Regarded as “semi-long life”
- “Life” dependent on a range of factors that include but are not limited to UV exposure, substrate, method of fixture, traffic type and volume etc.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to RPM Adhesives.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to RPM Adhesives.

Application Parameters

- RPM's must be clean and dry
- Refer to RPM Adhesives for application details
- Care must be taken to ensure that adhesive is not left on the visible surface
- Visual observation to confirm that RPM type, and location is correct

NZRF Roadmarking Materials Guide - Permanent Non Retroreflective Raised Pavement Markers – Category D, NZTA M 12

- RPM's must not be exposed to traffic until adhesive is set or dry.

Testing of Physical Properties

- Raised Pavement Markers may be tested to NZTA M 12 / AS/NZS 1906.3.

Handling, storage and packaging

- Store in cool dry place with packaging protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous.

Environmental Impacts

- Loose RPM's may cause significant damage /litter.

Occupational Health and Safety Hazards

- Installation / replacement of RPM has significant hazards, not least road traffic. Also refer to RPM adhesives.

Application Process

- RPM's must be clean and dry
- Refer to RPM Adhesives for application details.

Process Monitoring Equipment

- Refer to RPM Adhesives.

Test Methods

- Installation and maintenance requirements examined in accordance with NZTA M12.

Related National / International Standard Specifications

- NZTA M12 Specification for the design, manufacture, installation and maintenance of raised pavement markers
- AS 1906.3 Retroreflective materials and devices for road traffic control purposes

16 Permanent Retroreflective Raised Pavement Markers – Category G, NZTA M 12

General Description

- A small plastic object containing a retroreflective element adhered to the pavement surface aimed at providing both night-time visibility and audio-tactile feedback to motorists
- Variety of retroreflective lens protection including glass and ceramic coating
- Some have pre applied pressure sensitive adhesive (PSA).

Composition

- Commonly made of high impact plastic
- Variety of retroreflective elements used, including large glass spheres.

Physical Properties

- Self-cleaning
- High impact strength
- Colours: Full range including white, yellow, red, green and blue.
- Low water absorption
- Heat and UV resistant.

Performance Properties

- Retroreflectivity: Clause 7.6 of NZTA M 12 sets out the performance requirements for retroreflective class A, B and C for each coloured marker when measured using the retroreflectometer at: $\alpha = 0.2 \pm 0.1^\circ$, $\beta_1 = -1.0 - 0.0^\circ$ and $\beta_2 = 0.0 \pm 0.1^\circ$.
- Glass-faced RRPM's provide significant improvements in retroreflectivity over longer service periods than acrylic-faced RRPM's.

Durability

- Regarded as “semi-long life”
- “Life” dependent on a range of factors, which include but are not limited to UV exposure, substrate, method of fixture, reflective lens durability, traffic type and volume etc.
- Glass faced RRPM's and Ceramic coated RRPM's have longer performance life than acrylic faced RRPM's when adhered to smooth surfaces
- Type of adhesive / substrate may have significant effect on life.

NZRF Roadmarking Materials Guide - Permanent Retroreflective Raised Pavement Markers – Category G, NZTA M 12

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to RPM Adhesives.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to RPM Adhesives.

Application Parameters

- RRPM's must be clean and dry
- Road surface must be clean, dry and free from loose chips / material
- Refer to RPM Adhesives for application details
- Care must be taken to ensure that adhesive is not left on the visible body or lens of the RRPM, and that the bead of adhesive round the RRPM does not obscure the reflective element
- The entire base of the RRPM must be supported by adhesive to ensure that it does not fracture under load
- The adhesive should form a circle which just touches all four corners of RPM without submerging RRPM in adhesive
- Visual observation to confirm that RRPM type, alignment and orientation is correct
- RRPM's must not be exposed to traffic until adhesive is set or dry.

Manufacturing Process

- Typical manufacture has a plastic shell filled with resin. Some may be effectively one piece for added strength.

Testing of Physical Properties

- Retroreflective Raised Pavement Markers may be tested to NZTA M 12 and AS/NZS 1906.3.

Handling, storage and packaging

- Store in cool dry place with packaging protected from rain and moisture.
- Protect from excessive heat or contamination from fuels, oils or greases.
- Classified as Non Hazardous.

NZRF Roadmarking Materials Guide - Permanent Retroreflective Raised Pavement Markers – Category G, NZTA M 12

Environmental Impacts

- Loose RPM may cause significant damage / litter

Occupational Health and Safety Hazards

- Installation / replacement of RPM has significant hazards, not least road traffic. Also refer to RPM adhesives.

Application Process

- RRPM's must be clean and dry
- Glass-faced RRPM's should not be applied to coarse surfaces which are subject to chip / material loss
- Refer to RPM Adhesives for application details.

Process Monitoring Equipment

- Refer to RPM Adhesives.

Post-Application Measuring Equipment

- Retroreflectometer.

Test Methods

- Installation and maintenance requirements examined in accordance with NZTA M 12.

Related National / International Standard Specifications

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers
- AS/NZS 1906.3 Retroreflective materials and devices for road traffic control purposes
- ASTM D4280-02 Extended life type, non-ploughable, raised retroreflective pavement markers

Useful References

- Manufacturers Technical Data Sheets

17 Snow-Ploughable Retroreflective Raised Pavement Markers

General Description

- A small metallic object containing a retroreflective element adhered to the pavement surface aimed at providing both night-time visibility and audible / tactile feedback to motorists. The RRPM is designed in such a manner that the risk of it being damaged or removed by regular snow clearance operations is minimised
- A specifically designed RRPM that fits into a cast iron housing that in turn is milled into the road surface. The cast iron housing deflects the snow plough over the RRPM.

Composition

- One alternative is an aluminium body with a variety of types of retroreflective elements used
- RRPM's designed to be placed into cast iron housings are typically impact resistant plastic.

Physical Properties

- Self-cleaning
- High impact strength
- Heat and UV resistant
- Colours: White and yellow
- Thinner than standard RRPM's with a lower profile.

Performance Properties

- Retroreflectivity: Clause 7.6 of NZTA M 12 sets out the performance requirements for retroreflective class A, B and C for each coloured marker when measured using the retroreflectometer at: $\alpha = 0.2 \pm 0.1^\circ$, $\beta_1 = -1.0 - 0.0^\circ$ and $\beta_2 = 0.0 \pm 0.1^\circ$.

Durability

- Regarded as “semi-long life”
- “Life” dependent on a range of factors that include but are not limited to UV exposure, substrate, method of fixture, retroreflective lens durability, traffic type and volume etc.
- Some are designed such that retroreflective element can be replaced while RRPM is still in place.

NZRF Roadmarking Materials Guide - Snow-Ploughable Retroreflective Raised Pavement Markers

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to RPM Adhesives
- RRPM's designed for snow ploughable applications are typically designed with specific housings having devices to deflect the hard rubber blade of the snow-plough.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to Two-component RPM Adhesives.

Application Parameters

- RRPM's must be clean and dry
- The slots must be at a depth such that the RRPM sits proud of the road surface by approximately 12mm with the tips of the snow-plough deflecting surfaces below the pavement surface
- The four base lugs must be in contact with the pavement
- Refer to RPM two-component adhesives for application details
- Care must be taken to ensure that adhesive is not left on the visible body or lens of the RRPM, and that the bead of adhesive round the RRPM does not obscure the reflective element
- Visual observation to confirm that RRPM type, alignment and orientation is correct
- RRPM's must not be exposed to traffic until adhesive is set or dry.

Retroreflective Element Repair/Replacement

- The body casting must be cleaned of remaining traces of damaged element, this is commonly done by sandblasting
- Appropriate two-component adhesive is to be used to adhere element to body
- Care must be taken to ensure that adhesive is not left on the visible body or lens of the RRPM, and that the bead of adhesive round the RRPM does not obscure the reflective element
- Visual observation to confirm that RRPM type, alignment and orientation are correct.

Testing of Physical Properties

- Raised Pavement Markers may be tested to NZTA M 12 and AS/NZS 1906.3.

NZRF Roadmarking Materials Guide - Snow-Ploughable Retroreflective Raised Pavement Markers

Handling, storage and packaging

- Store in cool dry place with packaging protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous

Application Process

- RRPM's must be clean and dry
- Slots are machined into pavement surface to appropriate depth and width, this is commonly done using gang saw. Care must be taken not to cut detector loop wires
- Residue and loose material is removed from slot
- The slots are filled with epoxy adhesive. Sufficient adhesive is placed to ensure that all voids beneath and around the casting are filled or casting is adhered into position with RRPM already installed
- Refer to RPM two component adhesives for application details.

Note: Some types may allow or require the retroreflective element to be secured to base after fixing to the pavement.

Process Monitoring Equipment

- Refer to RPM Adhesives
- Height gauge.

Test Methods

- Installation and maintenance requirements in accordance with NZTA M 12.

Related National / International Standard Specifications

- ASTM D4383-02 Plowable Raised Retroreflective Pavement Markers

Useful References

- Item 621 Ohio Department of Transport Specifications

18 Roadstuds – Retroreflective Raised Pavement Markers

General Description

- A small metallic object containing a retroreflective element adhered to the pavement surface aimed at providing both night-time visibility and audible / tactile feedback to motorists. The RRPM is designed in such a manner that the risk of it being damaged or removed by arduous traffic conditions is minimised
- The RRPM has an anchor stem that is placed in a hole milled into the road surface.

Composition

- Aluminium with bi-convex lenses
- High Impact plastic and polycarbonate variations exist with prismatic lenses.

Physical Properties

- Self-cleaning
- High impact strength
- Heat and UV resistant
- Colours: Full range.

Performance Properties

- Retroreflectivity: Clause 7.6 of NZTA M 12 sets out the performance requirements for retroreflective class A, B and C for markers when measured using the retroreflectometer at: $\alpha = 0.2 \pm 0.1^\circ$, $\beta_1 = -1.0 - 0.0^\circ$ and $\beta_2 = 0.0 \pm 0.1^\circ$.

Durability

- Regarded as “long life”
- “Life” dependent on a range of factors that include but are not limited to UV exposure, substrate, method of fixture, retroreflective lens durability, traffic type and volume etc.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to RPM Adhesives

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement. Refer to Two-component RPM Adhesives

NZRF Roadmarking Materials Guide - Roadstuds - Retroreflective Raised Pavement Markers

Application Parameters

- RRPM's must be clean and dry
- The holes must be at a depth such that the RRPM base sits on the road surface
- The entire base must be in contact with the pavement.
- Appropriate grout is used
- Care must be taken to ensure that adhesive is not left on the visible body or lens of the RRPM, and that the bead of adhesive round the RRPM does not obscure the reflective element
- Visual observation to confirm that RRPM type, alignment and orientation is correct
- RRPM's must not be exposed to traffic until grout is set.

