

SECTION 813 - CRUSHED ROCK FOR LIGHT DUTY BASE AND SUBBASE PAVEMENT

##This section cross-references Sections 175, 304, 801, and 820.

If any of the above sections are relevant, they should be included in the specification.

If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent:

813.01 DESCRIPTION

This section covers the requirements of crushed rock and plant mixed wet-mix crushed rock for 20 mm nominal size Class 3 base, and for Class 4 crushed rock subbase for light duty pavements. The material class, pavement course use and nominal sizes shall be as specified in the special clauses and/or the drawings and/or the schedule.

Crushed rock products shall be supplied only from a VicRoads accredited source. Products shall be supplied as Plant Mixed Wet Mixed Crushed Rock (PMWMCR) if specified in Clause 813.05(c).

Source rock types from which crushed rock base and subbase can be produced are specified in Section 801 - Source Rock for the Production of Crushed Rock and Aggregates.

Requirements for crushed concrete are covered in Section 820 - Crushed Concrete for Pavement Subbase.

Construction requirements for unbound flexible pavements incorporating crushed rock are covered in Section 304 - Construction of Unbound Flexible Pavements.

813.02 DEFINITIONS

Additive

A ~~durable VicRoads approved~~ material that may be added to a crushed rock ~~in small quantities~~ to improve its workability and physical properties.

Aggregates

For the purposes of this specification, fine aggregate shall be the portion of the crushed rock mixture passing the 4.75 mm sieve and coarse aggregates shall be the portion of the crushed rock mixture retained on the 4.75 mm sieve.

Assigned Los Angeles Value

The assigned Los Angeles Value is a hardness rating derived from Los Angeles Value test results, which is assigned to each source by VicRoads on an annual basis as a part of the accreditation process. The value is assigned on the basis of test data obtained from testing products.

Crushed Brick

Crushed brick is a crushed material which principally consists of crushed fired brick but may contain also crushed concrete, aggregate and concrete paste. Mud brick or non fired brick shall not be used ~~in the production of crushed brick.~~

Crushed Rock

Crushed rock is composed of rock fragments produced by the crushing, scalping and screening of igneous, metamorphic or sedimentary source rock which conforms to the requirements of Section 801 – Source Rock for the Production of Crushed Rock and Aggregates, with or without additives, produced in a controlled manner to close tolerances for grading and plasticity.

For the purpose of this specification crushed rock is to be supplied in various in classes broadly defined as follows:

Class 3 is a high quality base material for light duty unbound flexible pavements

Class 4 is a subbase material for light duty pavements.

Plant Mixed Wet-Mix Crushed Rock (PMWMCR)

Plant mixed wet-mix crushed rock is a mixture of crushed rock and water, produced at a controlled mixing plant to close tolerances of grading and moisture content based on the modified optimum moisture content of the material.

813.03 SOURCE ROCK

Source rock shall comply with the requirements of Section 801 - Source Rock for the Production of Crushed Rock and Aggregates.

Material from a quarry or non-quarry site shall not be used until the source has been investigated and accredited in accordance with VicRoads Code of Practice for Source Rock Investigations as listed in Section 175.

The Superintendent's approval must be obtained prior to changing the source of material.

813.04 COMPONENTS

(a) Coarse Aggregates

Coarse aggregates shall consist of clean, hard, durable, angular rock fragments of uniform quality complying with unsound and marginal rock requirements specified in Table 813.052.

(b) Fine Aggregates

Fine aggregates shall consist of clean, hard, durable, angular rock fragments and quarry fines of uniform quality.

All fine aggregates will be accepted as sound if produced from the same bench and location within the source as the coarse aggregates such that on any day, the quality of the fine aggregates are represented by the Unsound and Marginal Rock Content tests undertaken on the coarse aggregates.

The Degradation Factor – Fine Aggregate of a sample of the combined fine aggregates prior to mixing in of any additives, shall not be less than 60.

(c) Additives

Additives which are non durable or subject to appreciable breakdown will not be permitted.

VicRoads will only approve the addition of an additive as a part of a registered crushed rock mix design submitted in accordance with VicRoads Code of Practice for Registration of Crushed Rock Mix Designs as listed in Section 175. The addition of any additive shall be subject to a registration process in accordance with VicRoads Code of Practice for Registration of Crushed Rock Mix Designs as listed in Section 175.

The total amount of any additive shall not exceed 25% (Class 3 base) and 50% (Class 4 subbase) of total dry mass of the crushed rock product unless otherwise specified. If clayey filler is used as all or part of the total additive, the total amount of clayey filler additive shall not exceed 2% of the total dry mass of the crushed rock product.

The addition of crushed brick or crushed glass to Class 3 or Class 4 subbase may be approved as a part of a VicRoads registered crushed rock mix design.

