

# Main Roads Technical Standard

## **MRTS35**

### **Recycled Materials for Pavements**

**April 11**

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# RECYCLED MATERIALS FOR PAVEMENTS

## 1 INTRODUCTION

### 1.1 Introduction to MRTS35

This Technical Standard applies to the use of recycled materials in road pavement materials. Use of this Technical Standard is project-specific in accordance with the documents for the contract.

Use of Recycled Asphalt Pavement (RAP) in asphalt materials is specified in MRTS30 *Dense Graded and Open Graded Asphalt*. Use of scrap rubber in bitumen binders is addressed in MRTS18 *Polymer Modified Binder*.

Under the provisions of this Technical Standard, recycled material blend/s may be used as a substitute for new material/s specified for the Works by the following technical standards where the requirements of this Technical Standard are supplementary to the respective technical standard –

- a) MRTS05 *Unbound Pavements*;
- b) MRTS07A *In situ Stabilised Subgrades using Quicklime or Hydrated Lime*; and
- c) MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*.

This Technical Standard shall be read in conjunction with MRTS01 *Introduction to Technical Standards*, MRTS50 *Specific Quality System Requirements* and other technical standards as appropriate.

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

### 1.2 Permissible Use of Recycled Material Blends

This Technical Standard may be used for Contracts where the pavements are designed in accordance with the *Queensland Department of Main Roads Pavement Design Manual* and -

- a) the requirements for unbound pavement materials in accordance with MRTS05 *Unbound Pavements* and –
  - i) For Queensland Department of Transport and Main Roads “District Roads” as defined in Department’s *Road Planning and Design Manual* and where the recycled material blend pavement layer is immediately below an asphalt layer –
    - Where the pavement design traffic load for a 20 year design life is less than  $10^6$  ESA, the asphalt (surfacing) layer shall be at least 25 mm thick; and
    - Where the pavement design traffic load for a 20 year design life is equal to or greater than  $10^6$  ESA, the combined thickness of the dense graded and/or stone mastic asphalt layers above the recycled material pavement layer shall be a minimum of 100 mm thick.
  - ii) For Queensland Department of Transport and Main Roads “National Highways”, “State Strategic Roads” or “Regional Roads” as defined in Department’s *Road Planning and Design Manual* and where the recycled material blend pavement layer is immediately below an asphalt layer, the combined thickness of the dense graded and/or stone mastic asphalt layers above the recycled material pavement layer shall be a minimum of 100 mm thick; and
  - iii) The recycled material blend shall not be used in:
    - any surfacing layer directly in contact with traffic, such as unsealed shoulder or unsealed road;
    - any pavement base layer below a spray sealed surfacing that is to be trafficked for longer than 3 months, including construction traffic and/or public traffic. Where the recycled material blend is used for this application, the maximum speed shall be 60kph;
    - any pavement layer to be constructed with MRTS05 *Unbound Pavements* Type 1 material;
    - any base or subbase pavement layer in a HILL pavement as defined in the *Queensland Pavement Design Manual*;
    - any material that is to be stabilised in accordance with MRTS08 *Plant-Mixed Stabilised Pavements Using Cement* and used in a base pavement layer noting that in all cases where recycled material blend is stabilised with cementitious material, in determining the quantity

of cementitious material, the UCS requirements for the stabilised material shall have precedence ; and/or

- any material that is to be stabilised with bituminous binders.
- b) the requirements for “new material to replace material not suitable for stabilisation”, as defined in Clause 6.1 of MRTS07A *In situ Stabilised Subgrades using Quicklime or Hydrated Lime* where the recycled material blend is a maximum of a 100 mm thick layer; and
- c) the requirements for “new material to replace material not suitable for stabilisation”, as defined in MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends* where the recycled material blend is a maximum of a 100 mm thick layer.

## 2 DEFINITION OF TERMS

The terms used in this Technical Standard shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Standards*. Further definitions are as defined in Table 2.