Manufacturing Process

- Aluminium sand casting
- Attachment of Bi-convex lens or glass faced prismatic lens using high strength adhesive.
- Polycarbonate moulding.
- Plastic welding of polycarbonate prismatic lens with ceramic coating

Testing of Physical Properties

- Raised Pavement Markers may be tested to NZTA M 12 or AS/NZS 1906.3

Application Process

- RRPM's must be clean and dry
- Holes are machined into pavement surface to appropriate depth. Care must be taken not to cut detector loop wires
- Residue and loose material is removed from hole
- The holes are filled with grout, sufficient being placed to ensure that all voids beneath and around the casting are filled
- Roadstud anchor is placed in hole and stud pressed into road surface until base is in contact
- Excess grout is cleaned from roadstud and surrounding pavement.

Process Monitoring Equipment

- Hole depth gauge.

Test Methods

- Installation and maintenance requirements in accordance with NZTA M 12.

NZRF Roadmarking Materials Guide - Roadstuds - Retroreflective Raised Pavement Markers

Related National / International Standard Specifications

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers
- EN 1463 Parts 1 and 2 Retroreflecting Road Studs

Useful References

- Manufacturers Technical Data Sheets

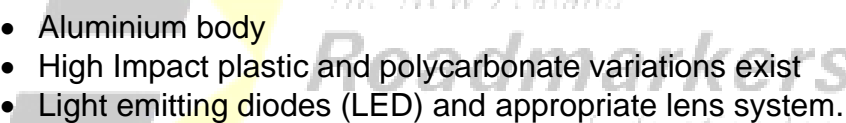


19 Illuminated Raised Pavement Markers

General Description

- A small metallic object containing a light source retroreflective element adhered to the pavement surface aimed at providing both night-time visibility and audible / tactile feedback to motorists
- The RRPM is powered either by an integrated solar power system, directly or inductively from a cable buried in the road surface close to the RPM. The inductive power system may be connected to a solar power system or to a reticulated electricity system
- The RRPM is designed in such a manner that the risk of it being damaged or removed by arduous traffic conditions is minimised
- The RRPM commonly has an anchor stem that is placed in a hole milled into the road surface.
- Flashing red RRPM's set across a transverse limit line are automatically activated by the presence of pedestrians using pedestrian crossings, or when traffic lights turn red at a signalised controlled pedestrian crossing. Flashing blue RRPM's in the centre of the road are activated through the use of a temperature sensor indicating icy may be present.

Composition

- 
- Aluminium body
 - High Impact plastic and polycarbonate variations exist
 - Light emitting diodes (LED) and appropriate lens system.

Physical Properties

- Self-cleaning
- High impact strength
- Heat and UV resistant
- Colours: White, yellow, red and blue.

Performance Properties

- Typically 50d at 8° vertical and 10° horizontal.

Durability

- Regarded as “long life”
- “Life” dependent on a range of factors that include but are not limited to UV exposure, substrate, method of fixture, retroreflective lens durability, traffic type and volume etc
- Inductively powered RPM's typically have longer life.

NZRF Roadmarking Materials Guide – Illuminated Raised Pavement Markers

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement
- Fixing systems typically licenced.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement
- Fixing systems typically licenced.

Application Parameters

- RRPM's must be clean and dry
- The entire base must be in contact with the pavement
- Appropriate grout is used
- Care must be taken to ensure that adhesive is not left on the visible body or lens of the RRPM, and that the bead of adhesive round the RRPM does not obscure the reflective element.
- Visual observation to confirm that RRPM type, alignment and orientation is correct
- RRPM's must not be exposed to traffic until grout is set.

Manufacturing Process

- Aluminium sand casting
- Attachment of Bi-convex lens or glass faced prismatic lens using high strength adhesive
- Polycarbonate moulding
- Insertion of light and power system
- Plastic welding of polycarbonate case
- Attachment of base.

Testing of Physical Properties

- Raised Pavement Markers may be tested to NZTA M 29

Application Process

- RPM's must be clean and dry
- Holes are machined into pavement surface to appropriate depth. Care must be taken not to cut detector loop wires
- Residue and loose material is removed from hole
- The holes are filled with grout, sufficient being placed to ensure that all voids beneath and around the casting are filled
- Stud anchor is placed in hole and stud pressed into road surface until base is in contact
- Excess grout is cleaned from stud and surrounding pavement

NZRF Roadmarking Materials Guide – Illuminated Raised Pavement Markers

- Inductive power cable trench cut, cable placed and road surface resealed. Care must be taken not to cut detector loop wires.

Process Monitoring Equipment

- Hole depth gauge.

Test Methods

- Installation and maintenance requirements in accordance with NZTA M 29.

Related National / International Standard Specifications

- NZTA M 29 Specification for internally illuminated pavement markers

Useful References

- Manufacturers Technical Data Sheets



20 Temporary Pavement Markers

General Description

- A small L shaped flexible plastic pavement marker used to hold the original line and marking location in chip and slurry seal road maintenance operations
- The markers may be unreflective or reflective on one or both sides. The reflective markers have a protective cover which is removed after the bitumin process to restore the reflective properties
- Commonly called “flickies”.

Composition

- Vinyl plastic with high tack butyl adhesive pad
- Retroreflective tape (optional) Covertape on these versions.

Physical Properties

- Flexible
- Colours: White and yellow.

Durability

- Regarded as “temporary” or disposable.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Application Parameters

- Commonly supplied in 100mm or 150mm widths, these may be cut down before use
- Marker is placed at critical dimension(s) of existing markings in such a manner that risk of removal during resealing operation is minimised.

Manufacturing Process

- Plastic extrusion
- Butyl adhesive and reflective tape application
- Cut to length.

NZRF Roadmarking Materials Guide - Temporary Pavement Markers

Handling, storage and packaging

- Store in cool dry place with packaging protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous.

Application Process

- Temporary marker and road surface must be clean and dry.

Test Methods

- Must confirm compliance with AS/NZS 1906.3 but are not required to undergo formal field testing.

Useful References

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers



21 Bituminous RPM Adhesive

General Description

- A bituminous material applied in a molten state to fix raised pavement markers to the road surface.

Composition

- Petroleum asphalt (Bitumen)
- Virtually 100 percent volume solids.

Physical Properties

- Black viscous semi-solid having Asphaltic odour
- Density 1.5 to 2
- Negligible solubility in water
- Melting point 40 to 100°C
- Boiling Point > 480°C.

Performance Properties

- Softening Point: >99°C when tested in accordance with ASTM D36
- Penetration: 10 to 20 mm when tested in accordance with ASTM D5

Note: these values match bituminous binders commonly used in road construction.

Durability

- Regarded as a “long life” material
- Bond strength matches common pavement surfaces
- Creates / provides enhanced impact resistance for RPM / Adhesive system by cushioning RPM.

Compatibility

- May cause a break down in the resin of waterborne paint
- Bituminous adhesive placed over cold-applied plastic and waterborne paints may fail
- Bituminous adhesive applied over alkyds of significant thickness, i.e. over 150 µm may fail.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement
- Can be applied immediately to fresh asphalt.

NZRF Roadmarking Materials Guide - Bituminous RPM Adhesive

Application Parameters

- Application temperature is not greater than 220°C
- Material should not be heated above 215°C
- Material should be stirred or agitated regularly to avoid settling or coke build-up
- Road surface needs to be clean and dry. Moisture tests need to be conducted prior to application
- Substrate prepared by air-hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt
- Road and air temperatures should be greater than 4°C and rising. Poor bond may develop if road temperature falls below 4°C.

Note: RPM removal is commonly carried out at times when low road surface temperature has a significant effect on the shear strength of the adhesive. See the NZRF RPM Removal Guide

Testing of Physical Properties

- NZTA M 12 requires written confirmation from the adhesive manufacturer that it is suitable for long term fixing of markers to road pavements.

Handling, storage and packaging

- Generally supplied as small bricks in a variety of containers
- Store in cool dry place protected from rain and moisture. Presence of moisture can cause foaming, spitting and expansion on heating
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous for transportation un heated
- Flash Point exceeds 280°C
- Do not heat above Flash Point. Hot asphalt may ignite flammable mixtures on contact
- Sulphur Oxides and Hydrogen Sulphide (which are both toxic) may be released on combustion
- Extinguishing media include Foam, Carbon Dioxide, and Dry Chemical. Water fog may be used on flat surfaces such as roads
- Do not use water on asphalt fire in tank or other containers as it may cause violent eruption and spreading of burning asphalt
- When Heated Typical Classification – refer to product specific data sheets
 - Proper Shipping Name: Elevated Temperature Liquid
 - Class: 9
 - Packing Group: III
 - HazChem Code: 2W

Environmental Impacts

- May burn although not readily ignitable

NZRF Roadmarking Materials Guide - Bituminous RPM Adhesive

- Gives off small amounts of Hydrogen Sulphide on heating

Note: Heat transfer oils used in pre-melters and applicators are classified as 3Z. Heat transfer oils may present particular hazards, refer to related Safety Data Sheets before disposal. LPG used as heating medium is classified as 2WE.

- In the period of 1st April 2007 to 31st March 2009, at least 3 incidents related to bitumen, and at least 76 related to LPG were reported to ERMA.

Occupational Health and Safety Hazards

Brick Form

- Negligible

Molten Form

- Burns
- Fumes (Hydrogen Sulphide)
- Fire
- Explosion / Fire hazard - LPG Burners.

Application Process

- The bituminous material is heated to approximately 180°C in a tank connected to an appropriate dispenser. This may be a simple trickle valve or a computerised pump.
- The adhesive is applied to the road surface to an approximate 2mm thickness that extends past the outside edges of the RPM
- RPM's are usually applied by hand at correct location.

Process Monitoring Equipment

- Bitumen temperature measuring / monitoring devices.

Test Methods

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers

Quick Reference Safety Guide

- Understand and carry instructions regarding treatment of burns
- Carry water / gel based treatment system specifically for the immediate treatment of burns
- Wear full length overalls and safety boots or shoes at all times
- Wear gloves when handling molten bitumen
- Ensure that heating vessels are free of excess water before commencing heating process
- Never operate heating systems while in transit

NZRF Roadmarking Materials Guide - Bituminous RPM Adhesive

- Provide adequate ventilation during loading and heating of heating vessels.
- Skin Protection: Wear overalls and gloves. Use face-shield where splashing may occur. Overalls must be safe at high temperature (i.e. cotton), safety boots must be covered to prevent entry of hot bitumen, gloves or gauntlets similarly need to be worn inside sleeves to prevent entry of hot bitumen
- Eye Protection: Use full face-shield while transferring molten material and checking holding vessels.
- Inhalation: Should be handled and used in well-ventilated areas. Note: Hydrogen Sulphide in high concentrations has no odour.
- If burnt, Do not attempt to remove any bitumen, cool the affected area with water, keep on cooling until medical aid is available, handle carefully, avoid disturbing the burn, remove belts and other constrictions, don't remove clothing, don't attempt to clean area, don't apply lotions or ointments, cover burns free from bituminous RPM adhesive with clean lint free material, keep patient warm without touching burns with blanket. Seek medical help, ensure that they read Burns Card and understand treatment. All RPM installation crew members should carry a CCNZ burns card. Stay with patient. Treat patient for shock. Only give small amounts of liquids at frequent intervals

Note: There are gel-based products that provide safe and reliable burn cooling effects

- If eye burn, flush with water for at least 20 minutes. Don't remove bitumen, seek medical help, ensure that they read Burns Card and understand treatment. Stay with patient. Treat patient for shock. Only give small amounts of liquids at frequent intervals.
- If dust or fumes inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.