Crushed brick and crushed glass added to Class 3 base shall not exceed 15% and not exceed 25% in the case of Class 4 subbase.

Crushed glass added to crushed rock mixes shall be 5mm minus, well graded, cubicle in shape and substantially free (<2%) of any detrimental impurities.

Crushed brick prior to addition to any crushed rock product shall have a wet strength not less than 100 kN and a wet/dry strength variation not greater than 35 when tested in accordance with the current Australian Standard – Wet/Dry Strength Variation as listed in Section 175.

Additives shall be:

- (i) in the case of clayey sands and clayey filler, supplied and/or processed to conform to the grading and plasticity requirements specified in Table 813.041;
- (ii) non-cementitious in nature except for lime added under the provision of Clause 813.05(d);
- (iii) free of vegetable matter;
- (iv) screened if necessary to remove all oversize particles, lumps and balls of clay or particles exceeding 4 mm in a clayey filler;
- (v) stored and maintained in a dry and free flowing state and added to the crushed rock as a separate component at any stage after completion of primary crushing;
- (vi) distributed into the crushed rock by a method that is capable of verifying that the pre-determined distribution rate has been achieved;
- (vii) uniformly mixed through the crushed rock by use of a pug mill.

Table 813.041 – Grading and Plasticity Requirements for Clayey Sand or Clayey Filler Additives

AS Sieve Size (mm)	Clayey Sand % Passing by mass	Clayey Filler % Passing by mass
9.5	100	100
4.75	90 - 100	100
2.36	75 - 95	95 - 100
0.425	45 - 65	70 - 100
0.075	30 - 50	50 - 100
Plasticity Index Range	10 - 20	30 - 55
Emerson Class No. (max)	No Requirement	6

(d) Blending of Products Containing Coarse Aggregates

Two or more crushed products containing coarse aggregates from different sources or rock types can only be combined as a part of a VicRoads registered crushed rock mix, which shall clearly state the proportions by mass retained on each sieve for each rock type that will be used in the blend.

Blending of products containing coarse aggregates shall be subject to the following conditions:

- (i) all rock types in the blend shall individually comply with the relevant requirements of Section 801 and unsound and marginal rock content requirements specified in Table 813.052 for the combined blend;
- (ii) all material to be blended shall be fully crushed and screened to the maximum aggregate size permitted in the product prior to blending;
- (iii) all fine aggregates in the blend shall comply with the relevant requirements of Clause 813.04(b);
- (iv) if the blend has not been subjected to field placement and compaction, the Contractor shall prove that the material is capable of consistently meeting all requirements of this specification;
- (v) once a suitable blend has been developed and registered, the total proportions by mass of each rock type in the blend shall not be varied by more than plus or minus 5% by mass.

813.05 PRODUCT

- (a) Crushed rock in stockpile shall be free from vegetable matter and lumps or balls of clay and shall comply with the relevant test requirements of Table 813.051.

Table 813.051 - Test Requirements

Test	Test Value			
			Class 3	Class 4
Liquid Limit % (max)	-	-	35	40
Plasticity Index (range)	-	-	0 - 10	0 - 20
California Bearing Ratio (%) (min) (++)	-	-	-	20
Flakiness Index (%) (max)	-	-	-	-
PI x % passing 0.425 mm sieve (max)	-	-	-	450
Crushed Particles (%) (min) (+++)	-	-	50	-
Permeability (m/sec) (++++)	-	-	5×10^{-9} #	5×10^{-9} #
<p>(+) Unless otherwise advised as a part of the crushed rock mix design registration process, the Plasticity Index shall initially be targeted to the middle of the range.</p> <p>(++) Value applicable to material passing 19.0 mm sieve: initially at optimum moisture content and 98% of maximum dry density as determined by test using Modified compactive effort, but then soaked for four days prior to the CBR test.</p> <p>(+++)</p> <p>(++++)</p> <p>Permeability values <u>to be included, if applicable</u>listed assume that pavement drains are not included in the works.</p> <p>Value applicable to material passing 19.0 mm sieve: initially at optimum moisture content and 98% of maximum dry density as determined by test using Modified compactive effort. The Contractor shall provide to the Superintendent the target grading and Plasticity Index required to satisfy the specified permeability requirement.</p>				

- (b) Unsound and marginal rock in that fraction of the product retained on a 4.75 mm AS sieve shall not exceed the percentages specified in Table 813.052.

Table 813.052 - Unsound and Marginal Rock Content

Class	Total of Marginal and Unsound Rock % (max)	Unsound Rock % (max)
3	20	10
4	-	-

- (c) For PMWMCR, the aggregates and water shall be mixed in a pug mill. PMWMCR shall be supplied at the moisture content as nominated by the Contractor to suit the weather conditions and the methods used for spreading and compaction of the material in the roadbed.

PMWMCR shall be supplied to the roadbed as specified in Table 813.053. If not specified, material may either be supplied as PMWMCR or as crushed rock.