**Table 2 – Definition of Terms**

<b>Terms</b>	<b>Definition</b>
Additive	A fine graded clayey sand and/or very fine clayey filler material that may be added to the crushed recycled material in a small quantity for improved grading/ cohesion/permeability.
Ceramic	An inorganic, non-metallic solid prepared by the action of heat and subsequent cooling. Ceramic materials have an inorganic crystalline or partly crystalline structure.
Contaminants	Material that is not the specified material to be recycled. Contaminants include debris and foreign material as specified in this Technical Standard, and materials that contravene environmental legislation and regulation.
Crushed recycled materials	Recycled materials that are crushed into a product that conforms with the specified properties, are produced in a controlled manner to close tolerances of grading and minimum foreign material content, and are homogeneous
Crushed brick	Crushed material that principally consists of crushed fired brick and may also include crushed concrete and concrete mortar.
Crushed concrete	Rock fragments coated with cement crushed from feeder material consisting primarily of reclaimed concrete from buildings and other structures.
ERA	Environmentally relevant activity as defined under Schedule 2 of the Environmental Protection Regulation 2008.
ESA	Equivalent Standard Axles
Glass	Formed by supercooling a molten mixture of sand (silicon dioxide), soda ash (sodium carbonate), and/or limestone to form a rigid physical state.
Glass cullet	A product of mixed recycled glass sourced from manufacturing and postconsumer waste, is 100 percent crushed glass and is generally angular, flat and elongated in shape. This fragmented material comes in colour or colourless forms. The size varies depending on the chemical composition and method of production.
In situ material	The in situ pavement material under MRTS07A and MRTS07B.
NRMB	Nominated Recycled Material Blend is a blended recycled material that has been accepted for the Works.
Parent technical standard	MRTS05 <i>Unbound Pavements</i> is the parent technical standards for unbound material. MRTS07A <i>In situ Stabilised Subgrades using Quicklime or Hydrated Lime</i> ; and MRTS07B <i>In situ Stabilised Pavements using Cement or Cementitious Blends</i> are the parent technical standards for in situ stabilised material.
Quarry product	Products from quarries complying with this technical standard and MRTS05.

Terms	Definition
RAP	Reclaimed asphalt pavement (RAP) material is asphalt which has been milled or excavated from existing asphalt pavements, or returned from job sites.
Recycled material blends	Made up of a combination of crushed recycled material with - if applicable – quarry product and/or additive. Recycled material blends are produced at a controlled mixing plant to close tolerances of grading and moisture content based on the optimum moisture content of the material.
Tile	A manufactured piece of ceramic or stone.
Type of recycled material	For the purpose of this Technical Standard, the types of materials that may be recycled and included in a recycled material blend include reclaimed concrete, glass cullet, brick and asphalt.
Weighted Linear Shrinkage	Linear shrinkage multiplied by the percentage of material passing the AS 0.425 mm sieve.
Weighted Plasticity Index	Plasticity index multiplied by the percentage of material passing the AS 0.425 mm sieve

### 3 REFERENCED DOCUMENTS

References used in this technical standard include, but are not limited to the latest versions of –

- a) *Land Protection (Pest and Stock Route Management) Act 2002 and Land Protection (Pest and Stock Route Management) Regulation 2003;*
- b) *Environmental Protection Act 1994 and Environmental Protection Regulation 1998;*
- c) *Pest Management Act 2001 and Pest Management Regulation 2003;*
- d) *Environmental Protection (Waste Management) Regulation 2000;*
- e) *Dangerous Goods Safety Management Act 2001 and Dangerous Goods Safety Management Regulation 2001;*
- f) ANZECC Water Quality Guidelines and the Queensland Water Quality Guidelines. Prescribed water contaminants are listed in Schedule 9 of the Environmental Protection Regulation 1998; and
- g) Draft Guidelines for the Management of Contaminated Land in Australia 1998.

### 4 STANDARD TEST METHODS

#### 4.1 Standard Test Methods

The following standard test methods apply to this technical standard –

- a) The test methods listed in Table 4.1; and
- b) The standard test methods listed in the parent technical standards.

Further reference to test numbers and test descriptions is provided in Clause 4 of MRTS01 *Introduction to Technical Standards*.

For all test methods, where the NRMB contains asphalt, the asphalt shall be removed from the sample prior to sample preparation, and discarded.