Recorded Health and Safety Incidents

- There has been at least one "Serious Harm" accident requiring skin grafts in New Zealand related to heated bituminous products

Related National / International Standard Specifications

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Civil Contractors New Zealand The bitumen safety book
- Gel-based Burn Treatment Systems
 - Jackson Allison Medical and Surgical Ltd

22 Two Component RPM Adhesive

General Description

- A two component epoxy resin material applied in a molten state to fix raised pavement markers and delineators to median barriers, parapets and the road surface.

Composition

- Two component moisture insensitive epoxy resin
- Part A normally contains epoxy resin
- Part B normally contains amine polymer.

Physical Properties

- Part A – White or grey resin paste
- Part B – Black or cream resin paste
- Filler - (if required) - White powder
- Negligible solubility in water.

Performance Properties

- Bond strength 450psi after 2 hours, 1800psi after 24 hours.

Note: these values are higher than many bituminous binders commonly used in road construction.

Durability

- Regarded as a “long life” material.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Application Parameters

- Material should be well mixed to a uniform colour
- Road and air temperatures should be greater than 5°C and rising. Poor bond may develop if road temperature falls below 5°C
- Road surface needs to be clean and dry. Moisture tests should be conducted prior to application

NZRF Roadmarking Materials Guide - Two Component RPM Adhesive

- Sandblasting, waterblasting or wire brushing is recommended
- Substrate prepared by air-hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt.

Testing of Physical Properties

- NZTA M 12 requires written confirmation from the adhesive manufacturer that it is suitable for long term fixing of markers to road pavements.

Handling, storage and packaging

- Supplied in 500 ml, 4, 5, 20 and 200 l containers
- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous for transportation
- Extinguishing media include Foam, Carbon Dioxide, and Dry Chemical.

Environmental Impacts

- Epoxy resin doesn't have major or identifiable volatile components
- Although both resin and hardener are not usually considered hazardous, some requirements may be stipulated for the disposal of waste
- RPM's torn or removed from bituminous road surface are generally accompanied by all the adhesive creating a larger object and hole than if a bituminous adhesive had been used.

Occupational Health and Safety Hazards

- Dermatitis
- Allergic dermatitis (Sensitisation)
- Severe Irritation and Chemical Burns
- Respiratory Irritation.

Application Process

- The two components are combined in a clean steel container and mixed with a slow speed drill attached to an appropriate epoxy-mixing paddle. The two components have differing colours to aid indication of even mixing
- Appropriate filler may be added to produce a mortar for filling or vertical surfaces
- Heating may be used to allow easier placement and / or shortening set and cure times
- Material is usually trowelled or "buttered" onto base of RPM
- RPM's are usually applied by hand at correct location.

NZRF Roadmarking Materials Guide - Two Component RPM Adhesive

Test Methods

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers

Quick Reference Safety Guide

- Epoxy resins are skin sensitising to some people.
- Part A contains epoxy resin that may cause skin sensitisation or other allergic responses. Avoid inhalation of vapour. Prevent contact with skin and eyes
- Part B contain amine polymer, avoid contact
- Skin Protection: Wear overalls and gloves. Use face-shield where splashing may occur. Use barrier creams
- Eye Protection: Use full face-shield / goggles while mixing.
- Inhalation: Should be handled and used in well ventilated areas
- If skin contact with Part A, wash immediately with soap and water.
- If eye contact with Part A flush with water for at least 20 minutes. Seek medical help.
- If contact with Part B immediately flush eyes or skin with water for at least 20 minutes. Seek medical help. Remove contaminated clothing and shoes. Wash clothes before reuse, discard contaminated footwear.

Recorded Health and Safety Incidents

- Allergic dermatitis (Sensitisation) is common.

Related National / International Standard Specifications

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

23 Self-Adhesive Pads

General Description

- Self-adhesive squares approximately 3mm thick designed for the application of raised pavement markers to smooth surfaces.

Composition

- Self adhesive, many are poly butyl rubber, although thermoplastic ones are available.

Physical Properties

- Solid
- Grey
- Semi-flexible under normal ambient conditions
- Specific Gravity 1.53.

Performance Properties

- Bond strength highly dependent on surface and application technique.

Durability

- Regarded as a “long life” material.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Application Parameters

- Road and air temperatures should be greater than 5°C and rising. Poor bond may develop if road temperature falls below 5°C
- Road surface needs to be clean and dry. Moisture should be conducted prior to application
- Sandblasting, waterblasting or wire brushing of the pavement surface is recommended
- Substrate needs to be prepared by air-hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt.

NZRF Roadmarking Materials Guide – Self-Adhesive Pads

Testing of Physical Properties

- NZTA M 12 requires written confirmation from the adhesive manufacturer that it is suitable for long term fixing of markers to road pavements.

Handling, storage and packaging

- Supplied in boxes of 200
- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases.
- Classified as Non Hazardous for transportation
- Extinguishing media include Foam, Carbon Dioxide, and Dry Chemical.

Environmental Impacts

- Poly butyl rubber doesn't have major or identifiable volatile components in the quantities encountered.

Occupational Health and Safety Hazards

- Respiratory Irritation.

Application Process

- A clean dry surface is required
- Sweep or blow off area with compressed air to remove all loose material in a 300 mm perimeter of where the marker will be installed
- Remove the slip sheeting from one side of the pad and place it on the ground the exposed surface facing up
- Center the marker on the pad. Press on the marker to secure it to the pad
- Lift the marker and remove the remaining slip sheet from the other side of the pad
- Follow manufacturer's instructions as to proper orientation of the marker on the desired location
- Press the marker down firmly onto road surface
- Slowly drive a vehicle on the marker and stop with a wheel directly on top of the marker
- Allow 15-20 seconds for the marker to set before removing the vehicle

Note: for optimum performance of the butyl pad, the recommended installation temperature is 10°C or above. When working below 10°C the pad, marker and road surface should be warmed to this temperature prior to installation.

NZRF Roadmarking Materials Guide – Self-Adhesive Pads

Test Methods

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers

Quick Reference Safety Guide

- Inhalation: Should be handled and used in well ventilated areas.

Related National / International Standard Specifications

- NZTA M 12 Specification for the design, manufacture, installation and maintenance of raised pavement markers

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets



24 Glass Beads

General Description

- Small spherical glass beads intended either for the surface application to a wet / unset film of pavement marking material or combined to the marking to provide or enhance the retroreflective properties of that marking
- Roadmarking glass beads are available in a range of size, clarity and refractive index classifications
- Various coatings are applied to reduce caking (i.e. enhance flow / add flotation), and / or to enhance the bond between bead and the marking material. Coatings include but are not limited to silicone (anticaking) and silane.

Composition

- Clear and colourless glass – amorphous non-crystalline silica.

Physical Properties

- Bulk density of approximately 1.6g/cc - 2.5g/cc
- Negligible solubility in water
- Size Distribution:

Type B in AS/NZS 2009: The size distribution when tested in accordance with AS 2009 is as follows:

Sieve Size μm	850	600	425	300	150
percent Passing	100	90-100	35-75	15-45	0-5

Type C in AS 2009: The size distribution when tested in accordance with AS 2009 is as follows:

Sieve Size μm	1300	1180	850	425	Pan
percent Retained	Trace	0-3	5-20	65-95	0-10

Type D in AS 2009: The size distribution when tested in accordance with AS 2009 is as follows:

Sieve Size μm	1700	1400	1180	1000	850
percent Passing	100	95-100	80-95	10-40	0-5

NZRF Roadmarking Materials Guide - Glass Beads

Performance Properties

- Essentially spherical
- Clear, free from opacity / inclusions / colour
- Free flowing (may be coated with flow/anti-caking compounds to assist this)
- Refractive Index:
- Standard refractive index at least 1.5
- High Index glass beads e.g. B-HR, C-HR and D-HR, refractive index is of the order of 1.55 or greater (AS 2009 bench test entry level minimum requirement of 600 mcd)

Durability

- Regarded as a “long life” material.

Compatibility

- Various coatings are applied to enhance the bond between bead and the marking material
- Beads applied to particular marking materials e.g. cold-applied plastic, thermoplastic, etc require an appropriate coating. Selection of coating needs to be made in consultation with glass bead manufacturer

Application Parameters

- NZTA P 22 requires machine application, hand spreading is not permitted
- Application equipment needs to be matched to application speed and desired retroreflectivity
- Care must be taken to minimise the effects of wind, airflow past dispenser and road speed
- A rate of 270 to 300 gm/m² is considered appropriate by AS/NZS 2009 for a smooth substrate. Greater application rates are generally required on coarse surface substrates. NZTA P 22 specifies an application rate of 275gm/m²
- Beads need to be applied directly following the application of material to ensure effective embedment without being coated in material. The use of dual gun arrangement is recommended for application of paint using high-pressure airless systems
- Optimum embedment is 60percent of the bead depth
- If angular material is required to be applied in conjunction with the beads, it is recommended that this is applied separately, immediately before the application of the glass. Mixing prior to application is not recommended
- Trafficking of the markings must not occur until material is sufficiently dry to retain beads. Dry through times will vary significantly with materials and film builds

NZRF Roadmarking Materials Guide - Glass Beads

- Over application may reduce effectiveness of marking through dirt entrapment and shadowing of surrounding beads.

Testing of Physical Properties

- Beads may be tested in accordance with AS/NZS 2009.

Handling, storage and packaging

- Supplied in bags in a range of sizes
- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases.
- Clean up spills immediately, particularly on smooth hard surfaces such as concrete
- Classified as Non Hazardous.

Environmental Impacts

- NZTA T 17 sets out heavy metal limitations
- APAS has specified in APAS AP-0042 levels of: Arsenic, (As)Antimony (Sb), Lead (Pb) : Mercury (Hg), Cadmium (as the oxide) (CdO), Chromium (hexa-valent) (Cr6+)

Occupational Health and Safety Hazards

- Slipping on smooth surfaces
- Dusts (Should contain no free silica nor high levels of respirable dust containing heavy metals).

Application Process – Surface Applied

- Material must be kept clean and dry to ensure smooth and constant flow
- Beads are normally surface applied gravity fed or under low pressure i.e. approximately 10psi (provided by compressed air) through an appropriated designed applicator, which applies them uniformly across the width of markings with minimal wastage. Bead tank air pressures are the control
- Equipment specifically designed for application at speed (e.g. Potters Speedbeader) may be required for higher application rates and higher marking speeds.

Application Process – Internally Mixed

- Class C AS/NZS 2009 which have a relatively wide diameter distribution are traditionally used as a constituent part to products such as thermoplastic

NZRF Roadmarking Materials Guide - Glass Beads

- Material must be kept clean and dry to ensure smooth and constant flow
- Glass beads are stirred through product using a ribbon blender or similar device
- Roadmarking material containing glass beads must be handled appropriately during processing, e.g. molten thermoplastic must be stirred continuously to ensure that the beads do not settle out.