Table 813.053 - Material to be Supplied as PMWMCR ##(delete all # symbols and insert "yes" as applicable):

Location	Material			
			Class 3	Class 4
##:			##:	##:

(d) Sulphide Mineralisation

Crushed rock produced from sources identified as containing sulphide/ sulphate mineralisation shall not be used unless the fraction of the crushed rock product passing the 2.36 mm sieve complies with the pH and conductivity test requirements specified in Table 813.054.

Table 813.054 - pH and Conductivity Test Requirements

Test	Test Value	Soil to Water Ratio
pH (units)	6.0 (min)	1 : 2.5
Conductivity (μ S/cm)	1500 (max)	1 : 1

Materials that do not comply with the specified requirements of Table 813.054 may be accepted subject to the approval of the Superintendent. In order to supply material conforming to the requirements of Table 813.054, the Contractor is required to specify the method and amount of hydrated or quick lime to be combined with the product to meet the requirements of Table 813.055.

Table 813.055 - pH of Material after Addition of Lime

Test	Test Value
pH (units)	10.0 (minimum)

Where it is intended to stockpile base or subbase crushed rock which contains sulphide mineralisation exceeding the test values contained in Table 813.054 the lime stabilising agent shall be added at the time of production of the crushed rock and before stockpiling.

(e) Assessment of Plasticity Index (PI)

The PI shall be tested for compliance with the limits specified in Table 813.051 at the frequency specified in Table 813.111 on a representative sample of the material.

813.06 ADDITION OF WATER

Water added to the crushed rock shall be clean and substantially free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances. Water sources shall be tested for electrical conductivity and pH, in accordance with the current Australian Standards as listed in Section 175 prior to use. The electrical conductivity shall not be more than 3500 μ S/cm and pH within the range of 6 to 10 unless otherwise approved by Superintendent. Water sources classified by the relevant Water Authority as potable water shall be exempt from this requirement. Water sources shall be tested at a maximum of twelve monthly intervals or when in the opinion of the Superintendent the nature of the water source has changed. The use of reclaimed water will require the approval of the Superintendent and shall conform to VicRoads guidelines for recycled water for road activities as listed under other referenced documents in Section 175.
~~Water added to the crushed rock shall be clean and substantially free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances. Water sources shall be tested for electrical conductivity and pH, in accordance with the current Australian Standards as listed in Section 175. The electrical conductivity shall not be more than 3500 μ S/cm and pH within the range of 6 to 10. Water sources classified by the relevant water authority as potable water shall be exempt from this requirement. Water sources shall be tested at a maximum of twelve monthly intervals or when the nature of the water source has changed. The use of reclaimed water will require the approval of~~

~~the Superintendent and shall conform to the VicRoads guidelines for reclaimed water as listed under other referenced documents in Section 175.~~

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813.07 GRADING OF UNCOMPACTED CLASS 3 CRUSHED ROCK AND PMWMCR BASE**(a) Class 3 Crushed Rock Base**

After completion of production, but before compaction, Class 3 crushed rock and PMWMCR base shall comply with the relevant grading requirements of Tables 813.071 to 813.073 corresponding to the assigned Los Angeles Value and the nominal size of the material. The crushed rock grading shall not extend from the coarse limit on one sieve to the fine limit on the following sieve or vice versa.

Unless otherwise advised as a part of the crushed rock mix design registration process, the initial target grading shall be at or near the centre of the specified grading envelope. The target grading may be varied from time to time to achieve the specified post-compaction grading. The specified grading limits shall remain unchanged regardless of the target grading..

The grading of 20 mm Class 3 base manufactured from an igneous (other than granitic) and metamorphic source rock with an assigned Los Angeles Value 25 or less shall comply with the requirements of Table 813.071.

Table 813.071 - Grading Limits for 20 mm Class 3 BaseSubbase from all Rocks (except Granitic Rocks) with a Los Angeles Value of 25 or less

Sieve Size AS (mm)	Test Value before Compaction – Limits of Grading (% Passing by mass)
26.5	100
19.0	95 – 100
13.2	75 – 95
9.5	60 – 90
4.75	42 – 76
2.36	28 – 60
0.425	14 – 28
0.075	6 – 13

The grading of 20 mm Class 3 subbbbase manufactured from an igneous and metamorphic source rock with an assigned Los Angeles Value 26 or greater and all sedimentary and granitic source rock shall comply with the requirements of Table 813.072.