**Table 4.1 – Standard Test Methods**

Property to be Tested	Test No.
Preparation of Disturbed Samples	Q101
Californian Bearing Ratio	Q113A
Chlorides	Q130A
Flakiness Index	Q201A
Linear Shrinkage	Q106
Liquid Limit	Q104A
Moisture Content	Q102A, Q102B, Q102C, Q102D, Q102E
Particle Size Distribution <sup>Note 1</sup>	Q103A
Permeability	Q125A
Plastic Limit and Plasticity Index	Q105
Sulphate Content	Q131A
Ten Percent Fines Value	Q205B
Wet / Dry Strength Variation	Q205A, Q205C
UCS	Q115

Note 1 - Where the NRMB contains asphalt, the asphalt shall be removed from the sample prior to sample preparation and sieved separately using the sieve sizes for the test method. The asphalt masses retained on each sieve shall be recorded and added to the cumulative masses for the equivalent sieve in testing the balance of the material. This shall be reported.

#### 4.2 Other Test Methods

The following test methods are additional and apply to this technical standard.

**Table 4.2 – Other Test Methods**

Property to be Tested	Test No.
Foreign Materials Content of Recycled Reclaimed Concrete	Roads and Traffic Authority (NSW) test method: RTA T276

## 5 QUALITY SYSTEM REQUIREMENTS

### 5.1 General

The Contractor shall comply with all statutory requirements, contract requirements and additional specific requirements of the recycled material blend.

In addition to the requirements of MRTS51 *Environmental Management*, all recycling activities including sourcing, transporting, processing and placing of recycled materials shall meet the requirements of all statutory and regulatory requirements.

### 5.2 Hold Points, Witness Points and Milestones

Hold Points, Witness Points and Milestones shall be as nominated in the parent technical standard for the construction including MRTS05 *Unbound Pavements* and MRTS07A *In situ Stabilised Subgrades using Quicklime or Hydrated Lime*; and MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*.

Additional Hold Points and Milestones applicable to this technical standard are summarised in Table 5.2.

**Table 5.2 - Hold Points and Milestones**

Clause	Hold Point	Milestone
5.3.1	1. Contractor Offer Document Noted	Submission of Contractor Offer Document

### 5.3 Contractor's Offer Document

#### 5.3.1 General

For each Nominated Recycled Material Blend (NRMB), the Contractor's Offer Document shall include details that –

- a) Nominate the corresponding pavement material /type/ subtype as specified in the parent technical standard that the NRMB may replace, noting that a maximum of one NRMB may be nominated for each such material in the parent technical standard;
- b) Demonstrate that the NRMB complies with the requirements of Clause 5.3.2 including a recent certificate (no older than 3 months) signed by the Manufacturer of the recycled material blend that verifies that the NRMB meets the material requirements of this technical standard;
- c) Include Construction and Handling Procedures in accordance with the requirements of Clause 5.3.3; and
- d) Are submitted by the Contractor to the Administrator not less than 28 days prior to their order for NRMB materials to be constructed in accordance with MRTS05 *Unbound Pavements* and 56 days prior to their order for NRMB materials to be constructed in accordance with either MRTS07A *In situ Stabilised Subgrades using Quicklime or Hydrated Lime* or MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blend* **Milestone**.

The Contractor shall not place the order for material until after the Administrator notes the Contractor's Offer Document **Hold Point 1**.

#### 5.3.2 Nominated Recycled Material Blend

For each NRMB, the Contractor shall submit to the Administrator the following NRMB details in the format required in Clause 1 of Annexure MRTS35.1. Where a Mix Registration Certificate is not required by Clause 1 of Annexure MRTS35.1, the Contractor shall submit the following details as part of the Contractor Offer Document –

- a) A unique identifying name for the NRMB;
- b) The Recycled Material Blend Type with which the NRMB complies in Table 6.2.2-A;
- c) That the NRMB complies with all requirements of the recycled material blend in this technical standard;
- d) As applicable to the particular mix design of the NRMB recycled material blend, a description of each of the constituents of the nominated recycled blend material including –
  - i) crushed concrete;
  - ii) crushed brick;
  - iii) RAP;
  - iv) glass cullet;
  - v) quarry product in accordance with the naming conventions (Sub-type) and requirements of MRTS05 *Unbound Pavements*; and
  - vi) additive in accordance with the requirements of Clause 6.3.6.
- e) Source of each of the NRMB constituents in d) above including –
  - i) the source by general region of each type of recycled material;
  - ii) the quarry source of the quarry product if quarry product is used in the blend;
  - iii) certification that regulatory requirements in relation to fire ants are met for use of the NRMB in the Works.
- f) Test results demonstrating conformance for all properties of the NRMB required to be tested by the parent technical standard and this technical standard where all test results shall be current (not more than 6 months old) at the time of submission.