Process Monitoring Equipment

- Bead tank air pressure gauge and regulator
- Volume / mass determination devices (dispenser calibration)
- Visual comparison panels.

Post-Application Measuring Equipment

- Retroreflectometer.

Test Methods

- SADOT MAT TP901 – South Australia Department of Australia Determination of Wet Film Thickness of Road Marking Paint / Glass Bead Application Rate, Plastic Bag Method.

Quick Reference Safety Guide

- Irritation of eyes and respiratory tract may result from high dust exposures. Handle in well-ventilated areas and limit exposure to dusts
- Glass beads are extremely slippery, flow freely and are hard to see on smooth surfaces – use carpet / mats to trap spilt beads and clean up spills immediately.
- Eye Protection: Use goggles where there is a risk of spill of material and / or dusts.
- Inhalation: Should be handled and used in well-ventilated areas.
- If eye contact flush with water until clear. Seek medical help if irritation continues.
- If dust inhaled remove to fresh air. If discomfort continues seek medical help.

Related National / International Standard Specifications

- AS/NZS 2009 – Glass beads for pavement-marking materials
- AS/NZS 3661 – Slip resistance of pedestrian surfaces
- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- EN 1423 Roadmarking Materials – Drop on materials – Glass beads, antiskid aggregates and mixtures of the two
- NZTA P 22 – Specification for Reflectorised Pavement Marking

NZRF Roadmarking Materials Guide - Glass Beads

Useful References

- Basic Principles – Retroreflection RI (night visibility) of roadmarkings caused by Glass Beads – Zehntner Testing Instruments – www.zehntner.com
- Potters Europe Datasheet: Glass Bead Coatings
- SADOT MAT TP901 – South Australia Department of Australia
Determination of Wet Film Thickness of Road Marking Paint / Glass Bead Application Rate, Plastic Bag Method
- Manufacturers Safety Data Sheets and Technical Data Sheets



25 High Index Beads

General Description

- Glass beads having a high index of refraction which are intended for both surface application and the incorporation into materials used for applications that require high viewing angles and high retroreflectivity.

Composition

- Clear and colourless high-density barium titanate glass.

Physical Properties

- Diameters in the range of 300 to 1000 μm (0.3 to 1mm)
- Negligible solubility in water.

Performance Properties

- Refractive index of approximately 1.9 to 1.92.

Durability

- Regarded as a “long life” material.

Compatibility

- Various coatings are applied to enhance the bond between bead and the marking material.
- Beads applied to particular marking materials e.g. cold-applied plastic, thermoplastic, etc require an appropriate coating. Selection of coating needs to be made in consultation with glass bead manufacturer.

Application Parameters

- As intermix – High index beads may be mixed into material by the manufacturer prior to application. These beads should be intermixed at a rate of not less than 20percent by mass
- These beads may also be applied as for Drop on – Type B beads, however higher application rates are recommended in the order of 500 gm/m² on smooth surfaces. Greater application rates are generally required on coarse surface substrates
- Where High Index Beads are applied as a Drop on;
 - Application equipment needs to be matched to application speed and desired retroreflectivity. Beads need to be applied directly following the application of material to ensure effective embedment without being coated in material. The use of dual gun arrangement is recommended for application of paint using high-pressure airless systems

NZRF Roadmarking Materials Guide - High Index Beads

- Application equipment needs to be matched to application speed and desired retroreflectivity
- Care must be taken to minimise the effects of wind, airflow past dispenser and road speed
- Optimum embedment is 60percent of the bead depth
- Trafficking of the markings must not occur until material is sufficiently dry enough to retain beads. Dry through times will vary significantly with materials and film builds
- Over application may reduce effectiveness of marking through dirt entrapment and shadowing of surrounding beads.

Handling, storage and packaging

- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Clean up spills immediately, particularly on smooth hard surfaces such as concrete
- Classified as Non Hazardous.

Environmental Impacts

- NZTA T 17 sets out heavy metal limitations
- APAS has specified in APAS 0042 not greater than 50ppm: Arsenic, (As)Antimony (Sb), Lead (Pb) and not greater than 10ppm: Mercury (Hg), Cadmium (as the oxide) (CdO), Chromium (hexa-valent) (Cr6+)

Occupational Health and Safety Hazards

- Slipping on smooth surfaces
- Dusts (Should contain no free silica nor high levels of respirable dust containing heavy metals).

Application Process

- Where high index beads are applied as a Drop on;
 - Material must be kept clean and dry to ensure smooth and constant flow
 - Beads are normally applied under low pressure i.e. approximately 10psi (provided by compressed air) through an appropriated designed applicator, which applies them uniformly across the width of markings with minimal wastage. Bead tank air pressures are the control
 - Equipment specifically designed for application at speed (e.g. Potters Speedbader) may be required for higher application rates and higher marking speeds.

NZRF Roadmarking Materials Guide - High Index Beads

Process Monitoring Equipment

- Where high index beads are applied as a Drop on;
 - Bead tank air pressure gauge and regulator
 - Volume / mass determination devices (dispenser calibration)
 - Visual comparison panels.

Post-Application Measuring Equipment

- Where high index beads are applied as a Drop on
 - Retroreflectometer.

Quick Reference Safety Guide

- Irritation of eyes and respiratory tract may result from high dust exposures. Handle in well-ventilated areas and limit exposure to dusts
- Glass beads are extremely slippery, flow freely and are hard to see on smooth surfaces – use carpet / mats to trap spilt beads and clean up spills immediately.
- Eye Protection: Use goggles where there is a risk of spill of material and / or dusts.
- Inhalation: Should be handled and used in well-ventilated areas.
- If eye contact flush with water until clear. Seek medical help if irritation continues.
- If dust inhaled remove to fresh air. If discomfort continues seek medical help.

Related National / International Standard Specifications

- AS/NZS 2009 – Glass beads for pavement-marking materials
- EN 1423 Roadmarking Materials – Drop on materials – Glass beads, antiskid aggregates and mixtures of the two

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

26 Quartz Angular Material

General Description

- Quartz angular material which is intended for the surface application to a wet / unset film of pavement marking material to provide or enhance the skid resistance properties of that marking
- This material may be applied in conjunction with glass beads.

Composition

- Crushed high purity quartz.

Physical Properties

- Cubic shapes
- White
- Bulk density in the range of 2.5 to 3
- Negligible solubility in water
- May be covered by licencing arrangements.

Performance Properties

- Hardness approximately Mohs 7

Durability

- Regarded as a “long life” material.

Compatibility

- Can be used with all types of roadmarking materials.

Adhesion

- Can be used with all types of roadmarking materials.

Application Parameters

- Machine application recommended
- Application equipment needs to be matched to application speed and desired skid resistance
- Rates of 200 to 275 gm/m² are considered appropriate for many materials / substrates to achieve skid resistance values similar to common road surfaces
- If angular material is required to be applied in conjunction with the beads, it is recommended that this is applied separately, immediately before the application of the glass. Mixing prior to application is not

NZRF Roadmarking Materials Guide - Quartz Angular Material

recommended. Material needs to be matched to bead size. An application rate of 1 part angular material to 2 parts beads may be found to be sufficient

- Trafficking of the markings must not occur until material is sufficiently dry to retain beads. Dry through times will vary significantly with materials and film builds
- Over application may reduce effectiveness of marking through dirt entrapment and shadowing of surrounding beads.

Handling, storage and packaging

- Commonly supplied in 25 kg bags
- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Clean up spills immediately, as it is highly abrasive
- Classified as Non Hazardous.

Occupational Health and Safety Hazards

- Dusts (Should contain no free silica nor high levels of respirable dust containing heavy metals).

Application Process

- Material must be kept clean and dry to ensure smooth and constant flow
- Angular material can be applied under pressure (provided by compressed air) through an appropriated designed applicator, which applies it uniformly across the width of markings with minimal wastage. Supply tank air pressures are the control
- Angular material may be pre-mixed with glass beads, although this method may suffer from separation of materials during transportation.

Process Monitoring Equipment

- Supply tank air pressure gauge and regulator (if pressure delivery)
- Volume / mass determination devices (dispenser calibration)
- Visual comparison panels.

Post-Application Measuring Equipment

- Skid Resistance Testers.

Test Methods

- NZTA P 22 – Specification for Reflectorised Pavement Marking
- NZTA P 30 – Specification for High Performance Marking
- TRL Overseas Road Note 3 – A guide to surface dressing in Tropical and Subtropical Countries

NZRF Roadmarking Materials Guide - Quartz Angular Material

- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- TRL Road Note 39: Design Guide for Road Surface Dressing

Quick Reference Safety Guide

- Irritation of eyes and respiratory tract may result from high dust exposures. Handle in well-ventilated areas and limit exposure to dusts
- Quartz angular material is extremely abrasive – clean up spills immediately.
- Eye Protection: Use goggles where there is a risk of spill of material and / or dusts.
- Inhalation: Should be handled and used in well-ventilated areas.
- If eye contact flush with water until clear. Seek medical help if irritation continues.
- If dust inhaled remove to fresh air. If discomfort continues seek medical help.

Related National / International Standard Specifications

- AS/NZS 3661 – Slip resistance of pedestrian surfaces
- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- EN 1423 Roadmarking Materials – Drop on materials – Glass beads, antiskid aggregates and mixtures of the two
- NZTA P 30 – Specification for High Performance Marking
- NZTA P 22 – Specification for Reflectorised Pavement Marking
- TRL Road Note 39: Design Guide for Road Surface Dressing
- TRL Overseas Road Note 3 – A guide to surface dressing in Tropical and Subtropical Countries

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

27 Silica Friction Material

General Description

- Silica friction material which is intended for the surface application to a wet / unset film of pavement marking material to provide or enhance the skid resistance properties of that marking
- This material may be applied in conjunction with glass beads.

Composition

- Silica sand.

Physical Properties

- Bulk density of in the range of 2.5 to 3
- Negligible solubility in water
- Varying shades of white
- Irregular shapes, shape varies significantly between individual particles
- Note: difficulty with sand is that it may be formed by a variety of materials and its characteristics may vary dramatically.

Performance Properties

- Hardness approximately Mohs 6 to 7
- Note: difficulty with sand is that it may be formed by a variety of materials and its characteristics may vary dramatically.

Durability

- Regarded as a “long life” material, however see note above.

Compatibility

- Can be used with all types of roadmarking materials.

Adhesion

- Can be used with all types of roadmarking materials.

Application Parameters

- Machine application recommended
- Application equipment needs to be matched to application speed and desired skid resistance
- Rates of 200 to 25 gm/m² are considered appropriate for many materials / substrates to achieve skid resistance values similar to common road surfaces

NZRF Roadmarking Materials Guide - Silica Friction Material

- If silica friction material is required to be applied in conjunction with the beads, it is recommended that this is applied separately, immediately before the application of the glass. Mixing prior to application is not recommended. Material needs to be matched to bead size. An application rate of 1 part silica sand to 2 parts beads may be found to be sufficient
- Trafficking of the markings must not occur until material is sufficiently dry to retain material. Dry through times will vary significantly with materials and film builds
- Over application may reduce effectiveness of marking through dirt entrapment and shadowing of surrounding beads.