Table 813.072 - Grading Limits for 20 mm Class 3 Subbase-Base from Granitic Rocks and all other Rocks with a Los Angeles Value of 26 or more

Sieve Size AS (mm)	Test Value before Compaction – Limits of Grading (% Passing by mass)
26.5	100
19.0	95 – 100
13.2	75 – 95
9.5	60 – 90
4.75	42 – 76
2.36	28 – 60
0.425	10 – 28
0.075	2 – 10

(b) Class 4 Crushed Rock Subbase

After completion of production, but before compaction, Class 4 crushed rock subbase shall comply with the relevant grading requirements of Table 813.073. The crushed rock grading shall not extend from near the coarse limit on one sieve to near the fine limit on the following sieve or vice versa.

Class 4 subbase crushed rock of nominal size differing from that specified may be accepted by the Superintendent provided it meets the grading requirements of Table 813.073 corresponding to a nominal size adjacent to that specified.

Table 813.073 - Grading Requirements for Class 4 Crushed Rock

Sieve Size AS (mm)	Test Value before Compaction - Limits of Grading (% Passing by mass)					
	Nominal Size (mm)					
		40			20	
75.0						
53.0		100				
37.5						
26.5					100	
19.0		64-90				
9.5						
4.75					42-76	
2.36						
0.425		7-23			10-28	
0.075		2-12			2-14	

813.08 CRUSHED ROCK MIX DESIGN

Crushed rock mixes proposed for use on specified works shall be registered in accordance with VicRoads Code of Practice for Registration of Crushed Rock Mix Designs as listed in Section 175.

Approval of a registered crushed rock mix for use under the Contract does not guarantee the handling properties or performance of the mix nor relieve the Contractor from contractual obligations in regards to rectification of defects.

The allowable production tolerances on the nominated target grading will be the full range of the grading envelope. However, where the supplied grading varies by more than + or - 2% of the target grading nominated, the Contractor will be required to provide any additional information requested to clearly demonstrate that all requirements (e.g. permeability) of the specification are still being met.

813.09 MOISTURE CONTENT

(a) Crushed Rock

Where payment is to be made on a mass basis, the average moisture content of crushed rock at the plant shall not exceed 4% by mass unless the Contractor has, at the time of tendering, nominated an upper limit of average moisture content greater than 4%. In the latter case the difference between the nominated value and the specified value will be taken into account when tenders are being considered. The average moisture content of crushed rock supplied on any one day will be determined from three samples taken at random on that day. If the average moisture content is greater than that specified or nominated, the material may be rejected. If material is accepted, payment will be made for the mass determined by deducting the calculated mass of excess moisture from the net mass shown on the delivery dockets.

(b) Plant Mixed Wet Mixed Crushed Rock

Where the Contract includes supply and delivery only, the moisture content of the mixture at the point of delivery, expressed as a percentage by mass, shall be within plus 0.5 to minus 1.0 of the target nominated ~~from time to time~~ by the Superintendent.

813.10 HANDLING OF CRUSHED ROCK PRODUCTS

Handling of crushed rock including stockpiling and loading of trucks shall be undertaken to minimise segregation.

813.11 MINIMUM TESTING REQUIREMENTS

The Contractor shall test the crushed rock and PMWMCR at such a frequency to ensure that the material consistently complies with the specification. The test frequency shall initially not be less than that shown in Table 813.111, except that the test frequency for Grading, Plasticity Index, Unsound Rock Content, pH and Conductivity, and Degradation Factor, may be halved where the most recent ten successive test results meet the specification. If any subsequent test result fails, another test shall be immediately undertaken. If the second test fails the test frequency shall revert to the minimum test frequency specified in Table 813.111 and the Contractor shall not return to half the test frequency until a further ten successive test results comply with the specification.

Table 813.111 - Minimum Frequency of Testing

Test	Minimum Frequency of Testing
Grading - Final Product	On each production day - One per 500 tonnes or part thereof.
Unsound Rock Content (+)	One per production day of a sample taken from the final product or from an individual size component.
Moisture Content - Crushed Rock (++) - PMWMCR	One per production day On each production day - One per 500 tonnes or part thereof
Plasticity Index	Classes 3 and 4 Subbase In each production month - One per 5000 tonnes or part thereof.
California Bearing Ratio (++++)	When in the opinion of the Superintendent, the nature and/or physical properties of the material have changed.
Degradation Factor - Fine Aggregate (+)	One per 1000 tonnes on each production day prior to addition of any additives.
Permeability	When in the opinion of the Superintendent, the nature and/or physical properties of the material have changed
pH and Conductivity (++++)	One per production day
Flakiness Index	One per production month
Crushed Particles (+++++)	One per production month
Testing of Additives	On each production day - Grading and Plasticity Index per 250 tonnes of additive, unless otherwise specified in the registered mix design.
(+)	Not applicable to Class 4 subbase unless otherwise specified
(++)	Applicable only when payment is to be made on a mass basis
(+++)	Applicable to Class 4 subbase
(++++)	Applicable only to sources identified in the current Quarry Investigation Report as containing sulphide/sulphate mineralisation
(+++++)	Applicable to crushed river gravels