- g) The NRMB Manufacturer including –
- i) Company details;
  - ii) The requirements of Clause 2 of Annexure MRTS35.1;
  - iii) Proposed date of commencement of supply;
  - iv) Documents demonstrating that, for all processing stages, the processing facilities retain relevant licensing requirements under the *Environmental Protection Act 1994* and/or, where relevant, the equivalent Federal regulations and local government requirements including –
    - the plant shall be licensed under ERA-62 (Waste Transfer Station Operation) and/or ERA-60 (Waste Disposal), where recycled materials are processed at the plant; and
    - the plant shall be licensed under the provisions of ERA-33 (Crushing Milling, Grinding or Screening where crushing, milling, grinding and/or screening activities occurs at a plant;
  - v) Documents demonstrating that all recycling activities including sourcing, transporting and processing of recycled materials satisfy the requirements for control of Red Imported Fire Ants under the requirements of the Queensland Department of Primary Industries and Fisheries.

### **5.3.3 Construction and Handling Procedures**

The Contractor shall prepare construction and handling procedures for all processes for the use of each NRMB including –

- a) procedures for handling, crushing and blending of the materials prior to placement; and
- b) procedures for placement of the recycled material blend.

The Construction and Handling Procedures shall –

- i) ensure adequate detection and management of contaminants, including procedures relating to storage and handling, processing, sampling, analysis and reporting; and
- ii) be appropriate to the physical and chemical nature of the material and its intended use.

## **6 MATERIALS**

### **6.1 General**

Materials and their manufacture, delivery, placement and use shall comply with all the requirements of all relevant legislation and regulation.

### **6.2 NRMB Material Requirements**

#### **6.2.1 General**

The NRMB material shall be mixed thoroughly to ensure that there is an even and homogenous distribution of constituent recycled materials types throughout the stockpile.

Where Clause 3 of Annexure MRTS35.1 nominates that the recycled material blend is to be in direct contact with galvanized or aluminium pipes/ fittings, the pH value of the nominated recycled material blend shall not exceed 11.

The permeability of the mix as specified in Clause 3 of MRTS35.1, if specified.

#### **6.2.2 Percentage Limits of Constituent Recycled Material Types**

The percentages of the constituent recycled materials types within each NRMB shall comply with –

- a) the requirements of Table 6.2.2-A; and
- b) the particle size distribution requirements of Table 6.2.2-B and Table 6.2.2-C.

An NRMB blend may contain quarry product conforming with the requirements of MRTS05 *Unbound Pavements*.

An NRMB may contain conforming additives where any clay component shall conform to the requirements of Clause 6.3.6 and shall not exceed 2% of the total dry mass of the NRMB.

The proportions of constituent recycled materials types within each NRMB shall remain unchanged during production and shall be consistent across all samples greater than 10 kg.

**Table 6.2.2-A – Percentage Limits of Constituent Recycled Material Types in Nominated Recycled Material Blends**

Recycled Material Blend Type	Parent Technical Standard	Material Sub-type in parent technical standard <sup>Note 1</sup>	Maximum Limit of each Constituent <sup>Note 2</sup> (percentage by mass)			
			Reclaimed concrete	RAP	Brick	Glass Cullet
RM001	MRTS05	Sub-type 2.1	100	-	-	-
RM002	MRTS05	Sub-type 2.2	100	20	-	-
RM003	MRTS05	Sub-type 2.3	100	20	15	-
RM004	MRTS05	Sub-type 2.4	100	20	15	-
RM005	MRTS05	Sub-type 2.5	100	20	45	5
RM006	MRTS07A	“New material to replace old material”	100	20	45	5
RM007	MRTS07B	“New material to replace old material”	100	20	45	5

Table Notes

Note 1 In all blends, a lower numbered type can be used as a higher numbered type, for example an RM003 can be used as a RM004 or RM005.