Manufacturing Process

- Quarried from either natural rock or sourced from rivers.

Handling, storage and packaging

- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Clean up spills immediately, as is highly abrasive
- Classified as Non Hazardous.

Occupational Health and Safety Hazards

- Dusts (Should contain no free silica nor high levels of respirable dust containing heavy metals).

Application Process

- Material must be kept clean and dry to ensure smooth and constant flow
- Angular material can be applied under pressure (provided by compressed air) through an appropriated designed applicator, which applies them uniformly across the width of markings with minimal wastage. Supply tank air pressures are the control
- Silica friction material may be pre-mixed with glass beads, although this method may suffer from separation of materials during transportation.

Process Monitoring Equipment

- Supply tank air pressure gauge and regulator (if pressure delivery)
- Volume / mass determination devices (dispenser calibration)
- Visual comparison panels.

Post-Application Measuring Equipment

- Skid Resistance Testers.

NZRF Roadmarking Materials Guide - Silica Friction Material

Test Methods

- NZTA P 22 – Specification for Reflectorised Pavement Marking
- NZTA P 30 – Specification for High Performance Marking
- TRL Overseas Road Note 3 – A guide to surface dressing in Tropical and Subtropical Countries
- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- TRL Road Note 39: Design Guide for Road Surface Dressing

Quick Reference Safety Guide

- Irritation of eyes and respiratory tract may result from high dust exposures. Handle in well-ventilated areas and limit exposure to dusts
- Quartz angular material is extremely abrasive – clean up spills immediately.
- Eye Protection: Use goggles where there is a risk of spill of material and / or dusts.
- Inhalation: Should be handled and used in well-ventilated areas.
- If eye contact flush with water until clear. Seek medical help if irritation continues.
- If dust inhaled remove to fresh air. If discomfort continues seek medical help.

Related National / International Standard Specifications

- AS/NZS 3661 – Slip resistance of pedestrian surfaces
- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- EN 1423 Roadmarking Materials – Drop on materials – Glass beads, antiskid aggregates and mixtures of the two
- NZTA P 30 – Specification for High Performance Marking
- NZTA P 22 – Specification for Reflectorised Pavement Marking
- NZTA T 10 Skid Resistance Deficiency Investigation and Treatment Selection
- TRL Road Note 39: Design Guide for Road Surface Dressing
- TRL Overseas Road Note 3 – A guide to surface dressing in Tropical and Subtropical Countries

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

28 Corundum Angular Material

General Description

- Corundum angular material which is intended for the surface application to a wet / unset film of pavement marking material to provide or enhance the skid resistance properties of that marking
- This material may be applied in conjunction with glass beads.

Physical Properties

- Bulk density of in the range of 2.5 to 3
- Negligible solubility in water.

Performance Properties

- Hardness approximately Mohs 9.

Durability

- Regarded as a “long life” material, however see note below.

Compatibility

- Can be used with all types of roadmarking materials.

Adhesion

- Can be used with all types of roadmarking materials.

Application Parameters

- Machine application recommended
- Application equipment needs to be matched to application speed and desired skid resistance
- Rates of 200 to 275 gm/m² are considered appropriate for many materials / substrates to achieve skid resistance values similar to common road surfaces
- If angular material is required to be applied in conjunction with the beads, it is recommended that this is applied separately immediately before the application of the glass. Mixing prior to application is not recommended. Material needs to be matched to bead size. An application rate of 1 part angular material to 2 parts beads may be found to be sufficient
- Trafficking of the markings must not occur until material is sufficiently dry enough to retain material. Dry through times will vary significantly with materials and film builds
- Over application may reduce effectiveness of marking through dirt entrapment and shadowing of surrounding beads.

NZRF Roadmarking Materials Guide - Corundum Angular Material

Handling, storage and packaging

- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Clean up spills immediately, as is highly abrasive
- Classified as Non Hazardous

Occupational Health and Safety Hazards

- Dusts (Should contain no free silica nor high levels of respirable dust containing heavy metals).

Application Process

- Material must be kept clean and dry to ensure smooth and constant flow
- Angular material can be applied under pressure (provided by compressed air) through an appropriated designed applicator, which applies it uniformly across the width of markings with minimal wastage. Supply tank air pressures are the control
- Angular material may be pre-mixed with glass beads, although this method may suffer from separation of materials during transportation.

Process Monitoring Equipment

- Supply tank air pressure gauge and regulator (if pressure delivery)
- Volume / mass determination devices (dispenser calibration)
- Visual comparison panels.

Post-Application Measuring Equipment

- Skid Resistance Testers.

Test Methods

- NZTA P 22 – Specification for Reflectorised Pavement Marking
- NZTA P 30 – Specification for High Performance Marking
- TRL Overseas Road Note 3 – A guide to surface dressing in Tropical and Subtropical Countries
- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- TRL Road Note 39: Design Guide for Road Surface Dressing

NZRF Roadmarking Materials Guide - Corundum Angular Material

Quick Reference Safety Guide

- Irritation of eyes and respiratory tract may result from high dust exposures. Handle in well-ventilated areas - –limit exposure to dusts
- Corundum angular material is extremely abrasive – clean up spills immediately.
- Eye Protection: Use goggles where there is a risk of spill of material and / or dusts.
- Inhalation: Should be handled and used in well-ventilated areas.
- If eye contact flush with water until clear. Seek medical help if irritation continues.
- If dust inhaled remove to fresh air. If discomfort continues seek medical help.

Related National / International Standard Specifications

- AS/NZS 3661 – Slip resistance of pedestrian surfaces
- EN 13036-4 : 2003 : Road and airfield surface characteristics - Test methods - Part 4 : Method for measurement of slip/skid resistance of a surface - The pendulum test
- EN 1423 Roadmarking Materials – Drop on materials – Glass beads, antiskid aggregates and mixtures of the two
- NZTA P 30 – Specification for High Performance Marking
- NZTA P 22 – Specification for Reflectorised Pavement Marking
- TRL Road Note 39: Design Guide for Road Surface Dressing
- TRL Overseas Road Note 3 – A guide to surface dressing in Tropical and Subtropical Countries

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

29 Alkyd Paint Thinners

General Description

- A colourless aromatic liquid (petrochemical) used as a diluent and cleaner for alkyd pavement marking paint.

Composition

- Petroleum based solvent
- Products may include but are not limited to:
- Methyl benzene
- Toluol
- Phenyl methane
- Methyl benzol

Physical Properties

- Colourless aromatic liquid
- Flash Point <12°C
- Density 0.7 to 0.8 kg/l
- Highly flammable
- Solubility in water approximately 0.5 kg/m³.

Application Parameters

- Refer to paint manufacturer's recommendations
- Addition to paint in excess of that specified by paint manufacturers will significantly degrade the performance of the applied coatings
- Use of thinners other than that specified by the paint manufacturers will significantly degrade the performance of the applied coatings.

Application Process

- Use of thinners not commonly used or desirable in application of paint by high pressure airless paint systems
- Thinners are required for application of alkyd paints by conventional air spray equipment
- Equipment cleaned / flushed with thinners

Durability

- Addition of thinners may have a significant impact on the durability of coatings.

Environmental Impacts

- Increases VOC's of painted product directly in ratio of addition rate

NZRF Roadmarking Materials Guide - Alkyd Paint Thinners

- Softens, dissolves bitumen pavement surfaces
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Handling, storage and packaging

- Approved 20L and 200L containers
- High flammability. Dangerous goods stores generally needed
- Haz Chem Code 3[Y]E
- UN Number 1294
- Packaging Group II
- Flash Point Less than 4°C.

Measuring Equipment

- Volume measuring containers and dipsticks.

Measurement Standards

- Not applicable.

Occupational Health and Safety Hazards

- Fire and explosion
- Fumes, gases, vapours
- Potential to poison
- Potential to lead to infection
- Lack of oxygen (also fumes vapours and gases). Confined spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Fluid injection
- Hazardous decomposition products on burning.

Process Monitoring Equipment

- Not applicable.

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist
- Inhalation: Half mask organic vapour respirator conforming to AS 1716
- Eye Protection: Chemical mono-goggles
- Skin Protection: Wear silver shield or nitrile rubber gloves, overalls and chemical resistant shoes or boots. Where splashing may occur, wear PVC apron. Use of silicone free barrier cream

NZRF Roadmarking Materials Guide - Alkyd Paint Thinners

- If inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If swallowed, DO NOT induce vomiting, give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.
- If skin contact, remove contaminated clothing. Wash skin with water using soap if available. If persistent irritation occurs, obtain medical attention.
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible. All paint crew members should carry the NZRF paint injection safety card.

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Worksafe "Reducing harm when working with organic solvents"



30 Chlorinated Rubber Modified Alkyd Paint Thinners

General Description

- A colourless aromatic liquid (petrochemical) used as a diluent and cleaner for chlorinated rubber modified alkyd pavement marking paint.

Composition

- Petroleum based solvent
- Products may include but are not limited to:
- Methyl benzene
- Toluol
- Phenyl methane
- Methyl benzoyl.

Physical Properties

- Colourless aromatic liquid
- Flash Point <12°C
- Density 0.7 to 0.8 kg/l
- Highly flammable
- Solubility in water approximately 0.5 kg/m³

Application Parameters

- Refer to paint manufacturer's recommendations
- Addition to paint in excess of that specified by paint manufacturers will significantly degrade the performance of the applied coatings
- Use of thinners other than that specified by the paint manufacturers will significantly degrade the performance of the applied coatings.

Application Process

- Use of thinners not commonly used or desirable in application of paint by high pressure airless paint systems
- Thinners are required for application of alkyd paints by conventional air spray equipment
- Equipment cleaned / flushed with thinners.

Durability

- Addition of thinners may have a significant impact on the durability of coatings.

NZRF Roadmarking Materials Guide - Chlorinated Rubber Modified Alkyd Paint Thinners

Environmental Impacts

- Increases VOC's of painted product directly in ratio of addition rate
- Softens, dissolves bitumen pavement surfaces
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Handling, storage and packaging

- Approved 20L and 200L containers
- High flammability. Dangerous goods stores generally needed
- Haz Chem Code 3[Y]E
- UN Number 1294
- Packaging Group II
- Flash Point Less than 4°C.

Measuring Equipment

- Volume measuring containers and dipsticks.

Measurement Standards

- Not applicable.

Occupational Health and Safety Hazards

- Fire and explosion
- Fumes, Gases, Vapours
- Potential to Poison
- Potential to Infection
- Lack of Oxygen (also Fumes vapours and Gases). Confined Spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Fluid Injection
- Hazardous decomposition products on burning.

Process Monitoring Equipment

- Not applicable

Quick Reference Safety Guide

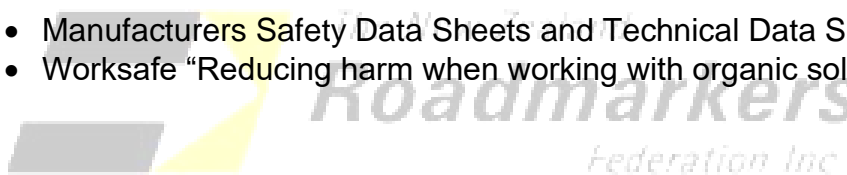
- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist.
- Inhalation: Half mask organic vapour respirator conforming to AS 1716

NZRF Roadmarking Materials Guide - Chlorinated Rubber Modified Alkyd Paint Thinners

- Eye Protection: Chemical mono-goggles
- Skin Protection: Wear silver shield or nitrile rubber gloves, overalls and chemical resistant shoes or boots. Where splashing may occur, wear PVC apron. Use of silicone free barrier cream.
- If inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If swallowed, DO NOT induce vomiting, give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.
- If skin contact, remove contaminated clothing. Wash skin with water using soap if available. If persistent irritation occurs, obtain medical attention.
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible. All paint crew members should carry the NZRF paint injection safety card.

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets
- Worksafe "Reducing harm when working with organic solvents"



31 Waterborne Paint Thinners

Important Note:

- Waterborne paints are not normally designed to be thinned in any way. The paint as supplied is specified by paint companies to deliver a balance of viscosity for handling with sufficient flow to allow film builds to be achieved without excessive drain on equipment. Any thinning must be carried out with care using materials recommended by the supplier to ensure that chemical composition of paint remains within specified limits for pH etc.

General Description

- A colourless liquid (containing various alcohols and glycols) used as a diluent and cleaner for waterborne pavement marking paint.

Composition

- Products may include but are not limited to:
- Ethyl alcohol
- Hydroxy –4 Methyl 2 pentanone
- Diacetone alcohol.

Physical Properties

- Clear low viscosity liquid with hydrocarbon odour
- Flash Point can be less than 15°C
- Density 0.8 to 1 kg/l
- Highly flammable
- Miscible in water.

Application Parameters

- Refer to paint manufacturer's recommendations
- Addition to paint in excess of that specified by paint manufacturers will significantly degrade the performance of the applied coatings
- Use of thinners other than that specified by the paint manufacturers will significantly degrade the performance of the applied coatings.

Application Process

- Use of thinners not commonly used or desirable in application of paint by high pressure airless paint systems
- Thinners are required for application of waterborne paints by conventional air spray equipment
- Equipment cleaned / flushed with thinners.

NZRF Roadmarking Materials Guide - Waterborne Paint Thinners

Durability

- Addition of thinners may have a significant impact on the durability of coatings.

Environmental Impacts

- Highly miscible with water
- Poisonous, oxidising agent, harmful to organisms
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Handling, storage and packaging

- Approved 20L and 200L containers
- High flammability. Dangerous goods stores generally needed
- Haz Chem Code 3[Y]E
- UN Number 1263
- Packaging Group II
- Flash Point can be less than 15°C

Measuring Equipment

- Volume measuring containers and dipsticks.

Measurement Standards

- Not applicable.

Occupational Health and Safety Hazards

- Fire and explosion
- Fumes, Gases, Vapours
- Potential to Poison
- Potential to Infection
- Lack of Oxygen (also Fumes vapours and Gases). Confined Spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Fluid Injection
- Hazardous decomposition products on burning.

Process Monitoring Equipment

- Not applicable.

NZRF Roadmarking Materials Guide - Waterborne Paint Thinners

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist.
- Inhalation: Half mask organic vapour respirator conforming to AS 1716
- Eye Protection: Chemical mono-goggles
- Skin Protection: Wear neoprene or nitrile rubber gloves, overalls and chemical resistant shoes or boots. Where splashing may occur, wear PVC apron. Use of silicone free barrier cream.
- If inhaled, Provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If swallowed, DO NOT induce vomiting, give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.
- If skin contact, remove contaminated clothing. Wash skin with water using soap if available. If persistent irritation occurs, obtain medical attention.
- If fluid injection occurs, contact a Doctor immediately. Injection of paint or solvents into the skin may cause serious injury both from traumatic compression of structures and inflammation and damage from the solvents or paint itself. It is important to treat the injury surgically as soon as possible. All paint crew members should carry the NZRF paint injection safety card.

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

32 Cold Applied Plastic Thinners

General Description

- A translucent blend of Methyl methacrylate, PMMA resin and wetting agents used as viscosity reducer used for Cold Applied Plastic Long life paints.

Composition

- Products may include but are not limited to:
- Methyl methacrylate
- Poly methyl methacrylate.

Physical Properties

- Colourless liquid with a sweet sharp fruity odour
- Flash Point <10.0°C
- Density 0.97 kg/l
- Highly flammable
- Boiling Point 101°C.

Application Parameters

- Refer to CAP manufacturer's recommendations
- Addition to CAP in excess of that specified by CAP manufacturers will significantly degrade the performance of the applied coatings
- Use of thinners other than that specified by the CAP manufacturers will significantly degrade the performance of the applied coatings.

Application Process

- Use of thinners not commonly used or desirable in application of CAP.

Durability

- Addition of thinners may have a significant impact on the durability of coatings.

Handling, storage and packaging

- Approved 20L and 200L containers
- High flammability. Dangerous goods stores generally needed
- Haz Chem Code 3(Y)E
- UN Number 1247
- Packaging Group II
- Flash Point <10.0°C.

NZRF Roadmarking Materials Guide - Cold Applied Plastic Thinners

Measuring Equipment

- Volume measuring containers and dipsticks.

Measurement Standards

- Not applicable.

Occupational Health and Safety Hazards

- Fire and explosion
- Fumes, Gases, Vapours
- Potential to Poison
- Potential to Infection
- Lack of Oxygen (also Fumes vapours and Gases). Confined Spaces. Vapours are heavier than air and may pool in depressions resulting in oxygen deficiencies
- Fluid Injection
- Hazardous decomposition products on burning
- It may polymerise in the presence of catalyst or elevated temperature.

Process Monitoring Equipment

- Not applicable

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat and naked flame
- Avoid contact with skin and eyes
- Avoid breathing the vapour and spray mist
- Inhalation: Type A Filter of sufficient capacity
- Eye Protection: Chemical mono goggles
- Skin Protection: Wear nitrile rubber gloves, overalls and chemical resistant shoes or boots. Where splashing may occur, wear PVC apron. Use of silicone free barrier cream.
- If inhaled, provide fresh air, rest and keep warm. If breathing shallow, give oxygen. Contact a Doctor or Poisons Information Centre.
- If swallowed, DO NOT induce vomiting, give several glasses of water. Contact a Doctor or Poisons Information Centre.
- If eye contact, wash with running water for at least 15 minutes. Seek medical attention.
- If skin contact, remove contaminated clothing. Wash skin with water using soap if available. If persistent irritation occurs, obtain medical attention.
- Remove contaminated clothing and shoes immediately. Wash clothes before reuse, discard contaminated footwear.

NZRF Roadmarking Materials Guide - Cold Applied Plastic Thinners

Recorded Environmental Hazards

- This material and its container must be disposed of as hazardous waste

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets



33 Waterborne Paint Catalysts

General Description

- A material used as a drying accelerant (catalyst) for waterborne pavement marking paint.

Composition

- Products are covered by patents and licencing agreements.

Physical Properties

- May be a clear low viscosity liquid with strong organic odour
- Water absorbing, acidified spherical beads, known as a drying adjuvants or dry speed boosters, which rapidly drop the pH and absorb water which is released slowly after the paint has dried.

Application Parameters

- Refer to paint manufacturer's recommendations
- The use of a drying adjuvant can be recommended when drying conditions are less than optimal. This can be characterised by high humidity, low temperature and low air flow. However, as has been demonstrated, there is a reasonable case to be made for use when there is a chance of rain impacting the work within 2 hours, protection of the work is limited due to local regulations or road geometry, or the specifications calling for a greater thickness of paint than might reasonably dry in the time provided
- Addition to paint in excess of the rates specified by paint manufacturers will significantly degrade the performance of the applied coatings.

Application Process

- Covered by Licence agreements
- Catalyst matched to base material
- Commonly applied during the pavement marking application.

Durability

- Use of catalysts / drying agents other than that specified by the paint manufacturer will significantly degrade the performance of the applied coatings.

NZRF Roadmarking Materials Guide - Waterborne Catalysts

Handling, storage and packaging

- Supplied in a range of container sizes
- Store in cool dry place protected from rain and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Clean up spills immediately, particularly on smooth hard surfaces such as concrete

Measuring Equipment

- Volume measuring containers and dipsticks.

Measurement Standards

- Not applicable.

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets



34 Benzoyl Peroxide

General Description

- A material used as the catalyst for poly methyl methacrylate (PPMA) / cold applied plastic (CAP)

Composition

- Benzoyl peroxide, (C₁₄ H₁₀ O₄), combined with other materials to facilitate mixing
- May be either of liquid or powder form (with or without beads)

Physical Properties

- Powder
- Appearance - White, granular, crystalline solid.
- Slightly soluble in water
- Melting Point - 103-105 °C
- Specific Gravity - 1.3340 @ 25 °C
- Flash Point – 40 °C (CC)
- Auto-ignition Temperature – 80 °C
- Decomposes explosively above 105 °C
- Liquid
- Appearance – White paste with slight ester odour
- Negligible solubility in water
- Boiling point – Decomposes
- Specific Gravity – 1.2 @ 25 °C
- Flash Point – Not Applicable

Application Parameters

- Refer to CAP manufacturer's recommendations
- Addition to CAP in excess of the rates specified by manufacturers will significantly degrade the performance of the applied coatings.

Application Process

- Covered by Licence agreements
- Catalyst matched to base material

Durability

- Use of catalysts other than that specified by the CAP manufacturer will significantly degrade the performance of the applied coatings.

Environmental Impacts

- Keep combustibles (wood, paper, clothing, oil etc.) away from spilled material.
- Prevent entry into waterways, drains, confined areas. Use water spray to knock down or divert vapour clouds. Use clean, non-sparking tool to collect material and place it into loosely-covered plastic containers for later disposal. Absorb with earth, sand or other non-combustible material and transfer to container.

Handling, storage and packaging

- Powder
 - Store in cool place and out of direct sunlight
 - Store in well ventilated area
 - Keep containers securely sealed and protected against physical damage
 - Dangerous goods of Class 5.2 (Organic Peroxide) are incompatible in a placard load with any of the following: Class 1, Class 2, Class 3, Class 4, Class 5.1, Class 7, Class 8, Fire risk substances and Combustible liquids
 - Store in original containers - Do not return product which has been taken out of original container
 - Protect from shock, friction, fire and other sources of ignition
 - Proper Shipping Name - Organic Peroxide Type C, Solid
- Liquid
 - Keep containers tightly closed when not in use. Rotate stock using the oldest material first
 - Do not use near food or drink
 - Avoid skin and eye contact - Wear personal protection equipment
 - Reseal containers immediately after use to prevent contamination and drying
 - Keep material in its original container away from any incompatible materials, direct sunlight or other sources of heat
 - Do not store with food or drink.
 - Store in an isolated, cool and well-ventilated area and remove only as needed
 - Keep material sealed to prevent contamination and drying.
 - Other precautions - Avoid any conditions that may cause contamination and drying. Do not leave material uncovered. Containers of this material may be hazardous when empty since they retain product residues, observe all warnings and precautions listed. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities.