Note 2 The maximum limit of each Constituent includes all materials whether included as primary mix design material, additive or foreign material

**Table 6.2.2-B – Particle Size Distribution for Recycled Material Blend Types RM001, RM002, RM003 and RM004**

AS Sieve Size (mm)	Percentage Passing by Mass for Each Nominal Size			
	RM001 and RM002		RM003 and RM004	
	Target Grading (% Passing)	Limits of Grading (% Passing)	Target Grading (% Passing)	Limits of Grading (% Passing)
37.5				
26.5	100	100	100	100
19.0	100	95 – 100	100	95 – 100
13.2	85	78 – 92	85	75 – 95
9.50	73	63 – 83	75	60 – 90
4.75	54	44 – 64	59	42 – 76
2.36	39	30 – 48	44	28 – 60
0.425	17	13 – 21	19	10 – 28
0.075	7	5 – 9	7	3 – 11

**Table 6.2.2-C – Particle Size Distribution for Recycled Material Blend Types RM005, RM006 and RM007**

AS Sieve Size (mm)	Percentage Passing by Mass for Each Nominal Size	
	Nominal 20 mm size	
	Target Grading (% Passing)	Limits of Grading (% Passing)
37.5	100	100
26.5	100	100
19.0	92	84 - 100
13.2	82	69 - 95
9.50	73	56 - 90
4.75	57	37 - 77
2.36	43	23 - 63
0.425	19	8 - 30
0.075	8	2 - 14

### 6.2.3 Tolerances of Constituent Proportions

Table 6.2.3 details the tolerance limits of the total proportions by mass of the constituents of an NRMB from the recycled material blend proportions stated in Table 6.2.2-A.

**Table 6.2.3 - Tolerance Limits by Mass of the Constituents**

Constituent	Tolerance (%)
Additives	± 1
Crushed concrete	± 5
Crushed brick and nonceramic tile	± 2
Quarry products	± 5
RAP	± 2
Glass Cullet	± 1
Moisture Content	-1.0% and +0.5 %

### 6.2.4 Property Limits

NRMB materials shall comply with the requirements of Table 6.2.4. Where an option is given in Table 6.2.4, the Contractor shall select between the plasticity index and linear shrinkage properties.

RM006 and RM007 materials shall –

- a) have a water soluble Sulphate Content not exceeding 1.9 grams of sulphate (expressed as SO<sub>3</sub>) per litre; and
- b) have a Weighted Plasticity Index of between 2200 and 3200.

**Table 6.2.4 – Property Limits for RM001, RM002, RM003, RM004, RM005, RM006 and RM007**

Property	Limit	Recycled Material Blend Type					
		RM001	RM002	RM003	RM004	RM005	RM006, RM007
Flakiness index (%)	Maximum	35	35	40	40	40	40
Wet/dry strength variation (%)	Maximum	35	40	45	45	45	45
Degradation factor <sup>Note 1</sup>	Minimum	-	-	-	-	-	-
Californian Bearing Ratio (%)	Minimum	80	60	45	35	15	15
Ten percent fines value (wet) (kN)	Minimum	85	85	70	70	-	-
Liquid Limit %	Maximum	35	35	35	35	40	40
Plasticity Index or Linear Shrinkage	Maximum	6	8	8	12	14	14
	Maximum	3.5	3.5	4.5	6.5	7.5	7.5
Weighted Plasticity Index or Weighted Linear shrinkage	Maximum	150	150	200	360	-	Range: 2200 - 3200
	Maximum	85	85	110	195	-	
Unconfined Compressive Strength (UCS) at 7 days <sup>Note 2</sup>	Maximum	0.7	0.7	0.7	0.7	0.7	0.7

Table Notes

- Any quarry product used in the NRMB shall comply with the Degradation Factor requirements of MRTS05 *Unbound Pavements*
- The UCS test result to be reported is the average strength for triplicate test specimens.

### 6.2.5 Contamination Limits

Foreign materials in that fraction of the product retained on a 0.475 mm sieve shall not exceed the percentages by mass in Table 6.2.5.

Asbestos shall not be incorporated into the NRMB consistent with Queensland legislation requirements.

**Table 6.2.5- Limits of Foreign Material Requirements in Nominated Recycled Material Blends (Maximum Allowable %)**

Foreign Material Type	Constituents of Foreign Material Type	Recycled Material Blend (Refer Table 6.2.2-A)	Maximum Limit by Mass
1	Brick, Metal, Glass, Ceramics and Slag (other than blast furnace slag)	RM001, RM002, RM003, RM004	3%
2	Metal, Ceramics and Slag (other than blast furnace slag)	RM005, RM006, RM007	2 %
3	Plaster, Clay Lumps and Other Friable Material	RM001, RM002, RM003, RM004, RM005, RM006, RM007	1%
4	Rubber, Plastic, Bitumen not part of Asphalt, Paper, Cloth, Paint, Wood and Other Vegetable Matter	RM001, RM002, RM003, RM004, RM005, RM006, RM007	0.2%
5	Asphalt	RM001	1 %

### 6.2.6 Additional Aggregate Requirements

Coarse aggregates shall consist of crushed fragments that are clean, sound, hard, durable, and angular where the crushed fragment shall be free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material; and

All quarry produced components of a recycled material blend shall comply with the requirements of MRTS05 *Unbound Pavements* for the applicable size and subtype as stated in Table 6.2.2-A.