Measuring Equipment

- Volume measuring containers and dipsticks.

Measurement Standards

- Not applicable.

Occupational Health and Safety Hazards

- Powder
 - Acute - Swallowed May cause abdominal pain, nausea and vomiting
 - Acute (Eye) - irritating to eyes, may cause redness and pain
 - Acute (Skin) - May cause sensitisation by skin contact, may cause redness and pain, stinging or burning sensation may occur for a brief time after application to skin
 - Acute (Inhaled) -Dust may cause irritation to mucous membranes with coughing and sore throat
 - Chronic - Repeated or prolonged skin contact may cause chronic dermatitis, may cause asthmatic effects in some individuals.
- Liquid
 - Skin Absorption - May cause irritation and redness of the skin
 - Eye Contact - Eye contact may cause inflammation
 - Ingestion - Poison by ingestion, may cause human systemic eye effects by ingestion: hallucinations distorted perceptions, nausea or vomiting and kidney, urethra or bladder changes
 - Inhalation - Not expected to be an inhalation hazard.

Process Monitoring Equipment

- Dosing rate monitors

Quick Reference Safety Guide

- Provide adequate ventilation during use
- Keep away from heat, naked flame, or impact
- Avoid contact with skin and eyes
- Powder
 - Swallowed - Rinse mouth thoroughly with water immediately. Give plenty of water to drink and induce vomiting. Use fingers in the throat, Ipecac Syrup (APF) or similar emetic. Seek immediate medical assistance.
 - Eye- Immediately irrigate with copious quantity of water for at least 15 minutes. Eyelids to be held open. Seek immediate medical assistance.

NZRF Roadmarking Materials Guide - Benzyl Peroxide Catalyst for PMMA

- Skin- Wash affected areas with copious quantities of water immediately. Remove contaminated clothing and wash before re-use. Seek medical attention.
- Inhaled - Remove victim to fresh air. Employ artificial respiration if indicated. Seek medical attention.
- Liquid
 - Skin - Immediately remove any contaminated clothing. Wash contaminated area thoroughly with soap and copious amounts of water for at least 15 minutes. If irritation or adverse symptoms develop, seek medical attention.
 - Eyes - Remove any contact lenses at once. Flush eyes with water for at least 15 minutes. Ensure adequate flushing by separating the eyelids with fingers. If irritation or adverse symptoms develop, seek medical attention.
 - Ingestion - Contact a physician, hospital or Poison Control Centre at once. Do not induce vomiting.

Recorded Health and Safety Incidents

- Effects of over-exposure - May cause dermatitis, asthmatic effects, testicular atrophy, and vasodilatation. Mutation data reported.

Useful References

- Manufactures Safety Data Sheet and Technical Data Sheets



35 Modified Epoxy Resin

General Description

- A two-part modified cold-applied thermosetting epoxy resin designed for use with a surface applied aggregate having an appropriate colour and skid resistance. This product can be used either as a binder for a high friction surfacing system or coloured permanent overlay marking system.

Composition

- Epoxy pavement overlay material is tailored for specific conditions and application methods
- Products are covered by patents and licencing agreements
- May contain inorganic and organic colour pigments

Physical Properties

- Appearance – Coloured viscous liquids
- Viscosity Part A 3,000 cps @25 °C
- Viscosity Part B 15,000 cps @25 °C
- Density Part A 1.0 kg/l
- Density Part B 1.1 kg/l
- Odour – Characteristic, Part A – ammonical
- Boiling Points >190 °C
- Flash Points 100 °C
- Insoluble in water

Performance Properties

- Odourless after cure
- Shore Hardness Type D in the range of 65 to 75
- Tensile Strength (ASTM D638) >10 N/mm² after 24 hours, > 13 after 7 days
- Colour: approved colours are set out in NZTA M 29

Durability

- Regarded as “long life” as far as “wear” is concerned
- Resistant to oil, petrol and de-icing salts

Compatibility

- Can be used on many types of surfaces.

NZRF Roadmarking Materials Guide – Modified Epoxy Resin

Adhesion

- Can be applied to most pavement surfaces and textures
- Friable / highly absorbent surfaces such as porous concrete require priming.

Application Parameters

- Both components need to be thoroughly machine stirred. It is recommended that the component containing the hardener is machine stirred
- Part A and Part B must be proportioned to the correct ratio (typically 50:50 \pm 4percent by weight) and mixed
- Road and air temperatures should be in the range of 5 and rising up to a maximum of 40°C
- Recommended application rates of 1 to 2.5 kg/m². Increased rates required for surfaces having greater texture depths
- Use of specially built applicators which require accurate measuring devices and / or calibrated containers
- Hand applied binder requires serrated edged squeegee to control applied thickness
- Aggregate application by hand requires skill and experience
- Aggregate application rates need to be in excess of 6 kg/m² to ensure sufficient coverage / embedment – no compaction is required.

Testing of Physical Properties

- NZTA M 29, and AS 4049.4

Handling, storage and packaging

- Available in a variety of containers
- from 25 to 1500 kg
- Keep away from food and drink
- Store in cool dry place protected from rain, sun and moisture
- Protect from excessive heat or contamination from fuels, oils or greases
- Typical Classification – refer to product specific data sheets
- Part A
 - Proper Shipping Name: Environmentally Hazardous Substance, Liquid, NOS
 - UN Number: 3082
 - Class: 9
 - HazChem Code: 2X
 - ADR: 11c

NZRF Roadmarking Materials Guide – Modified Epoxy Resin

- Part B
 - Proper Shipping Name: Corrosive Liquid, Toxic, NOS
 - UN Number: 2922
 - HazChem Code: None
 - ADR: 86

Environmental Impacts

- Do not allow to enter drains, rivers and watercourses
- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
- Materials are special waste and need to be disposed of by licenced contractor – Contaminated packaging or clothing should be disposed of identically to the product itself
- Uncontaminated packaging may be treated as household waste
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Occupational Health and Safety Hazards

- Part A
 - Irritating to eyes and skin
 - May cause sensitisation by skin contact
 - Carcinogen, Category 2
 - May cause cancer
- Part B
 - Toxic in contact with skin or if swallowed
 - Causes burns
 - Carcinogen, Category 2
 - May cause cancer

Application Process

- Products and their application are covered by patents and licencing agreements
- The two part epoxy binder material cannot be applied on a wet surface, if the ambient and/or surface temperature is below 5 °C or above 40 °C, or if the anticipated weather conditions would prevent the proper application of the surface treatment as determined by the manufacturer
- Existing surfaces need to be cleaned by use of mechanical sweepers, high pressure air or other methods
- All existing pavement markings and utilities are covered / protected prior to placement.
- All inadequately sealed joints and cracks greater than 5 mm are filled / sealed with the manufacturers approved crack sealant.
- The two part modified epoxy binder components part A / part B are combined (proportioned to the correct ratio of 50:50 ± 4percent by

NZRF Roadmarking Materials Guide – Modified Epoxy Resin

weight and mixed using a low speed high torque drill fitted with a helical stirrer

- The binder material is then spread by serrated edge squeegee such that it is uniformly distributed over the pavement section to be treated and within the temperature range specified
- Operations need to proceed in such a manner that will not allow the epoxy material to chill, set up, dry, or otherwise impair retention of the covered aggregate.
- Immediately after the binder is laid the aggregate is spread onto the binder at a rate in excess of 6 kg/m². The placement of this material does not require any compaction.
- The treatment is allowed to cure in accordance with manufacturer recommendations, approximately 3 hours at an ambient temperature of 4 C and rising
- The excess aggregate is removed by hand or suction sweeping before opening to traffic.

Process Monitoring Equipment

- Weighing devices
- Thermometer
- Viscometer
- Atmospheric condition measuring / monitoring devices

Post-Application Measuring Equipment

- Skid resistance testers

Test Methods

- Skid Resistance, refer also to Glass Beads and Angular Material

Quick Reference Safety Guide

- Part A causes burns
- Part B may cause sensitisation by skin contact
- Skin Protection: Wear overalls, boots and gloves. Use chemical resistant face-shield where splashing may occur. Use barrier creams
- Eye Protection: Use full face-shield / goggles while mixing.
- Inhalation: Use respirator, should be handled and used in well ventilated areas
- General: In all cases of doubt, or where symptoms persist, seek medical attention
- Eye Contact: Rinse immediately with water for at least 15 minutes and get medical attention immediately.
- Skin Contact: Wipe with absorbent paper disposable towels. Wash with plenty of soap and water – do not use organic solvents. In case of dermatitis or if irritation persists, get medical attention.

NZRF Roadmarking Materials Guide – Modified Epoxy Resin

- Inhalation: Move affected person to fresh air. In case of irritation to respiratory system or mucous membranes, or if you feel unwell or in case of prolonged exposure, get medical attention.
- Ingestion: Immediately rinse the mouth with water. If swallowing has occurred drink water in small sips. Do not induce vomiting. Seek medical attention promptly.
- Contaminated clothing and shoes: Remove immediately. Wash clothes before reuse, discard contaminated footwear.

Recorded Health and Safety Incidents

- Reports of dermatitis, and allergic dermatitis (Sensitisation) are common.
- Specialist sector groups interested in the safe use of epoxies established overseas

Related National / International Standard Specifications

- Products and their application are covered by patents and licencing agreements
- NZTA P 33 Specification for coloured pavement surfacings
- AS 4049.4

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets



36 Modified Polyurethane Resin

General Description

- A two-part modified cold-applied thermosetting polyurethane resin designed for use with a surface applied aggregate having an appropriate colour and skid resistance. This product can be used either as a binder for a high friction surfacing system or coloured permanent overlay marking system.

Composition

- Polyurethane pavement overlay material is tailored for specific conditions and application methods
- Products are covered by patents and licencing agreements
- May contain inorganic and organic colour pigments

Physical Properties

- Appearance – Coloured viscous liquids
- Density Part A 0.94 kg/l
- Density Part B 1.21 kg/l
- Odour – Characteristic, Part A – Aromatic, Part B – Musty / mouldy
- Flash Point Part B .190 °C
- Auto-ignition Temperature Part B >260 °C
- Insoluble in water

Performance Properties

- Odourless
- Shore Hardness Type D 50
- Tensile Strength (ASTM D638) >10 N/mm² after 24 hours
- Colour; approved colours are set out in NZTA M 29

Durability

- Regarded as “long life” as far as “wear” is concerned
- Resistant to oil, petrol and de-icing salts

Compatibility

- Can be used on many types of surfaces.

Adhesion

- Can be applied to most pavement surfaces and textures
- Friable / highly absorbent surfaces such as porous concrete require priming.

NZRF Roadmarking Materials Guide – Modified Polyurethane Resin

Application Parameters

- Both components need to be thoroughly machine stirred. It is recommended that the component containing the hardener is machine stirred
- Part A and Part B must be proportioned to the correct ratio (product typically supplied in packs which control ratio) and mixed
- Road and air temperatures should be in the range of 5°C and rising up to a maximum of 40°C
- Recommended application rates of 1.35 to 2.8 kg/m². Increased rates required for surfaces having greater texture depths
- Use of specially built applicators which require accurate measuring devices and / or calibrated containers
- Hand applied binder requires serrated edged squeegee to control applied thickness
- Aggregate application by hand requires skill and experience
- Aggregate application rates need to be in excess of 6 kg/m² to ensure sufficient coverage / embedment – no compaction is required.

Testing of Physical Properties

- AS 4049.4

Handling, storage and packaging

- Available in a variety of containers from 25 to 1500 kg
- Keep away from food and drink
- Store in cool dry place protected from rain, sun and moisture
- Protect from excessive heat or contamination from fuels, oils or greases.

Environmental Impacts

- Not regarded as hazardous to the environment
- Do not allow to enter drains, rivers and watercourses
- Refer to NZRF Roadmarking Note # 11 HSNO Regulations Emergency Management Requirements - Guideline

Occupational Health and Safety Hazards

- Part A
 - Not regarded as a health or environmental hazard under current legislation
- Part B
 - Harmful by inhalation
 - Irritating to eyes, respiratory system and skin
 - May cause sensitisation by inhalation and skin contact

NZRF Roadmarking Materials Guide – Modified Polyurethane Resin

Application Process

- Products and their application are covered by patents and licencing agreements
- The two part epoxy binder material cannot be applied on a wet surface, if the ambient and/or surface temperature is below 5 °C or above 40 °C, or if the anticipated weather conditions would prevent the proper application of the surface treatment as determined by the manufacturer
- Existing surfaces need to be cleaned by use of mechanical sweepers, high pressure air or other methods
- All existing pavement markings and utilities are covered / protected prior to placement.
- All inadequately sealed joints and cracks greater than 5 mm are filled / sealed with the manufacturers approved crack sealant.
- The two part modified epoxy binder components part A / part B are combined proportioned to the correct ratio and mixed using a low speed high torque drill fitted with a helical stirrer
- The binder material is then spread by serrated edge squeegee such that it is uniformly distributed over the pavement section to be treated and within the temperature range specified
- Operations need to proceed in such a manner that will not allow the epoxy material to chill, set up, dry, or otherwise impair retention of the covered aggregate.
- Immediately after the binder is laid the aggregate is spread onto the binder at a rate in excess of 6 kg/m². The placement of this material does not require any compaction.
- The treatment is allowed to cure in accordance with manufacturer recommendations, approximately 3 hours at an ambient temperature of 24 °C and rising
- The excess aggregate is removed by hand or suction sweeping before opening to traffic.

Process Monitoring Equipment

- Weighing devices
- Thermometer
- Viscometer
- Atmospheric condition measuring / monitoring devices

Post-Application Measuring Equipment

- Skid resistance testers

Test Methods

- Skid Resistance, refer also to Glass Beads and Angular Material

NZRF Roadmarking Materials Guide – Modified Polyurethane Resin

Quick Reference Safety Guide

- Part A not regarded as a health hazard
- Part B harmful by inhalation, irritating to eyes, respiratory system and skin, may cause sensitisation by skin contact
- Skin Protection: Wear overalls, boots and gloves. Use chemical resistant face-shield where splashing may occur. Use barrier creams
- Eye Protection: Use full face-shield / goggles while mixing.
- Inhalation: Part B - Use respirator, should be handled and used in well ventilated areas
- General: In all cases of doubt, or where symptoms persist, seek medical attention
- Eye Contact: Make sure to remove contact lenses before rinsing. Rinse immediately with water for at least 15 minutes and get medical attention immediately.
- Skin Contact: Wipe with absorbent paper disposable towels. Wash with plenty of soap and water – do not use organic solvents. In case of dermatitis or if irritation persists, get medical attention.
- Inhalation: Move affected person to fresh air. Provide fresh air, warmth and rest, preferably in a comfortable upright sitting position. Get medical attention.
- Ingestion: Do not induce vomiting. Immediately rinse the mouth with water. If swallowing has occurred drink water in small sips. Seek medical attention promptly.
- Contaminated clothing and shoes: Remove immediately. Wash clothes before reuse, discard contaminated footwear.

Recorded Health and Safety Incidents

- Reports of dermatitis, and allergic dermatitis (Sensitisation) are common.
- Specialist sector groups interested in the safe use of epoxies established overseas

Related National / International Standard Specifications

- Products and their application are covered by patents and licencing agreements
- NZTA P 33 Specification for coloured pavement surfacings
- AS 4049.4

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets

37 Roller Applied Cement Based Coatings

General Description

- A compound consisting of white Portland cement and aggregates which when mixed with water (or an emulsion) cures by hydration. Glass beads are injected prior to setting to provide retroreflectivity.

Composition

- Commonly provided as a two component mix under Licence
- Part A containing a blend of white Portland cement with selected aggregates and additives, including glass beads
- Part B containing a blend of acrylic emulsion, water, titanium dioxide and other additives.

Physical Properties

- Part A – White powder - High miscibility in water
- Part B – Liquid emulsion - Soluble in water
- Bond strength (on concrete) 4.3 Mpa after 45 days.

Performance Properties

- Retroreflectivity: Dependent on bead type and application rate, typically in the range of 280 to 460 mcd
- Skid Resistance: Commonly formulated to have a minimum skid resistance of 45 BPN
- Note: The skid resistance of a marking material is not a fixed property for any given formulation. It may vary considerably according to the temperature at which it is laid and will also vary throughout its life according to conditions such as traffic and weather.

Durability

- Regarded as a “long life” material as far as “wear” is concerned, expectancy greater than 8 years in roading environment.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

NZRF Roadmarking Materials Guide – Roller Applied Cement Based Coatings

Application Parameters

- Material should be well mixed
- Road and air temperatures should be greater than 5°C and rising. Poor bond may develop if road temperature falls below 5°C
- Road surface needs to be clean and free from oils and greases. Primer tests need to be conducted prior to application
- Sandblasting, waterblasting or wire brushing is recommended
- Substrate prepared by air-hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt.

Handling, storage and packaging

- Part A supplied in 25kg bags
- Part B supplied in 10l containers
- Store in cool dry place protected from rain and moisture. Store Part A off the floor.
- Protect from excessive heat or contamination from fuels, oils or greases.
- Classified as Non Hazardous.

Environmental Impacts

- Materials are miscible in water, care must be taken to ensure that any spills or cleaning materials do not enter or contaminate soil or waterways.

Occupational Health and Safety Hazards

- Dust
- Skin irritation.

Application Process

- The two components are combined in a clean container and mixed with a slow speed drill attached to an appropriate epoxy-mixing paddle
- Appropriate filler may be added to produce a mortar for filling or vertical surfaces
- In very hot conditions, the emulsion can be cooled with ice
- Material is rolled to suit the desired finish at a thickness of 2 to 3 mm
- Glass beads are injected using a special bead gun.

Post-Application Measuring Equipment

- Retroreflectometer
- Skid Tester

NZRF Roadmarking Materials Guide – Roller Applied Cement Based Coatings

Quick Reference Safety Guide

- Part A contains cement dust resin that may cause inflammation of the lining tissue of the interior of the nose, and inflammation of the cornea. Prevent contact with skin and eyes
- Part B contains emulsions that may cause skin irritation
- The wet mixture can dry the skin and cause caustic burns.
- Skin Protection: Wear overalls and gloves. Use face-shield where splashing may occur. Use barrier creams. Avoid continual contact with wet mix.
- Eye Protection: Use full face-shield / goggles while mixing or in dusty environments.
- Inhalation: Should be handled and used in well ventilated areas. In dusty environments use a disposable respirator.
- If skin contact, wash immediately with soap and water.
- If eye contact flush with water for at least 20 minutes. Seek medical help.
- Remove contaminated clothing and shoes. Wash clothes before reuse, discard contaminated footwear.

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheets



38 Spray Applied Cement Based Coatings

General Description

- A compound consisting of white Portland cement and aggregates which when mixed with water (or an emulsion) cures by hydration. Glass beads are injected prior to setting to provide retroreflectivity.

Composition

- Commonly provided as a two component mix under Licence
- Part A containing a blend of white Portland cement with selected aggregates and additives, including glass beads
- Part B containing a blend of acrylic emulsion, water, titanium dioxide and other additives.

Physical Properties

- Part A – White powder - High miscibility in water
- Part B – Liquid emulsion - Soluble in water
- Bond strength (on concrete) 4.3 Mpa after 45 days.

Performance Properties

- Retroreflectivity: Dependent on bead type and application rate, typically in the range of 280 to 460 mcd
- Skid Resistance: Commonly formulated to have a minimum skid resistance of 45 BPN.
- Note: The skid resistance of a marking material is not a fixed property for any given formulation. It may vary considerably according to the temperature at which it is laid and will also vary throughout its life according to conditions such as traffic and weather.

Durability

- Regarded as a “long life” material as far as “wear” is concerned, expectancy greater than 8 years in roading environment.

Compatibility

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

Adhesion

- Can be used on most types of surfaces, bitumen, asphaltic concrete and Portland cement.

NZRF Roadmarking Materials Guide – Spray Applied Cement Based Coatings

Application Parameters

- Material should be well mixed
- Road and air temperatures should be greater than 5°C and rising. Poor bond may develop if road temperature falls below 5°C
- Road surface needs to be clean and free from oils and greases. Primer tests need to be conducted prior to application
- Sandblasting, waterblasting or wire brushing of pavement surface is recommended
- Substrate must be prepared by air-hand / mechanical brooming or use of high velocity / high pressure air blowing to remove loose paint, dust and dirt.

Handling, storage and packaging

- Store in cool dry place protected from rain and moisture. Store Part A off the floor.
- Protect from excessive heat or contamination from fuels, oils or greases
- Classified as Non Hazardous.

Environmental Impacts

- Materials are miscible in water, care must be taken to ensure that any spills or cleaning materials do not enter or contaminate soil or waterways.

Occupational Health and Safety Hazards

- Dust
- Skin irritation

Application Process

- The two components are combined in a clean steel container and mixed with a slow speed drill attached to an appropriate epoxy-mixing paddle
- Appropriate filler may be added to produce a mortar for filling or vertical surfaces.
- In very hot conditions, the emulsion can be cooled with ice
- Glass beads are injected using a special bead gun.

Post-Application Measuring Equipment

- Retroreflectometer
- Skid Tester

NZRF Roadmarking Materials Guide – Spray Applied Cement Based Coatings

Quick Reference Safety Guide

- Part A contains cement dust resin that may cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Prevent contact with skin and eyes
- Part B contains emulsions that may cause skin irritation
- The wet mixture can dry the skin and cause caustic burns.
- Skin Protection: Wear overalls and gloves. Use face-shield where splashing may occur. Use barrier creams. Avoid continual contact with wet mix.
- Eye Protection: Use full face-shield / goggles while mixing or in dusty environments.
- Inhalation: Should be handled and used in well ventilated areas. In dusty environments use a disposable respirator.
- If skin contact, wash immediately with soap and water.
- If eye contact flush with water for at least 20 minutes. Seek medical help.
- Remove contaminated clothing and shoes. Wash clothes before reuse, discard contaminated footwear.

Useful References

- Manufacturers Safety Data Sheets and Technical Data Sheet