The use of crusher fines passing the 4.75 mm sieve which are not produced from crushing concrete, will be permitted, provided the crusher fines are produced from an igneous or metamorphic rock source and have a Degradation Factor – Fine Aggregate of not less than 60.

## 6.3 Constituent Material Properties

### 6.3.1 General

Each NRMB shall comply with the requirements of the applicable parent technical standard for material subtype applicable to the recycled material blend type as stated in Table 6.2.2-A except that –

- a) for each recycled material type, the source rock requirements in MRTS05 *Unbound Pavements* do not apply; and
- b) the requirements of this technical standard override the requirements of the parent technical standard.

Recycled materials contaminated with chemical substances as evidenced by alkali-silica reaction and rust stains on concrete shall not be used in the recycled material blend.

### 6.3.2 Crushed Concrete

Crushed concrete that contains appreciable unhydrated cement or free lime shall not be used.

This will facilitate control of tufa precipitate formation in pavement drainage structures.

### 6.3.3 Reclaimed Asphalt Pavement (RAP) Material

RAP material included in the NRMB shall be processed to a well graded, free flowing and consistent state. Minimum processing shall involve crushing and screening operations to ensure a maximum size no greater than the maximum aggregate size of the recycled material blend being produced.

RAP material shall not contain tar binder and shall be free of contaminants such as clay, organic matter or any other deleterious material.

### 6.3.4 Crushed Brick

Crushed brick included in the NRMB shall be tested in accordance with Q205C and the wet strength and wet/dry strength shall be reported.

### 6.3.5 Glass Cullet

The following requirements shall apply to any NRMB utilising recycled glass cullet –

- a) Recycled glass source –  
Glass shall be sourced from food and beverage containers, and building or window glass. Glass that shall not be used includes recycled glass classified as hazardous waste, light bulbs, laboratory equipment, televisions, computers, cathode ray tubes, porcelain products, cook tops, automobile and vehicle glass including windscreens, and fluorescent tubes.
- b) Contaminants –  
Cullet shall contain no more than 5.0% by mass contaminants such as paper, foil, cardboard, metal, organics, plastic wrappers and bottle tops.
- c) Cleanliness –  
The cullet shall be cleaned to ensure that undesirable odours are eliminated.
- d) Crushing –  
Cullet crushing operations shall include crushing by a shaping crushing plant (eg Barmac impactor or equivalent) and shall produce a well-graded product.

- e) Grading -  
 The cullet grading shall comply with Table 6.3.5.
- f) The plus 4.75 mm component of the cullet shall not contain more than 1% of particles with a maximum dimension to minimum dimension ratio greater than 5:1.

**Table 6.3.5 - Cullet Grading**

AS Sieve Size	Percent Passing
9.5 mm	100
4.75 mm	70 – 100
2.36 mm	35 – 88
1.18 mm	15 – 45
0.30 mm	4 – 12
0.075 mm	0 – 5

**6.3.6 Additives**

Where the Contractor elects to use an additive component in the NRMB, the additive shall –

- a) be 100% passing the 2.36 mm sieve;
- b) not be cementitious in nature;
- c) be free of organic matter, lumps and balls of clay, oversize particles of rock and other deleterious material;
- d) be of a size that it can be effectively and uniformly distributed throughout the crushed recycled material;
- e) be delivered and stored to ensure that it is free-flowing when incorporated into the blend;
- f) shall have a Weighted Plasticity Index  $\leq 1200$ ; and
- g) crusher fines not produced from crushed concrete shall be produced from an igneous or metamorphic rock source with a Degradation Factor of not less than 60.

**7 MATERIAL MANUFACTURE**

**7.1 General**

Materials and their manufacture, delivery, placement and use shall comply with all the requirements of all relevant legislation and regulation.

The NRMB shall be manufactured at a controlled mixing plant to achieve tolerances of grading and moisture content.

The constituent material distribution, consistency and workability of the NRMB shall be such that it can be handled and transported without segregation and can be placed, worked and compacted so that resulting pavement layer is homogeneous.

**7.2 Blending**

The constituent recycled materials types within the NRMB shall be added, combined and blended using procedures that –

- a) are controlled to ensure uniformity and homogeneity of the NRMB;
- b) ensure that the NRMB shall be processed to a well graded, free flowing and consistent state; and
- c) are consistent with the blending operations specified in the parent technical standard.

**7.3 Moisture Content**

Unless otherwise stated in Clause 4 of Annexure MRTS35.1, during manufacture of the NRMB material water shall be added –

- a) so that the amount of water shall be not less than 5% by mass;

- b) using a controlled, measured process;
- c) not more than 48 hours prior to placement of the material in the pavement; and
- d) so that it is uniformly distributed throughout the material by using a pug mill or equivalent mechanical process.

## **8 STOCKPILE REQUIREMENTS**

In addition to the stockpile requirements of the parent technical standard applicable to the NRMB –

- a) the Contractor's Environmental Management Plan (Construction) in accordance with MRTS51 *Environmental Management* shall include provisions that the location of and clearances to a stockpile shall suitably protect ground water and water bodies from any deleterious leachates;
- b) where processed NRMB material has been stockpiled for some time and is no longer in a free flowing condition, it shall be reprocessed to ensure it is in a free flowing condition at the time of use;
- c) the stockpile site shall be clean, adequately paved, and well drained;
- d) if a stockpile is constructed in more than one layer, each layer shall be fully contained within the area occupied by the upper surface of the preceding layer;
- e) glass cullet shall be in a separate discrete stockpile prior to blending;
- f) the surface of the stockpile shall be kept damp to prevent a net loss of moisture and to minimise the generation of airborne dust; and
- g) any other additional overriding requirements as stated in Clause 5 of Annexure MRTS35.1.

## **9 CONSTRUCTION**

### **9.1 General**

Materials and their manufacture, delivery, placement and use shall comply with all the requirements of the applicable parent technical standard and all relevant legislation and regulation.

### **9.2 Supply of Material to the Works**

#### **9.2.1 General**

Unless otherwise specified in Clause 6 of Annexure MRTS35.1, NRMB shall be supplied in trucks covered with a water proof covering.

If the Contractor elects or is required to supply the recycled material blend to stockpile prior to delivery to the roadbed, the product after recovery from the stockpile shall comply with this Technical Standard.

Material shall be stored in accordance with the requirements of the parent technical standard.

#### **9.2.2 Delivery of Dockets**

Delivery to the Site shall be accompanied by a delivery docket that states the following minimum information –

- a) name of the NRMB material;
- b) name and address of Manufacturer of the NRMB material;
- c) date of manufacture of the NRMB material;
- d) production lot number and stockpile number; and
- e) certification that the NRMB material has been sampled and tested and that those properties comply with the requirements of this technical standard.

Delivery dockets shall be made available for inspection by the Administrator.

#### **9.2.3 Construction Layer Thicknesses**

Unless otherwise specified in Clause 7 of Annexure MRTS35.1, individual compacted layer thicknesses for the purpose of construction shall be chosen to suit the construction process within the following limits –

- a) 100 mm to 200 mm for layers other than base or subbase; and
- b) 100 mm to 150 mm for base or subbase.

## 10 COMPLIANCE AND TESTING

### 10.1 General

Acceptance of NRMB material shall be undertaken on a lot basis and the total quantity of NRMB material in the lot shall be subject to acceptance or rejection in accordance with the parent technical standard.

The Contractor is responsible for carrying out sufficient testing to ensure the NRMB complies with the requirements of this Technical Standard.

The Contractor's testing program for the NRMB and its constituents shall be in accordance with the Contractor's quality control and compliance testing procedures.

### 10.2 Lots

A lot of NRMB shall be produced under uniform conditions from the same source materials and/ or the same consistent components and be essentially homogeneous with respect to composition and general appearance.

Samples for materials compliance testing shall be taken from the stockpile used for the Works. Lots shall be traceable by the Contractor's written records to the stockpile tested.

### 10.3 Material Compliance Testing

#### 10.3.1 General

The Contractor shall demonstrate compliance of the NRMB material.

Samples for compliance testing shall be by random sampling from the stockpile.

The frequency for compliance testing shall initially be undertaken at the normal level. This may change in accordance with the following criteria –

- a) After no nonconformances have occurred in four consecutive lots, a reduced level may be applied; and
- b) In a reduced level testing regime when two nonconformances have occurred over two consecutive lots, a normal level shall be reapplied.

#### 10.3.2 Conformance Testing Requirements for Greater than 1000 Tonnes of an NRMB Material used in the Works

Where 1 000 or more tonnes of an NRMB material are used in the Works, unless otherwise stated in Clause 8 of Annexure MRTS35.1, the Contractor's testing program for the NRMB shall be such that lot sizes and the number of tests are not less than those stated in Table 10.3.2-A and Table 10.3.2-B, with a minimum of one test for the Works.

**Table 10.3.2-A Minimum Testing Frequencies for Compliance Testing of Recycled Material Blends**

Property	Test Procedure	Minimum Test Frequency		Maximum Lot Size for Testing (tonnes)
		Normal Level	Reduced Level	
Foreign Materials Content of NRMB	RTA276	2	1	2500 or one day's production, whichever is lesser
Particle Size Distribution (of NRMB)	Q103A	2	1	
Particle Size Distribution (of Cullet)	Q103A	1	1	
Moisture Content	Q102A, Q102B, Q102C, Q102D, Q102E	2	1	
Linear Shrinkage (and Weighted Linear Shrinkage)	Q106	2	1	
Plasticity Index (and Weighted Plasticity Index)	Q105	2	1	

**Table 10.3.2-B – Minimum Testing Frequencies for Additional Testing of Recycled Material Blends**

Property	Test Procedure	Minimum Test Frequency		Maximum Lot Size for Testing (tonnes)
		Normal Level	Reduced Level	
Ten Percent Fines Value	Q205B	2	1	5000
Wet / Dry Strength Variation	Q205C	2	1	5000
Flakiness Index	Q201A	2	1	5000
Californian Bearing Ratio	Q113A	2	1	5000
Liquid Limit	Q104A	2	1	5000
UCS at 7 days	Q115	1	1	10000
Permeability	Q125A	1	1	10000
Sulphate content	Q131A	1	1	10000
pH	Q121	1	1	10000

### 10.3.3 Testing Requirements for Less than 1000 Tonnes of an NRMB Material used in the Works

Where less than a total of 1 000 tonnes of any NRMB material is used in the Works, for each property of that NRMB material –

- a) The Contractor shall demonstrate compliance with the requirements of the property limits and test frequencies of Table 10.3.2-A; and
- b) Unless otherwise specified in Clause 9 of Annexure MRTS35.1, the Contractor shall demonstrate compliance with each property limit and its associated test frequency for all properties detailed in Table 10.3.2-B by either:
  - I) testing the NRMB material used in the Works; or
  - II) testing NRMB material used outside the Works where the property compliance –

- i) is demonstrated for an NRMB material that is the same NRMB material that is used in the Works and the Contractor provides the Administrator with details of where the NRMB material used outside the Works has been used (location and date of supply);
- ii) is demonstrated to the minimum test frequency and lot size of Table 10.3.2-B;
- iii) testing shall be completed for all the NRMB supplied by the Manufacturer (that is, “continuous” testing and no test results are excluded);
- iv) is demonstrated through Contractor submission to the Administrator of –
  - test results and charts of test results for all of the past tests for the NRMB up to 30 tests;
  - calculations and charts of the rolling averages and standard deviations for the last 10 results for each property, where the rolling average shall conform with the respective property limit; and
  - legible test results and charts.

**10.4 Testing for Reporting Only**

The testing detailed in Table 10.4 shall be completed and –

- a) the Contractor’s testing program for the NRMB shall be such that lot sizes are not greater than 10 000 tonnes and the number of tests is not less than those stated in Table 10.4; and
- b) test results shall be submitted to the Administrator for reporting only and do not form part of the compliance requirements.

**Table 10.4 - Minimum Testing Frequencies for Testing for Reporting Only**

Property	Test Procedure	Minimum Test Frequency	
		Normal Level	Reduced Level
Water Absorption (% content)	Q214B	1	1
Weak Particles	Q217	1	1
Chlorides	Q310	1	1